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GOVERNING THE GLOBAL FISHERIES COMMONS

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ABSTRACT

Despite significant advances in our understanding of the biophysical and institutional causes of overfishing, we have made little progress in addressing the depletion of our global fisheries stock. Investigations of potential solutions tend to be either too broad (mischaracterizing global fisheries as a singular commons problem to be addressed at the supranational level) or too narrow (focusing on improving management of small fisheries at the micro level). This article attempts to bridge the gap between our scientific understanding of our collective dilemmas and pragmatic solutions. Building on insights from Nobel laureate Elinor Ostrom, we frame the depletion of global fisheries as a nested set of diverse and interconnected collective action problems organized at different horizontal and vertical levels, where decisions and actions of one jurisdictional unit reinforce and amplify problems (and solutions) for other units. We examine features of the global fisheries system such as nonstationarity, nestedness, and prohibitive transaction costs, and we explore potential solutions. We argue that the success of our conservation goals depends on our ability to craft institutional rules at the lower levels that are adaptive to local conditions, address incentive misalignment issues, and allow for the transfer of positive externalities to adjacent and higher levels.

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Governing the Global Fisheries Commons

Humans have a more complex motivational structure and more capability to solve social dilemmas than posited in earlier rational-choice theory. Designing institutions to force (or nudge) entirely self-interested individuals to achieve better outcomes has been the major goal posited by policy analysts for governments to accomplish for much of the past half century. Extensive empirical research leads me to argue that instead, a core goal of public policy should be to facilitate the development of institutions that bring out the best in humans.

Elinor Ostrom, Nobel Lecture[1]

1. INTRODUCTION

Since the industrialization of the fishing process began in the early 19th century, global fisheries have remained under persistent threat of population collapse. But the decline has been continually masked by geographical expansion and technological innovation that has led to an increased access to previously unexploited fisheries (Pauly et al., 2002). Since the 1980s, the depletion of marine ecosystems has intensified. Global marine fisheries landings have decreased by roughly 0.7 million tons each year. Of the world's fish stocks, 52% are deemed exploited, and 28% are overexploited or depleted (Watson and Pauly, 2001). Only about 15% of the world's fish stocks are underexploited or moderately exploited (Kalfagianni and Pattberg, 2013). Overfishing has long been recognized as a chief explanation for the decline in fish populations, although environmental shocks such as El Niño events have played some role (Pauly et al., 2002). Despite commitments by governments and intergovernmental organizations to act swiftly, no tangible large-scale programs have been implemented to meaningfully overcome overfishing challenges at the global scale. What is more, governments continue to subsidize large-scale fisheries, generating perverse economic incentives to overfish and undermining ongoing marine ecosystem preservation efforts (Sumaila et al., 2021).

For more than two decades, the World Trade Organization (WTO) has been attempting to address overfishing problems by forging a global consensus on the issue, but the barriers to global collective action have proven to be insurmountable thus far. Although much emphasis has been given to it, the WTO consensus is not likely to be the panacea it is presumed to be. Even if the necessary two-thirds consensus is achieved, it will likely remain a purely symbolic gesture. Such a high-level consensus, without the necessary buy-in and backing of subnational stakeholders, is unlikely to sufficiently alter underlying economic incentives facing various actors participating in overfishing activities across different jurisdictions with varying levels of overfishing restrictions and enforcements. Given the unbending political stalemate, the insufficiency of fragmented solutions, and the prohibitive costs of meaningful global collective action, there is a dire need for institutional and technological innovations to overcome the social dilemmas facing the global fisheries commons.

The depletion of global fisheries has garnered significant scholarly attention (Kooiman et al., 2005; Pauly, 2008; Basurto and Nenadovic, 2012; Costello et al., 2016; Szuwalski and Thorson, 2017; Young et al., 2018). Economists studying natural resource systems have long understood that global fisheries are susceptible to the problem of the commons (Ostrom, 1990; Stavins, 2011; Smith, 2012; Wilson et al., 2013; Dasgupta, 2019; Kroetz et al., 2022). Howard Scott Gordon's

[1] Ostrom, 2009a.

(1954) seminal paper attributes the fisheries' commons problem to fish stocks' common-property and open-access nature. Gordon's analysis and subsequent bioeconomic literature rely on a model of a single fisheries stock, which is a "principally metaphorical" way of depicting a fundamental incentive mismatch (Smith 2012). The common ownership (or the absence of ownership) of the fisheries stock incentivizes fishers to maximize their catch through overcapitalization and disincentivizes them from investing any resources toward the preservation of the total stock. Knowing that one person's actions are unlikely to be noticed or reciprocated by others, an individual fisher is unlikely to exercise restraint over others whenever using collective resources simultaneously. Thus, in open-access fisheries, where property rights are either absent altogether or unenforceable because of prohibitive exclusion costs, intensification of fishing activities beyond the system's regenerative capacity is to be expected. Nobel laurate Vernon Smith (1969) later expanded the model of a single fish species (with a fixed stock X_t and a natural regenerative capacity) to explore the dynamics of the open-access fishery under an open-access regime. Subsequent work has progressed well beyond the metaphorical single-species models of fisheries to account for spillovers across multiple species, the interseasonality of human and fish behavior, spatial heterogeneity, and the diversity of resource systems and institutions. Nevertheless, an expanding theoretical and empirical literature on fisheries has persistently recognized the common-property regime and its associated problems, such as the unenforceability of regulations, open access, and free-riding as the fundamental problems undergirding the tragedy of the fisheries commons.

