GÖTEBORGS UNIVERSITET

DEPARTMENT OF POLITICAL SCIENCE

DOES RESOURCE DEPENDENCE MATTER?

A consideration of artisanal fishing in the relationship between democracy and marine health

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Abstract

This paper examines the interplay between democracy, artisanal fishing, dependence on marine resources, and the health of marine ecosystems. The focus on artisanal fishing opportunities examines how local organization can affect the status of fisheries. The study provides new nuances to the prevailing notion in environmental political theory that democracy is a better system to promote pro-environmental outcomes, highlighting the need for context-specific analyses. This is done by using regression analysis on a global sample of coastal countries. The results suggest that democracy, at least its deliberative component, does not necessarily correlate with better marine health, although it does have a positive impact in countries that are expected to be more dependent on marine resources. However, the study also uncovers negative moderating effect of the empowerment of artisanal fishing on the relationship between democracy and marine health in countries that are expected to have smaller dependence on fisheries. The paper emphasizes the relevance of considering local conditions, perspectives, and socioeconomic factors in studying environmental issues, to merge social and environmental problems as connected challenges.

Keywords: *democracy, fisheries, resource dependence, artisanal fishing*

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Introduction

Democracy's competence to deal with environmental problems and emergencies has been debated in the environmental literature from diverse points of view. Environmental policy scholars have questioned whether democracy as a system is good of bad for the environment (Povitkina, 2018). The answer is still up to debate. This paper joins this debate, in the case of democracy's relationship to marine health, but incorporates an innovative perspective regarding resource dependence and socioeconomic conditions of local fishing groups. The proposed approach incorporates these conditions as potential intervening mechanisms in the way the democratic system –or some of its processes—might be capable to tackle marine health decline.

The environmental problems that democracy tries to handle are tied by definition to what Mancur Olson describes as collective action problems: situations where the short-term interests of individual actors come into conflict with collective interests that might play out in the long-term, thus generating the risks that no collective benefit will be achieved (Olson, 1965). Common pool resources encounter these exact problems.

Keeping a common-pool resource alive seems simple: do not harvest over its capacity for recovery. In terms of fisheries: do not fish faster than the ecosystem's capability to recover. Nevertheless, the tragedy of the commons (Hardin, 1968) stays relevant time and time again, to a point where the health of the oceans has become threatened by intense human activities.

The Marine Trophic Index indicates a worrying trend of fishing down the food chain, which means that intensive fishing activities are leading to the capture of smaller animals as the bigger ones that are higher in the food chain get overfished. This trend also affects key predators for marine ecosystems, resulting in unbalanced marine habitats in coastal countries (Sjöstedt, 2013).

Despite this, fishing and aquaculture are fundamental sources of food security and responsible for the nutrition of millions. In 2018 the global production of aquatic animals was estimated at a record 179 million tons (FAO, 2022). At the same time fishery resources are steadily declining, and overfishing, pollution and poor resource management are compromising their recovery.

Fishing activities range widely in scale and dimension, the focus here turns to smaller-scale fishing activities that are considered artisanal. Artisanal fishing[1] is a key source of food, nutrition, and livelihood opportunities, among other services, especially in developing nations (Allison & Ellis, 2001). It is mostly used for direct human consumption, and in the last decade artisanal fishing amounted to over half of the world's marine and inland fish catch, employing over 90 percent of the more than 35 million fishers, supporting in consequence an approximate 90 million people who are employed in jobs associated within the fishing sector (OHI, 2022). Being such a relevant part of the fishing sector world-wide, this paper attempts to incorporate small-scale fishing into the research field of ocean health and sustainability of fisheries.

Having problematized this, it seems as if developing the fishing sector to provide opportunities to the millions whose livelihoods depend on it is incompatible with preserving the health of marine resources. This is the case because fishing represents the ultimate common-pool resource dilemma, for every caught fish means one fish less in the ocean, and for every fish outside of the water, marine health is negatively affected. If the goal is to restore oceanic ecosystems, the solution points to a complete stop in fishing practices. This problem becomes more complicated when focusing on near-shore fish caught by local groups that are less mobile than offshore species, and therefore easier to deplete. Having stated this, artisanal fishing practiced in a sustainable manner is still perceived by specialists as an opportunity to achieve the goal of preserving oceans and feeding populations in need, through its shift towards sustainability (OHI, 2022; FAO, 2022). Therefore, considering artisanal fishing as an opportunity to preserve oceanic health while promoting livelihoods that depend on fish resources is one of the main intentions behind this paper.