Despite significant progress in our understanding of the biophysical and institutional causes of overfishing, curbing the depletion of global fisheries stock has proven to be—at best—an elusive goal. The problem can be explained, in part, by the disconnect between vast scientific knowledge of diverse fish species and fisheries systems and socioeconomic models of human behavior and institutions. Even when the diagnostics of the scientific findings are accurate, proposed policy prescriptions tend to presume idealized human actors operating within perfect institutions. Ostrom and Cox (2010) refer to this as the "panacea problem": any deviations from the perfect scenario are interpreted as aberrations, to be rectified presumably by an external authority (p. 451). Thus, scholarly prescriptions are often not implementable because of enormous transaction costs associated with imperfect real-world institutions that are vastly different from their idealized counterparts. In other instances, such prescriptions fail to adequately account for the costs of recommended institutional change and economic tradeoffs between choices.

Within the burgeoning literature examining the problem of overfishing, not much attention has been devoted to linking scattered insights from studies of diverse fisheries systems in the institutional economics, environmental studies, or political economy literatures. Thus, this paper attempts to provide a novel and encompassing analytical framework for understanding the fisheries commons problem and its potential solutions by synthesizing key insights from institutional economics, political economy, environmental economics, and environmental studies. A crucial contribution of our work is that we delineate an original and conceptual way forward for environmental economics to understand better the problem of "the global fisheries commons" as a nested governance challenge by incorporating insights from institutional economics and political economy. We argue that the global fisheries commons pose a nested governance challenge analogous to many challenges related to climate change and pandemics (Ostrom, 2012; Paniagua, 2022). Although conveniently aggregated as a singular problem, the tragedy of the global fisheries commons is, in fact, a conglomeration of numerous tragedies, which are organized in multiple nested levels, and involves different organizations, political jurisdictions, and authorities. Thus,

we contend that complex environmental and economic challenges, such as the depletion of fish stocks in our world, are better conceptualized as nested externalities and multilayered governance challenges. Next, we sketch some pragmatic ways to improve global governance of fisheries by using an entire menu of existing institutional and technological solutions.

The remainder of the paper is organized as follows. Section 2 explains the nature of the commons problem, with a particular focus on the global fisheries commons. Section 3 argues that the challenge of governing the global fisheries commons is a nested governance challenge. Section 4 explores and unbundles various aspects of nestedness to better understand the social dilemmas facing diverse participants in the commons and multileveled governance challenges. Section 5 examines existing institutions and organizations involved in the governance of global fisheries and explores ways in which they interact with one another in a nested manner. This section also discusses potential and complementary solutions to the commons problem in light of its nested character and paves a path toward improving the future of the global fisheries commons. Section 6 concludes.

2. THE PROBLEM OF THE GLOBAL FISHERIES COMMONS

A *commons* refers to a resource system that is shared by many users (Sarker et al., 2015). Although they are often conflated with open-access systems—and increasingly with common-pool resources (CPRs), following groundbreaking work by Elinor Ostrom (1990)—commons need not be either. Both open-access systems and CPRs can be understood as specialized types of commons (i.e., subsets). Open-access systems are defined by their lack of ownership or any form of property rights, which precludes anyone from excluding others from accessing or appropriating the resource system. Whereas a CPR may or may not have defined property rights ascribed to it, it is difficult (but not impossible) to exclude others from benefiting from CPRs, and the associated benefits are subtractable—that is, one person's use necessarily depletes the available stock, thus making the appropriated unit unavailable to others (Ostrom, 1990; Ostrom et al., 1994). The distinction is crucial because open-access systems and CPRs lead to different types of collective action problems and have vastly different policy implications (Ostrom, 2003). Specifically, when analyzing problems associated with the fisheries commons, one ought to exercise caution not to conflate fisheries governed under a CPR regime with open-access fisheries.

The tragedy of the commons remains an influential analogy to describe the fundamental problem affecting global fisheries (Van Long and McWhinnie, 2012). The idea is generally credited to Garrett Hardin (1968). Drawing on Malthusian principles, Hardin asked readers to "picture a pasture open to all" and imagine sheepherders who ask themselves, "What is the utility to *me* of adding one more animal to my herd?" before they decide how much to expropriate from the pasture that is shared with other sheepherders. Individual sheepherders, guided by self-interest, each choose to maximize gains for themselves and ignore the costs imposed onto the rest of the sheepherders. Hardin's general message is straightforward: narrow self-interest and rationality direct individuals to engage in an "unconstrained consumption of a shared resource—a pasture, a highway, a server"; the result is "congestion and, worse, rapid depreciation, depletion, and even destruction of the resources" (Hardin, 1968). To prevent such a tragedy would require dramatic measures such as abandoning the commons (i.e., radical privatization) or relinquishing individual freedoms (i.e., the statization of the resources).

Hardin's conclusions were subsequently refuted by natural resource economists, who showed that self-governing resource users can and do successfully avert the tragedy (Anderson and Hill, 1975; Ostrom, 1990). Empirical findings based on historical data and field studies from around

the world revealed that humans are capable of devising institutions to restrain their exploitative impulses and conserve the resource system for their long-term collective benefit. Unlike Hardin's pasture, which is devoid of institutions and rules for governance, resource users in the real world live under a diverse set of institutions: social arrangements, laws, and customs. Resource users implement a variety of rules to monitor their own resource extraction rates and to exclude outsiders from exploiting the resource system. They do so by developing elaborate mechanisms of mutual monitoring, sanctioning, and conflict resolution in case of violations. Thus, in reality, the tragedy is neither inevitable nor unsolvable, as resource users create and adapt diverse institutions to overcome their social dilemmas.