Evidence shows that effective management can successfully rebuild fish stocks and increase economic activity within ecosystemic boundaries. Nevertheless, small-scale producers remain vulnerable, with precarious working conditions, despite their critical role

[1] Artisanal fishing refers to "fisheries involving households, cooperatives or small firms (as opposed to large, commercial companies) that use relatively small amounts of capital and energy and small fishing vessels (if any), make relatively short fishing trips, and use fish mainly for local consumption or trade" (OHI, 2022).

in the sector (FAO, 2022). It is undeniable that humans are a key part of the marine systems globally (OHI, 2022), which is why it is important to find ways to make practices around fisheries sustainable. However, studies tend to emphasize that resource dependence, especially in developing countries, and the open-access nature of fisheries inevitably contribute to depletion of the resource and the perpetration of poverty and marginalization (Allison & Ellis, 2001).

Compared with terrestrial natural systems, the management of marine resources is more challenging, due to their less-known systems and understudied high variability through spatial and time dimensions (Ferse et. al., 2010). This always represents an additional challenge when attempting to find solutions for the management of a resource, and therefore, any results might have to be handled with care. Some specialists have even suggested that the truly complex behavior of fish stocks means there can never be enough information to manage fisheries based on numerical evidence (Alison & Ellis, 2001).

There is an ongoing debate in the environmental literature regarding which key aspects of a country (either its political system, institutions, or social characteristics) are more important in determining successful outcomes when it comes to environmental governance and figuring out schemes that benefit resource users and prevent excessive use that leads to depletion. This paper intends to contribute to this debate in one aspect regarding the capacity of local communities to contribute to a successful regulation in the use of marine resources when their livelihoods are almost completely dependent on fish catch. The idea behind it is that local communities whose nutrition and livelihoods are based on fish catch might have an important role in the health of the coastal ecosystem, reinforcing other important requisites like human development or democratic institutions.

By focusing on factors such as artisanal fishing opportunities, this study sheds light on the potential significance of other components of successful environmental outcomes, different to the ones that the literature has found to be key, like democracy (see Povitkina et. al., 2015), control of corruption and the presence of institutions (see Sjöstedt & Jagers, 2014).

The idea behind the concept of artisanal opportunities is the capacity to pursue sustainable artisanal scale fishing whenever there is a necessity for it. Put differently, that authorities provide spaces for artisanal fishing groups to satisfy their necessities. This dependency condition is important, and it can be a consequence of several socio-economic conditions, although one of the most direct predictors remains the percent of population that lives below the poverty threshold (OHI, 2022).

In other words, artisanal fishing opportunities are a key condition in determining whether local users profit from fisheries in a sustainable way. The mechanism that links artisanal fishing and sustainability in marine resources is derived from the notion that if fishing communities have access to the resources when they need them, they will have more cooperative behaviors and work to preserve it, as they depend on it. The expectation is thus that this condition is favorable to the relationship between democratic processes that seek to achieve sustainable use of marine resources. This precondition should be stronger in countries that are not considered as developed, as larger parts of their population may live below poverty thresholds and thus depend on a stronger extent on fisheries. Research that focuses on a global scale tends to neglect local conditions that are different between fishing groups, as opposed to specific case studies that delve deep into each community they study. Although this can limit the knowledge provided by the results, it also contributes to a more enlightened comprehension of the stakes in sustainable fisheries. An important contribution of this paper is that it will be the first to make an analysis in a global sample of coastal countries but will also consider local resource users by incorporating a variable that is closer to the outcome variable than the ones that have traditionally been considered at the aggregate-level like development, democracy, or corruption.

In the next section I review the literature that discusses democracy, environmental problems, and common pool resources, then I theorize about the problems this thesis tackles. Next, I present my hypotheses and the methods I will use to test them. I continue with the statistical analysis as well as the discussion of results. Finally, I recap the paper in the conclusion and present some potential opportunities for the future research.

Literature review

Democracy and the environment

The environmental literature has long debated whether democracy is a better system than others when it comes to environmental outcomes, more precisely if democratic institutions and democratic procedures, among other necessary features, are enough in guaranteeing the ground for collective action that result in desired environmental outcomes.

One side of the theoretical argument states that a healthy environment can be perceived by a democratic government as a fundamental right that has to be promoted, and therefore that the democratic system is better at promoting pro-environmental policies. On the other hand, scholars argue that liberal democracy might be a very permissive system that obeys citizens' and corporations' aversion towards environmental practices, thus preventing the state from implementing strong and successful environmental regulations (Povitkina et. al., 2015).

Although the literature that considers that democracy should be exchanged for other forms of government to successfully overcome environmental issues seems outdated and not completely empirically backed, one important point is that the liberal aspects of the democratic model seem to be at the roots of major environmental problems (Povitkina & Jagers, 2022). In this sense, more recent theoretical approaches that criticize liberal democracy and that move towards ecological democracy call for analyses through the lens of environmental justice (Agyeman et. al., 2016), to focus on accountability and legitimacy in environmental governance in all its levels that might be achievable through democratic reforms (Biermann & Gupta, 2011), to include non-human representation within the system to ensure environmental sustainability while also preserving democracy (Pickering et. al., 2020).

For democracy to be a positive influence for environmental outcomes, a strand of research suggests that it needs to be consolidated within a country to have effective mechanisms of action to combat environmental degradation. Therefore, younger, and weaker democracies are expected to have similar levels of environmental loss as more authoritarian regimes. This follows the reasoning that young democracies with unstable processes have elites that tend to cater to themselves as well as their closest supporters. Consequently, corruption is more pervasive and public goods like a healthy environment are usually under-provided (Sjöstedt & Jagers, 2014). Moreover, in many cases of developing countries democracy has often been implemented from outside, sacrificing its legitimacy as a system, and negatively affecting the correspondence between formal and informal institutions, which are fundamental in promoting collective action against environmental problems (Povitkina et. al., 2015).

Sjöstedt and Jagers' (2014) study on African fisheries tests these conditions and finds that age of democracy has an important effect on marine trophic levels, where younger democracies are vulnerable to patronage and clientelism. However, the empirical models performed in this study only take macro level independent variables into account (democracy, corruption, trade, population size, GDP per capita, age of democracy and an island dummy), and do not pay attention to the specific ways of the fishing communities that depend on the marine resources.

Povitkina and co-authors (2015) argue that positive effects of democracy on environmental outcomes are conditioned by levels of economic development. They report negative effects of democracy in countries with low economic development indicators, and positive effects after economic development reaches a certain threshold. Some studies even report no effect of political regimes on environmental outcomes in developing countries, further questioning the relevance of the democratic thesis where it is most relevant to focus conservation efforts. An important note to be made is that when both studies were conducted, the availability of data around democracy and its institutions was far more limited than nowadays, perhaps making use of more up-to-date measurements, the results would be different.

Contradicting the argument of the primacy of well-established democracy as the strongest predictor of good environmental outcomes, studies that focus specifically on local communities and their interests, stress the cruciality of local governance and equitable conservation as they involve a respect for local rights and local institutions, and to a certain amount respect for the decision-making processes of the local users and adherence to their standards (Dawson et. al., 2021).

A study by Ouréns and co-authors (2022) finds that stakeholders' perceptions of governance attributes, like participation, representation, transparency, or accountability positively relate with the performance of small-scale fisheries, which goes in line with the idea that democracy as an ideal system might not be directly linked with environmental outcomes, but its attributes that manifest through enabling conditions are part of the causal chain that links the political system with environmental performance, particularly for the case of small-scale fisheries.

The ideal of Democracy (with capital D) as a system, does not justify its existence for environmental purposes. However, as seen by this literature review, some of the features of the democratic system, if correctly implemented, can be beneficial for environmental outcomes. This paper is to contribute to this literature through a more precise incorporation of democratic mechanisms as precursors of favorable environmental results specifically in marine health. In this sense, one of the goals of this paper is to give clarity regarding the chain that links democracy and environmental health.

Common pool resources

To get a better understanding on the object of this study it is important to get an overview on common-pool resources and the challenges for collective action.

Natural common-pool resources are characterized by the difficulty of excluding users, which naturally leads to free-riding behaviors as users have little incentives to incur the costs of preserving the resource, and by the subtractability of its elements or the resource itself. Thus, theorists on common-pool resources suggest that the establishment of institutions that shape the incentives to prevent overexploitation might be a solution to the drama of the commons and avoid depletion of the resource (Ostrom & Gardner, 1993).