Moreover, the creation of institutions itself is endogenous to the economic system (Anderson and Hill, 1975). That is, the cost-benefit calculus determines the extent to which investments toward efficient rules are made. When the value of the resources (and of efficiently managing them) exceeds the opportunity costs associated with defining and enforcing rights, such investments are more likely to occur. Since the commons are jointly owned (by definition) and investments to design institutions are typically large, some form of collective action is necessary. Thus, the management of the commons is a *governance challenge* involving the multilevel collective action problems of (i) creating a system of rules that allow, prescribe, or proscribe certain actions for specific actors and (ii) monitoring and enforcing the rules to distribute the costs and benefits to different actors. The creation of such rules can occur through a top-down assignment, a bottom-up system of property rights and voluntary exchange, or some hybrid form that combines features of each (Taylor, 2021; Paniagua and Rayamajhee, 2023). The design of institutions (i.e., the institutional choice) has important implications for the sustainability of a resource system and likelihood of a tragedy.

Despite a large amount of scholarship disproving the tragedy of the commons' inevitability, the notion tends to resurface in various forms in contemporary global commons discourse. It is easy to see the appeal of the analogy. It offers a simple and compelling explanation for otherwise convoluted and seemingly intractable problems. Many of our global problems indeed share some important elements underlying the logic of the tragedy of the commons—namely, that these problems are caused by individuals' attempts to maximize private benefits and leave the costs of maintenance and preservation of the resource system to the public (the concentrated benefits and dispersed costs type of logic). The logic suggests that unconstrained, narrow rationality pushes individuals to exert ownership over the benefits but discard the costs, which results in the tragedy—an utter deterioration of the resource system. Such phenomena have been noted by scholars examining climate change, environmental pollution, pandemics, and banking (Paniagua, 2020; Paniagua and Rayamajhee, 2021; Lofthouse and Herzberg, 2023; Murtazashvili et al., 2023).

Economists have long recognized that global fisheries provide archetypal cases of the tragedy of the commons. Property rights are incomplete and difficult to implement, especially in the high seas and large, jurisdictionally ambiguous bodies of water. As a result, many fisheries resemble open-access systems and are highly susceptible to tragedies comparable to Hardin's pasture. Overexploitation can occur because of three main reasons

First, marine systems are vast geographical areas that follow an open-access logic. They belong to no one, or rather to anyone who can access them through maritime technology. Because they lie outside the purview of any government, fishers are free to extract unlimited quantities of fish, with the only limits posed by technology, gear, and the environment. Even in inland systems that are sufficiently large, formal laws will likely be insufficient to deter violators. Second, even

when *de jure* rules are in place to prevent overextraction, monitoring resource use and sanctioning rule breakers entail significant costs. Such systems can remain open access in fact, despite being technically restricted. Third, the migratory and fugitive nature of fish species makes it difficult to enforce both *de jure* and *de facto* property rights over most fish stocks. So, the rule of "first come, first capture" prevails, incentivizing rational fishers to race to overexploit the resource (Moustakas et al., 2006). Empirical evidence suggests that the race is more intense in systems where more fish migration is possible. For example, shared stocks in marine systems and international waters are more prone to overexploitation than smaller and more contained fisheries (McWhinnie, 2009). Thus, these factors make the problem of global fisheries highly complex and multilayered.

3. GLOBAL CHALLENGES AS NESTED COLLECTIVE ACTION PROBLEMS

One critical insight from Nobel laureate Elinor Ostrom's work on natural resource management is that large-scale externalities spanning multiple governmental jurisdictions should be viewed as a set of nested collective action problems rather than as a singular problem (Ostrom, 2009b, 2012; Paniagua and Rayamajhee, 2021). According to Ostrom, externalities are nested if one decision-making unit's choices and actions produce costs or benefits for other units located at different scales (Ostrom, 2012, p. 356).

Global externalities such as those involving global fisheries fit that description. They involve different countries, states, cities, municipalities, cultures, firms, and organizations. Actions of each unit (a fisher, firm, or government) generate costs and benefits that percolate to other units. For example, an environmental policy targeting large-scale fisheries in Nova Scotia province in Canada, once in effect, will immediately affect fishing communities in Maine in the United States. Similarly, because of the migratory nature of fish, poor management of a lobster fishery by communities in southern Maine will directly affect the size of the available stocks in other communities (Schlager and Ostrom, 1992). Even the choices made by secondary economic actors—such as processors, marketers, supporting industries, and consumers—have implications for the overall sustainability of fisheries (Webster, 2015).

Nestedness is a feature that is not unique to large-scale externalities (Paniagua and Rayamajhee, 2023). A society itself can be described as a nested system. There are small social orders embedded within other larger social orders. Marshall (2008, p. 77), for example, conceptualizes nested arrangements as cooperative systems that encourage the autonomous functioning of smaller, more exclusive units that operate within broadly agreed-upon principles. Thus, the nestedness of externalities can be thought of as a byproduct of the nestedness of the social orders within which they materialize. The larger a problem is, the higher the chances are that it presents a higher-order nested externalities challenge. In other words, in dealing with a small-scale problem, smaller jurisdictional units are often able to govern themselves insofar as the problem does not spill over to neighboring jurisdictions. When the challenge is of a greater scale, two or more smaller units can come to an agreement on objectives and rules consistent with their mutual interests. When the number of affected parties rises beyond a certain threshold, the costs of collective decision-making as a singular unit can grow exponentially because of diverging interests and hold-out problems (Buchanan, 1973). Thus, although aggregation is still technically feasible, it will be more difficult and may require clustering at multiple centers.