In locally situated resources with small-scale user groups, research has come to suggest that users are capable of formulating arrangements through formal or informal institutional settings or management agreements in order to allocate the benefits in ways that are perceived as generally fair. According to Agrawal (2001) the ability of these arrangements to last through time is key in maintaining a sustainable profit from natural resources.

Attempts to investigate common-pool resources and the ways local communities manage them constantly face the diverse challenges regarding their configurations, which have almost infinite variations, but also regarding the human configurations that adapt to those features. In this sense, Agrawal (2001) contends that research on this field has often been negligent in understanding how the features of the resources, the user groups and their membership, and the contextual environment effectively affect how institutions last in the long-term management of resources. Allison and Ellis (2001) further examine this limit particularly in the case of fisheries, and state that from a researcher's perspective it cannot be assumed that fisheries are composed by fishing groups that are homogenous and behave as communities, as this concept comes with many assumptions that might exclude important conditions in the study.

Field and experimental research has found that resource users locally constitute and effectively enforce their own rules, based on trust and reputation, and successfully manage the use of the resource (Ostrom & Gardner, 1993; Milinski et. al., 2002).

Similarly, research on indigenous peoples and local communities has found that involving them makes conservation more equitable and has the potential to generate better outcomes in terms of sustainability. However, from all cases reviewed, less than 10 percent constitute those of communities dependent on marine resources (Dawson et. al., 2021).

Fisheries and wildlife management in general depends on a vertical relationship between governmental authorities and users, but also on a horizontal relationship between resource users, where communication is crucial (Sjöstedt, 2013).

In success cases of regulation, closeness to the resource appears to be a key condition, as experience has often shown that attempts by central government authorities are often unfruitful (Ostrom, 1999). To empower local and traditional users, it is important that they perceive a sense of independence and self-organization, as oftentimes the involvement by central authorities that attempt to regulate the use of the resource results in counterproductive arrangements and represent disadvantages to those users (Agrawal, 2001).

The formation of institutions that shape the incentives around the use of common pool resources are dependent on the democratic processes that precede them. In this sense, incorporating theory that studies common pool resources and that links democracy to environmental outcomes is necessary.

Institutions that attempt to regulate the use of fisheries vary greatly in their configuration and the ways they shape incentives. Some examples are individual transferable quotas and individual effort quotas (ITQ, IEQ), territorial use rights (TURF), and marine protected areas (MPA) (Sjöstedt, 2010). Institutions like Exclusive Economic Zones (EEZ) and extended fisheries jurisdiction (EFJ) can be perceived as attempts towards a process of semi-privatization of ocean resources, although coastal communities have not necessarily been compensated by their implementation (Berkes, 1986).

Scholars call some of these configurations, like marine protected areas, “green grabbing” or more precisely “blue grabbing”, in the sense that it is a design by external actors that follows a colonizing ideology in detriment of local communities, and that they should be given larger recognition when addressing biodiversity loss (Dawson et. al., 2021). In fact, recent research has shown the limited effects of existing marine protected areas, and growing consensus points to the necessary involvement of local communities as a fundamental condition for successful marine environment management (Ferse et. al., 2010). For example, community-based natural resource management (CBNRM) research has given interesting lessons to the advocates of MPAs, even though it is hard to link both concepts. MPAs that are implemented effectively can lead to “increased biomass of targeted species, increased biodiversity and export of biomass to adjacent areas” (Ferse et. al., 2010), p. 24), nevertheless, their success is ultimately determined by the way they incorporate socioeconomic factors, like the interests of local users. Many studies have shown that locals feel disenfranchised by the imposition of rules that oppose their well-being, which leads to non-compliance. Customary marine tenure can raise local acceptance and lead to more efficient conservation results through local practices that regulate the use of resources (Ferse et. al., 2010).

Mbatha (2022) provides some evidence on the inadequacy of multi-level governance systems in promoting conservation that is successful but also provides equitable outcomes in African countries and argues that these systems perpetuate marginalization and fail to address the root causes in conservation issues.

These institutional arrangements are based on the supposition that the regulations imposed at the domestic level work effectively, and that the resource users that follow them are local fishing communities.

However, when powerful and industrialized fishing fleets with a deeper know-how on operating under the law are involved, the relevance of any arrangement can be challenged.