For tractability and other reasons, analysts and policymakers often ignore the costs of collective decision-making and implementation, presume homogeneity and linearity, and aggregate multiple small problems into a larger singular unit. Analysts may find it convenient—for analytical purposes—to assume a static and singular governmental body that can twist policy

levers through regulation, taxation, subsidies, or other behavioral nudges. But such perspectives have significant blind spots with regards to subnational institutions, geographical variation, and dispersed knowledge prevalent at the local level (Ostrom, 1990). Aggregating problems into a singular decision-making unit does not make these decision-making costs go away. They are simply arbitrarily suppressed to zero (by assumption) and tend to resurface in other forms, such as high implementation costs, high noncompliance rates, and even societal instability.

Consequently, miscalculations of the costs and benefits become inevitable, because the nested nature of certain socioeconomic and ecological problems is ignored, thereby generating unintended and counterproductive outcomes for communities and the resource or economic system. Higher-level decision-makers that hand down policies to local jurisdictions and communities are unlikely to carefully consider the diversity and heterogeneity of communities, their interconnectedness, and the nestedness of their collective problems (Ostrom and Cox, 2010). Thus, misaligned incentives and institutional mismatch are the inevitable outcomes of policies that homogenize a nested set of collective action problems and aggregate them into a singular large-scale problem.

The literature on governance that accounts for the nestedness of global externalities is growing (Murtazashvili et al., 2023; Paniagua and Rayamajhee, 2023). Thus far, the most analyzed cases of nested global externalities are related to climate change (Ostrom, 2009b; Ostrom, 2012; Lofthouse and Herzberg, 2023) and natural resource systems such as water (Garrick et al., 2013; Lubell et al., 2014; Svensson et al., 2021). Ostrom (2012) emphasized that the challenge of climate change is particularly difficult to tackle because it is rife with free-riding and coordination problems across all levels, from the international politics and nation-states level at the top to private firms, corporations, families, local communities, and individuals all the way down. Actors at all levels emit carbon into the atmosphere in small or big ways and are thus all positioned to contribute toward mitigating net carbon emissions. However, public discourses remain fixated on the nation-state- or global-level solutions, ignoring the nestedness of associated externalities. As Ostrom argues:

> The literature on global climate change has largely ignored the small but positive steps that many public and private actors are taking to reduce greenhouse gas emissions. A global policy is frequently posited as the only strategy needed.… Positive actions are underway at multiple, smaller scales to start the process of climate change mitigation. Researchers need to understand the strength of polycentric systems where enterprises at multiple levels may complement each other. Building a global regime is a necessity, but encouraging the emergence of a polycentric system starts the process of reducing greenhouse gas emissions and acts as a spur to international regimes to do their part. (Ostrom, 2012, p. 353)

Polycentricity offers a useful analytical device to understand large-scale nested externalities. A system is defined as polycentric if it is composed of many autonomous and overlapping decision centers, each representing heterogeneous units linked through different exchange relationships (collaborative, competitive, or hybrid forms). Within such a system, citizen preferences can be aggregated and organized within multiple governing authorities at different scales to best match private incentives with the collective agenda. For instance, the users of a common-pool resource would have significant authority to devise many rules regarding the management, use, and preservation of the resource (Ostrom, 2005, p. 283). Recent scholarship has begun to examine large-scale externalities, such as those associated with climate change, through the lens of polycentric governance (Lofthouse and Herzberg, 2023). At the heart of the polycentric perspective is the acknowledgment that climate change poses a set of nested global-

scale externalities that cannot be solved by a singular governing authority because of epistemic and incentive-related difficulties. Solving problems of this type often requires efforts from all governmental levels. But governmental efforts alone are insufficient to address them. They also require meaningful participation and inputs from nongovernmental actors such as private firms, nonprofit organizations, and civil society.

This implies that the focus of public policies must be on generating sufficient incentives for private actors to innovate disruptive technologies and to improve efficiency through institutional innovations. The specific contents and provisions of such policies are likely to vary across jurisdictions and contexts, and they cannot be determined ex ante without an adequate consideration of institutional context, geographical peculiarities, and a host of other factors. Instead, policy design and implementation should be viewed as a dynamic process with built-in provisions to adapt to feedback and institutional change. In other words, despite our political and academic obsession with optimal policy design, there is no panacea to solve our existing environmental and ecological problems (Ostrom and Cox, 2010). In fact, one should be wary of any proposals that prescribe a singular one-size-fits-all solution to nested externality challenges such as climate change or global fisheries.

Ultimately, different types of solutions may resolve small parts or fractions of the large-scale commons and jointly contribute to alleviating the problem at different scales and under different contexts. For instance, at the meta-level, solutions such as climate clubs (of nations) may be effective in introducing incentives through joint resolutions and trade treaties (Nordhaus, 2015). At the local level, a wide range of novel institutions may coexist to promote climate adaptation while respecting local conditions (Dorsch and Flachsland, 2017). Concurrently, market mechanisms such as pollution permits and other economic incentive–based devices could stir innovation and entrepreneurship and promote wider adoption of cleaner goods and services.

4. THE GLOBAL FISHERIES COMMONS

One goal of this essay is to explore the essential features of the global fisheries system and its associated externalities that make it susceptible to overexploitation and depletion. Global fisheries share three key characteristics with large-scale externality challenges such as climate change and pandemic.

First, the resource system is nonstationary. Stocks of different species of fish move around the globe, across national and international waters. Although it may be technically feasible to contain fish stocks by assigning and enforcing property rights, such endeavors tend to be prohibitively costly, especially in the high seas. The costs of technology and resources needed to implement property rights are substantial. Such efforts are also rife with free-riding problems that make it extremely cumbersome to generate sufficient political consensus and overcome uncertainties associated with collective decision-making. Those difficulties are akin to the problem of curtailing greenhouse gas emissions, which are also fugitive externalities whose origins are nearly impossible to trace once they are released into the atmosphere. Thus, the nonstationary nature of the resource makes it difficult to assign rights and responsibilities to individuals, firms, and organizations.

Second, the problems associated with global fisheries are nested. Each fish species is part of the vast marine ecosystem, which is itself an aggregation of numerous interconnected sub-ecosystems. Each fish species relies on other fish species, eggs, plants, crustaceans, and a variety of food sources for its survival. All fish species are part of a complex, delicate, and interconnected ecosystem, in which one species can have profound effects on other species. Any human intervention in the nested marine ecosystem will similarly generate positive or negative effects

throughout the nested ecological systems. These effects also naturally extend to human societies in the form of costs and benefits, which are distributed in unpredictable manners and pose governance challenges. Hence, the governance of fish stocks is difficult because it involves many institutional and organizational arrangements at different levels and scales, ranging from sparsely populated rural communities to vastly populated coastal cities. Within and across each of these communities are small-to-large private businesses, local nonprofits, corporations, subnational and national entities, and large international nonprofit organizations. Programs and policies enacted at one political jurisdictional level will affect outcomes at other levels, either directly by producing external costs and benefits or indirectly by influencing institutions and underlying economic incentives. Moreover, actions taken by individuals, communities, businesses, and organizations in one unit will have repercussions for actors in other units. These dynamics, which stem from the nestedness of externalities, were most apparent during the recent COVID-19 pandemic (Paniagua and Rayamajhee, 2021; Paniagua, 2022).

Third, global fisheries face steep monitoring and exclusion costs, which must be overcome if natural resources are to be managed sustainably (Ostrom, 2000). The costs can be outright prohibitive in the absence of enforceable property rights in the high seas. Even when property rights are defined and technically enforceable, devising monitoring and exclusion mechanisms may remain economically inviable because of high costs of associated technology and capital. Global fisheries span vast geographical areas, transcending national and continental boundaries. Diverse types of international waters—such as oceans, large marine ecosystems, enclosed or semi-enclosed regional seas and estuaries, rivers, lakes, aquifers, and wetlands—are home to a vast share of global fisheries.

These water bodies are considered ungoverned territories, as they do not fall under any state's jurisdiction. Under the doctrine of *mare liberum*, international waters are immune to claims of ownership and sovereignty owing to their fluid and seemingly limitless nature (Gümplová, 2023). This implies that states have unconstrained rights to engage in fishing (or overfishing), navigation, overflight, cable and pipe laying, and scientific research in the international waters. In fact, a vast portion of natural resources of the planet, including fish stocks, are located in areas that are "traditionally acknowledged to be beyond the exclusive legal jurisdiction of sovereign states" (Soroos, 1988, p. 1). For those reasons, the resources are deemed "global commons," susceptible to the tragedy of the commons, and they are similar to Hardin's open-access pasture in having no means of overcoming monitoring and excluding problems and no enforceable property rights (Zou, 2018).

To be clear, international waters are not entirely open access. The 1994 United Nations Convention on the Law of the Sea implemented exclusive economic zones (EEZs) in waters adjacent to all coastal nations, extending national-level property rights to 42% of the ocean and allowing coastal countries to manage fisheries within their jurisdictions and exclude foreign fleets. Per the convention, the remaining 58% of the ocean would still be under an open-access regime (White and Costello, 2014). That said, the net conservation gains of decomposing the global commons into multiple national commons remains dubious, especially in light of the fugitive nature of the resource system under consideration.

To conclude, the three features just described *jointly* make the governance of global fisheries extremely challenging. The nonstationary and migratory nature of the resource system, the nestedness of associated collective action problems, and the exorbitant monitoring and exclusion costs pose severe coordination challenges for institutions at all levels. As a result, property rights are either entirely absent or are prohibitively costly to enforce, leading rational individuals to

engage in a permanent race to fish beyond sustainable levels and act against their own long-term mutual interests. In the next section, we will examine existing institutions and organizations involved in the governance of global fisheries and explore ways in which they interact with one another in a nested manner.

5. TOWARD A POLYCENTRIC APPROACH TO GOVERNING THE GLOBAL FISHERIES COMMONS

Now that we have expounded the fundamental causes of the tragedy of the global fisheries commons, we can begin to examine some potential and complementary solutions throughout, using our nested economic framework. Political economists and natural scientists have debated intensely regarding ways to prevent the collapse of global fisheries and rebuild the stocks (Costello et al., 2008; Worm et al., 2009). Economists have made important contributions to modeling and illustrating the fundamental incentive mismatch that undergirds the problem. However, their proposals (such as establishing private property rights) have been criticized by marine biologists, environmental scientists, and anthropologists for ignoring institutional context, geographical and ecological diversity, and complexity—maybe rightly so. But economists' proposals are still valuable as first approximations, and there may be gains for us to make by improving upon and adding nuances. Moreover, economists' emphasis on realigning economic incentives with resource conservation goals gets to the heart of the problem and cannot be ignored. Hence, we propose a conceptual framework that could act as a bridge between (i) economists focusing on property rights and incentives in the abstract and (ii) environmental scientists focusing on applied matters of governance, local challenges, and geographical nuances.