Studies around fisheries need to incorporate the challenges that Illegal, Unregulated and Unreported (IUU) fishing practices represent. The estimation of IUU is intricate due to its *under the water* component, yet it constitutes a great challenge in the strive towards sustainable fisheries and towards the reduction of poverty, which inspires a strand of the research around the reasons behind fishermen's incentives to follow regulations (Sjöstedt, 2010). In this challenge, the enhancement of collaboration and coordination between resource user groups, authorities and other stakeholders comes to be crucial in the action against the pest of IUU fishing (Temple et. al., 2022).

The economic viability of small-scale fishing is highly dependent on group's access to the resources, as well as the benefits they might drive and their support in management practices that promote sustainable activities, which is why it is fundamental to understand the economic and social dimensions of the communities to identify the requirements to improve their livelihoods (Kushardanto et. al., 2022).

Where the livelihoods of fishing communities depend on the marine ecosystem, the idea that having alternative options, for example through additional income, does not guarantee that they will discontinue excessively extractive activities. This option should then be based on ecosystem protection (like ecotourism) to avoid destructive activities and should also provide better returns to the resource users, which makes the shift towards alternative activities problematic (Ferse et. al., 2010).

Summary and problematization

As this section has documented, the existing literature effectively discusses and analyzes the relevance of the democratic system in environmental results, and under which circumstances its impact is positive. On the other hand, literature on common pool resource management – more specifically fisheries—and small-scale users, emphasizes the importance of local management and the involvement of local stakeholders to successfully formulate formal and informal institutions that regulate the use and preservation of ecosystems. It is worth noting that the existing literature tends to focus more exclusively on the institutions and management configurations around fishing groups, but inevitably overlooks the very act of fishing activities done at the local level, which is why this paper attempts to take a deeper look at artisanal fishing as a path towards sustainable management of oceanic resources. On the other hand, existing studies have yet to perform an analysis on a global sample that tests what mechanisms at a local level matter most in achieving optimal incentives to profit from fisheries while accounting for variations in political, social and development conditions that affect their impact in environmental outcomes. The literature has yet to consider extreme dependence of fishing groups on marine resources, including interdependence between users of the resource as a condition that incentivizes democratic organization to use it sustainably and avoid depletion. In this line, this study is guided by the ambition of uncovering if relevant conditions that affect fishing populations may affect the previously theorized relationship between democracy and ocean health.

This paper does that by focusing specifically on how different levels of resource dependence and the role of artisanal fishing groups can intervene in the motivations behind the democratic processes and efforts to preserve coastal fisheries.

Aim of the study

Is there a relationship between democracy and ocean health? If so, how much does resource dependence can affect this relationship? And can the relationship between democracy and ocean health be moderated by local conditions of resource users? These are the main questions that this paper aims to answer.

First, I examine the relationship between democratic institutions and profit from marine resources, then I explore the position that dependence to fisheries may impact this relationship between democracy and marine health. And finally, I explore how access opportunities of small-scale users moderate the relationship between democracy and marine health, and if this might also be conditioned by resource dependence.

Theory: Artisanal fishing groups, an opportunity towards sustainability.

The previous section has presented the state-of-the-art regarding how democracy seems to hold the key to achieve institutional configurations that –under precise circumstances—lead to a successful organization around the profit from natural resources like fisheries, touching also on common pool resources and their management. It appears as the combination of a solid democracy with well-functioning institutions, and the condition of a certain level of development is necessary in the argument of democracy as the better system to promote pro-environmental action. Along these lines, it might be the case that those conditions are only present in quite reduced regions of the globe: Western Europe, North America, Australia, Japan, and New Zealand tick off the necessary boxes of the ideal setting of a democratic regime, but most of the countries have a troublesome relationship with either democratic consolidation, development, or both. For that reason, an additional variable that approximates local conditions is considered here, as it might be helpful in understanding how institutions like democracy can lead to sustainability in fisheries.

There is an interesting area of improvement on the field that combines a study of democracy, and the local circumstances of fishing groups as an indispensable consideration in optimizing the use of marine resources. It is systematic in the sense that it considers a global sample of coastal countries, but it is also specific in the sense that it distinguishes between groups of countries in terms of their dependence towards fisheries, measured by proxy with a variable of human development, and how these conditions need to be differentiated in an analysis that intends to incorporate features that are particular to fishing groups and their relationship with the resources they profit from.