Yet the critics of the economic approach (narrowly conceived) are correct in the sense that the precise tools that are commonly proposed—namely, establishing and enforcing property rights and prices—are not meaningful in an institutional void. Many small-scale fisheries around the world are managed by communities using intricate traditional systems of rules without directly relying on private property rights and prices. In fact, Elinor Ostrom's (1990) influential work examining the governance of small-to-medium-scale commons demonstrates numerous cases of fisheries in various countries where prices and property rights—at least in the narrowest sense of exchangeable ownership rights—are neither necessary nor sufficient to govern collectively owned resources. On the other hand, the criticism also applies broadly to non-economists who advocate for a global overseeing authority and a uniformly applicable regulatory approach to circumvent the economic forces at play. Proponents of nonmarket solutions similarly fall prey to panacea thinking that presumes away, in part or entirely, the very problem it purports to solve (Ostrom, 2009a).

The nested and polycentric thinking that we advance in this paper cautions against prescribing one-size-fits-all solutions of all kinds—including but not limited to market-based and global government–oriented approaches—to govern global fisheries. The global need not connotate the singular. In fact, as argued in the previous section, the problems facing global fisheries are not a single problem, but rather a set of nested social dilemmas of varying scales organized across many horizontal and vertical levels. Although those dilemmas may share some features, each one has unique features corresponding to the characteristics of the fish species, local ecological conditions, geographical context, institutional setting, and socioeconomic background (Basurto and Coleman, 2010). As Worm et al. (2009) argue:

> [T]he feasibility and value of different management tools depends heavily on local characteristics of the fisheries, ecosystem, and governance system. For example, the most important element of small-scale fisheries success has been community-based management, . . . in which local

> communities develop context-dependent solutions for matching exploitation rates to the productivity of local resources. . . . Yet it is generally evident that good local governance, enforcement, and compliance form the very basis for conservation and rebuilding efforts. . . . Finding the best management tools may depend on the local context. (Worm et al., 2009, pp. 583–584).

In other words, the key to crafting pragmatic solutions to governing the global fisheries commons going forward lies *not* in some optimally designed supranational and overarching regulatory policy, but rather in *balancing* top-down supportive and mediative roles with diverse small-to-medium-scale efforts from the bottom up. A great degree of adaptability and flexibility is needed on the part of governmental authorities to "facilitate the development of institutions that bring out the best in humans" in a global fisheries context (Ostrom, 2009a). Likewise, scholars and policy analysts may benefit from regularly revising their blackboard theories using insights from individuals and communities on the ground tackling a wide range of problems while being more sensitive to context and local knowledge.

Rather than insisting on one set of solutions such as the creation of markets, a deeper appreciation of existing solutions and fruitful practices—combined with an openness to novel scientific and institutional innovations—is called for. A range of proven tools, such as ownership rights; alternative rights-based management; and rules dictating catch restrictions, monitoring, gear and vessel modification, establishment of closed areas in the high seas, and ocean zoning, must all have a place in applicable contexts, helping us to solve fractions of the problem at different levels. In the following subsections, we will explore some market-oriented solutions and some government- or community-based solutions, and we will discuss contexts where they can be fruitful.

5.1 Market-Based Solutions: Individual Transferable Quotas

One widely implemented market-based solution to the global fisheries commons problem is the individual transferable quotas (ITQs) system. Although implementation of ITQs requires a substantial governmental role, ITQs rely on price mechanisms and voluntary transactions between buyers and sellers in the open market. ITQs work as follows: Scientists assist governmental authorities in setting the annual allowable catch, which is equal to the efficient catch based on the specific fishery's natural regenerative capacity.

Governments then either allocate or auction off catch quotas to fishers and companies. The catch quotas serve as tradable property rights that give their holders the authority to extract a specified quantity of fish per year. The holders of the rights may extract the fish themselves or buy and sell their quotas in the secondary market (Weitzman, 2002; Stavins, 2011). Because the total quotas do not exceed the fishery's regenerative capacity, ITQs help to ensure that fishing levels are sustainable. ITQs are also welfare maximizing because they use a price system to direct resources to where they are valued the most.

Seventeen countries—including Australia, Canada, Iceland, and New Zealand—have implemented different forms of ITQs in about 150 fisheries (Newell et al., 2005). Of those countries, New Zealand uses ITQs to manage its entire commercial fishing industry (Newell et al., 2005, p. 91). Mounting evidence suggests that ITQs render fishing less dangerous, increase supply, and improve the quality and quantity of fish for all consumers. ITQs can also be *self-enforcing*, since fishers on site have incentives to take policing, monitoring, and reporting roles to ensure that everyone respects the quotas. Because each fisher is a partial owner of the fish stock and benefits from an increase in its value, fishers have an interest in properly managing the

fishery to preserve the quantity and quality of the fish stock. ITQs' tradability guarantees that fishers who wish to catch more than their originally allotted quotas may do so by purchasing larger quotas in the open market rather than resorting to more costly and potentially dangerous measures. Even though this system gets the label of "privatization," the reality is that the shares are distributed by governments and are based on the advice of a scientific body, while also devolving part of those rights to local communities. Hence, they can also be granted to local communities, families, and cooperatives.

Costello et al. (2008) analyzed data on more than 11,000 fisheries worldwide from 1950 to 2003. They conclude that fisheries managed under the ITQ system were half as likely to collapse as fisheries under alternative management systems. Moreover, the longer a fishery used the ITQ system, the less likely it was to collapse and the more likely it was to rebuild. Strikingly, every time an ITQ system has been adopted, management has improved and overfishing trends for the targeted fishery have halted and reversed. Subsequent studies have reached similar conclusions (see Worm et al., 2009, p. 583).