The emphasis in considering these characteristics derives from the notion that many theoretical approaches that seem to have previously worked in a global sample of countries might give different, even contradicting results when certain characteristics that differentiate countries are incorporated into the analysis, as countries deal with very different struggles that affect environmental governance and the management of common pool resources. In this sense, the analysis around these topics should be performed in a global sample, but also consider the different challenges posed by the geopolitical North/South divide to generate more accurate results and formulate more appropriate conclusions.

When users' economic activities are considered artisanal and small-scale, implying that their livelihoods are tightly linked to the marine resources they profit from (i.e., fish for nutrition), it is expected that they also become dependent on each other's behaviors to preserve the resources, and are more likely to find solutions to an equitable and sustainable management of the resource. This condition is expected to become especially important in contexts of low- and middle-income countries –considered as developing countries—because the premise of democratic processes as a means towards environmental outcomes tends to fail (see Povitkina et. al., 2015). In simple terms, the more a country struggles with development, the more likely an important part of its fishing groups may largely depend on marine resources and, as the stakes are higher in preserving fisheries for nutrition, they can better organize to collectively achieve profit schemes that are sustainable. This idea of mutual dependence as a precursor of cooperation is drawn from the theory listed by Barnaud and co-authors (2018) which says that if people do not feel mutually interdependent, they are unlikely to use their time and energy in voluntary collective action that would lead them to the necessary agreements to preserve the resource.

To develop this theory and understand the concept of interdependence among users, and between users and the resource, it is important to observe what kind of actors profit from fisheries in coastal waters, as well as their levels of dependency to the resource based on how key fisheries are to their survival. However, it is important to note that these conceptualizations are just for the purpose of visualizing how the interactions may work, as they can hardly represent the true heterogeneity of fishing groups all over the world.

A survey study in artisanal fishing communities in developing countries indicated that a range of socioeconomic factors like income, education, age, social status, alternative livelihood opportunities, community ties and support from the government affect users' readiness to exit fisheries in decline. The study concluded that these factors need to be considered when designing strategies and plans for declining fisheries (Cinner et. al., 2009).

As stated in the introduction, artisanal fishing groups and communities that are subsistence fishers often depend on the resource as their main source of food and nutrition. These groups have the highest dependency towards the resource as their lives mostly revolve around it, and in this sense these groups are the most dependent on other groups' activities as it determines the availability of fish in the region.

Also, artisanal fishing groups and communities that either feed on the resource or exchange it for a monetary value, present a high dependency on fisheries as their main economic activity, and revenues are based on their catch. These groups may have the chance of diversifying their activities seasonally or depending on the availability of fish and can oftentimes find compensations when fish stocks are low or start to be depleted. Following the theoretical reasoning developed here, if given the opportunity to access fisheries, these dependent groups should manage to organize their economic activities sustainably, as they have too much to lose in case of depletion.

Both these groups are captured in the statistical analysis where this paper attempts to find if higher dependence measured through level of human development, results in more effective democratic cooperation.

Scaling up in terms of capacities, commercial fishing boats whose origin may often be outside of the coast they fish on and that employ fishermen to catch and sell for profits are not as dependent as local groups, as they have the capacity to sail to other areas in case of depletion. The dependence of these groups is not as high, and therefore their incentives to care for fish stocks are lower and their motivations to overfish are big.

Finally, international and industrial fishing fleets that sail globally and have the biggest damaging power in terms of bycatch and degradation of the ecosystem present the lowest dependency to a resource and its other users, as its only incentive is to maximize catch to maximize profit. Their practices are the most unsustainable as their capacities to catch fish overcome the capability of fish species for reproduction and recovery to previous levels. Nevertheless, it is worth noting that countries often impose catch limits to these fleets based on ecosystems' capacities to recover thus limiting their capability to deplete marine resources.

These groups, larger in power are also incorporated in the statistical analysis, however, the operationalization of the concepts is limited by the availability of data, as they are accounted for by a variable that measures a fishing technique called trawling, that is considered more invasive and with stronger potential to damage marine ecosystems.

In summary, this conceptualization of the different groups of users of fisheries suggests that the bigger the capacities of catch, the lower the dependency and the less incentives to take part in democratic processes to protect marine resource to prevent its depletion. In this line, the involvement of asymmetrical actors makes the terms of interdependence also asymmetrical (Barnaud et. al., 2018), and therefore it is expected that different levels of cooperation vary from one resource to the other, depending on what kinds of players are involved in the fishing activities around it.