Despite those benefits, ITQs are not the panacea some make them to be. They have technical and geographical limitations. Many countries lack the necessary scientific expertise and political will to implement the system credibly and effectively (Costello et al., 2010). ITQs are a form of property rights, the applicability of which relies on the accountability of local governments. Economists have recognized that establishing property rights is not always welfare maximizing and can even be wealth destroying (Leeson and Harris, 2018). Crucially, for ITQs to be welfare enhancing, they must be tailored to the local ecological and geographical context. For countries that lack credible formal institutions, ITQs can essentially transfer de facto communal rights from self-governing communities to extractive private organizations with the wherewithal to buy off corrupt political actors. That can lead to devastating consequences both for the ecology and the communities that rely on the resource system. To prevent a single firm or entity from taking over too large a section of a given fishery, consolidation caps and community-owned quotas have sometimes been implemented. Such measures have been shown to increase competition and participation. Thus, the basic rule is not that private property is necessary but that "property rules must reflect the local conditions" (Cai et al., 2022, p. 13). What are necessary are (i) a more nuanced and less ideologically driven analysis of property and property rights and (ii) institutions crafted to better fit the microgranular conditions.

Finally, ITQs have been used effectively in inland waters and within countries' EEZs. But in the context of high seas and the open ocean, where the underlying political institutions are absent, ITQs are unlikely to generate positive outcomes. Likewise, international waters and contested territories present additional risks and challenges for ITQs or any system. Nevertheless, despite their limitations in scope, ITQs can be a valuable tool to reverse fisheries decline, especially when deployed with complementary governance strategies. With proper design, careful monitoring, and adaptation to changing environmental and local conditions, catch shares can lead to better management of global fisheries. Next, we will turn to complementary tools for dealing with overfishing within the high seas.

5.2 Governmental Action: Rescinding Government Subsidies

Fisheries subsidies have become archetypal examples of well-intended government policies that have led to catastrophic consequences. In the United States, subsidies were put in place in the post–World War II years with the purported goals of stimulating regional economic development and supporting fishing communities. Instead, they have led to sustained capital overinvestment,

overcapacity, and overfishing (Cox and Sumaila, 2010). The economic effects of fishing subsidies vary, depending partly on the type of management regime adopted. Poorly designed and protracted subsidies can result in intergenerationally transmitted dependency for many fishing communities, whereas incentive-compatible subsidies may improve the economic well-being of some communities. Nonetheless, subsidies' effects on *all* fish stocks have been detrimental, regardless of the management regime type adopted (Munro and Sumaila, 2002).

Although those adverse effects are well documented, many countries continue to make significant fiscal transfers to the fishing industries operating both within their territories and in the high seas. Sumaila et al. (2010) estimate that the subsidies paid to bottom trawl fleets outside the EEZs are around US$152 million per year. In fact, total government support to the fishing sector worldwide amounts to more than US$35 billion per year, roughly equivalent to 20% of the total value of the marine fish caught at sea and brought to port (Martini, 2018). Sala et al. (2018) concludes that the current rate of overfishing is enabled by public subsidies, without which 54% of high-seas fishing grounds would become unprofitable.

The economic logic of fishing subsidies was that they would directly help local fishing communities and boost the fishing industry, which was much smaller at the outset. If the average cost to an individual taxpayer was small (or presumably negligible), the positive outcome for the target population could then be rationalized on efficiency grounds. That calculus seems to have missed (or ignored entirely) the external ecological costs subsidies would generate in the form of depleted fish stocks and lost fish species. Fishers and businesses likewise have faced many of the adverse effects: stock depletion, decreased yield, lower quality, and the gradual decrease in revenues (Martini, 2018). As public-choice theory would predict, instead of their purported beneficiaries, subsidies have helped large-scale fishers and well-connected companies at the expense of climatically vulnerable small-scale fishing communities (Sala et al., 2018). Subsidies have also led to inequities in food security, as high-value species such as tuna and other deep-sea fishes are transported to markets in high-income countries and sold at subsidized prices, leaving less for subsistence-based fishing communities in developing countries (Sala et al., 2018, p. 8).

The most harmful sorts of fisheries subsidies are the ones that encourage overfishing in the high seas, where large and well-capitalized fishers can conduct their operations using methods that would be proscribed in regulated environments. Those payments reduce such fishers' overall operating costs and increase profits by subsidizing fuel, gear, and shipping vessels. As fishers can obtain the required inputs at below-market prices, they overinvest and engage in overfishing, ultimately depleting fish stocks below sustainable levels. Given the structure of incentives and the de facto extra-legal, open-access logic of the high seas, overfishing in these areas is a likely and "rational" outcome (White and Costello, 2014).

In sum, government subsidies have increased the economic viability of overfishing. They have tragically countervailed relentless efforts by dedicated conservationists and stakeholders to curb the depletion of global fisheries. The scientific community has issued numerous calls for an end to fisheries subsidies, particular in the high seas (Munro and Sumaila, 2002; Pauly et al., 2002; Sumaila et al., 2021). Some countries have taken constructive steps toward reducing fisheries subsidies. Norway set an encouraging example by eliminating fisheries subsidies altogether at the national level (Cox and Sumaila, 2010). The slow progress elsewhere is understandable, given the possibly high political costs of eliminating subsidies altogether. One pragmatic way around those costs is to phase subsidies out over time by partly shifting subsidies to fisheries within the EEZs or inland fisheries whose activities are more compatible with preservation goals.

Finally, it is worth noting that getting rid of subsidies alone is insufficient to prevent overfishing. It may even have adverse short-term welfare effects for many fishing communities that rely on them. Thus, policies aimed at rescinding fisheries subsidies or reforming them to make them compatible with sustainability goals must be considered *in tandem with* ITQs, alternative property rights–based mechanisms, and improved management regimes. Gradual rescinding of subsidies may be supplemented by transitional support programs such as skill development and other opportunities for small-scale fishers and communities practicing subsistence fishing. Other promising programs include disaster payments, special income tax concessions, and seasonal employment insurance, which aims to increase fishers' incomes while shifting fishing away from the high seas and toward EEZs and inland fisheries (Martini and Innes, 2018). Also, schemes such as tradable catch and bycatch quotas can produce reasonable results in incentivizing fishers to avoid the catch of threatened species (Branch and Hilborn, 2008).

5.3 Community-Based Approaches: Mobilizing Social Capital for Collective Action

Successes and failures of fisheries systems are typically assessed through the dichotomous lens of markets versus states. This view holds that failures stem either from the presence of uninternalized externalities leading to market failures or from governmental mismanagement and corruption (that is, governmental failure). Such a perspective presumes that governments and markets are the only relevant players for the preservation of the global fisheries stock. This is far from the truth. Fishing communities are integral parts of any fisheries system. As such, communities' productive roles are essential for the viability of fisheries. As Jentoft (2000, p. 53) puts it, "viable fish stocks require viable fisheries communities." Fisheries systems do not exist merely within the confines of formally organized markets and neatly demarcated political boundaries. They are enmeshed within fishing communities composed of individuals and families whose economic, cultural, and social lives are embedded in fishing. Thus, stressing the vital role of communities while analyzing the problem of overfishing is a crucial first step to overcoming collective action problems associated with the depletion of fisheries stock.

Because the social and economic well-being of fishing communities depends critically on the health of their fisheries stock, the logic of collective interest dictates that those communities are naturally inclined to invest in efforts and resources to preserve their fisheries system. Those investments can take the form of complex and adaptive institutions, often constituting elaborate systems of operational, collective-choice, and constitutional-level rules to constrain expropriative behavior of individual fishers and to incentivize them to contribute to fishery stock conservation. Where formal property rights are absent, communities often leverage their local knowledge and community social capital to devise informal rules and assign rights and responsibilities to different community members. Because the rules are created through extensive collective deliberations and are more likely to address local needs, they tend to elicit higher compliance rates. Moreover, institutions of this type tend to be self-enforcing because each member is invested in the preservation of the resource system and is thus likely to invest significant time and effort in monitoring and sanctioning mechanisms. Thus, these factors make community-based institutions better poised to succeed than formal rules handed down by formal authorities.

The famous case of the Maine lobster fishery, as documented by Schlager and Ostrom (1992), provides an illustration of an effective community-based solution to the problem of overfishing. The state government holds the de jure ownership rights to the lobster grounds off its coast. Lobstering businesses and fishers can then obtain authorized user rights by obtaining licenses from the state. However, the prevailing system of public ownership was insufficient to manage

and preserve the lobster fisheries. To fill this governance gap, fishing communities exercised de facto proprietor rights, which granted them all the privileges of ownership rights minus the rights to alienate the resource system. The de facto proprietor rights were enforced after being unbundled into several categories—access rights, withdrawal rights, management rights, exclusion rights, and alienation rights—and recombined in different configurations. Different members of the fishing community would then serve in different positions and exercise different bundles of rights granted to those specific positions. For instance, a manager of the fisheries would be granted the rights to regulate the use of resources by other members, whereas authorized users would not be able to exercise such rights but could still access and withdraw from the resource system provided they follow the established appropriation rules. Thus, communities are not passive beneficiaries of efforts by private enterprises or public authorities but play active roles in fisheries management and contribute to overcoming the tragedy of the fisheries commons by crafting self-governing institutions.

6. CONCLUSIONS

Analyses of the problem of global fisheries depletion suffer from the panacea problem (Young et al., 2018). Thus far, significant scholarly efforts have been expended in establishing the superiority of a specific solution and in refuting alternative solutions that are deemed suboptimal. As a result, the problem has been inappropriately aggregated, homogenized, and simplified, and the institutional context has been stripped away to comply with the assumptions and conclusions of academic exercises. Simple and elegant solutions derived from such exercises conducted within an institutional void, when implemented in the real world, either do not work or generate counterproductive results.

In this paper, we offer an analytical alternative to move away from the panacea trap. Rather than viewing the global fisheries commons as a singular problem, we argue that it is a nested set of collective action problems of diverse scales and features, organized in different horizontal and vertical levels and affecting different parties across overlapping jurisdictions. Under this alternative framework, our perspective emphasizes the complementarity of diverse solutions at different levels. Market-based approaches such as ITQs that rely on price signals have proven their efficacies in many fisheries around the world. But their applicability is limited to contexts where effective and accountable political institutions are present. Where such institutions are absent, ITQs can serve as extractive tools that governments and external entities can use to take away de facto property rights from indigenous communities. The role of governments is also critical in addressing coordination challenges at the higher level. One achievable government action could be in rescinding fisheries subsidies, which have led to massive declines in fisheries stock around the world. Finally, we discuss the importance of community-based solutions in addressing the problem at the local level in a manner that can promote concerted efforts to solve the challenge of governing the “global fisheries commons” by partitioning it in more manageable local problems.

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