In a globalized world, it is not only the local users of fish resources that are responsible for fisheries' health. The scaling up in the economic chain brings in a multiplicity of relevant actors and stakeholders that affect the marine resources' stability, ranging from local fishing communities, domestic populations, governmental actors, to transnational fishing fleets and entire economies around the consumption of fish and other marine resources. As local users' economies become intertwined with larger markets, involving money exchanges and incorporating external interests, the literature suggests that subsistence users like artisanal fishing communities become more likely to increase their catch, not only because of external threats, but because they might encounter the opportunity to receive monetary income (Agrawal, 2001).

Attempting to understand and propose a model that shines a light on what causes a marine ecosystem to be healthy on a country coastline becomes then a methodological challenge, that might need to incorporate the different incentives introduced by market trends and the emergence of new technologies.

When new actors gain access to a resource, for example when large fishing fleets want to locate their activities to a country's coast, many more incentives and variables come into play: their interests might signify strong economic implications for the region, involving state authorities into the privatization of the resource which would then affect the existing arrangements that were under common property management (Agrawal, 2001).

Furthermore, the incorporation of large fishing fleets, that have better means to capture fish can also introduce problems of asymmetric access to the resource vis à vis artisanal fishing communities, similar to the problem present in many irrigation systems, where some users are head-enders, and the tailenders receive almost only what remains unused. Janssen and co-authors' (2011) study simulating irrigation systems defends the conclusion that equality of earnings often leads to better outcomes in terms of efficiency. Thus, if artisanal and industrial actors compete for a fishery, cooperation will be largely challenged. The theoretical argument that links equal access to artisanal fishermen and sustainable use of marine resources will inevitably be interrupted by the incorporation of external interests, thus affecting the health of the coastal ecosystem. However, if local fishermen can gain from the resource at rates that they perceive as equal, the results might be of efficiency.

Large-scale fishing activities, like trawlers that have the capacity of depleting complete areas and moving to the next are not likely to be involved in local-level management agreements. In this sense, community-level management is less likely to be successful in the case of offshore fish that are targeted by these large and more mobile fleets (Berkes, 1986). On the other hand, and this could be the case especially in developing countries, the presence of foreign private capital could also be accompanied by stronger demands for governance, sustainability, and regulations that could mean more sustainable use of the natural resource, depending on the demands of the markets (Povitkina et. al., 2015).

These theoretical arguments thus lead to the expectation that different levels of dependence towards fisheries affect the relationships between democratic features and their sustainability. The figure below illustrates this dynamic visually.

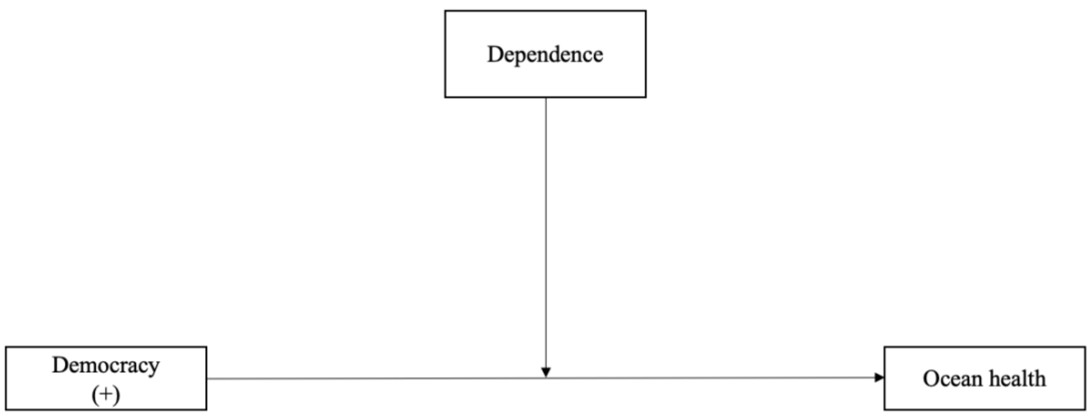


Figure 1. The relationship between democracy, dependence, and ocean health

On the other hand, dependency towards fisheries might also be some condition that affects how well small-scale fishing groups manage to sustainably profit from fisheries, thus moderating this local organization around the resource. Communities that depend largely on fisheries may reach agreements through democratic processes, thus reinforcing an expected positive relationship, but on the other hand, groups that do not suffer from the depletion of a resource should have less incentives to find sustainable schemes for profit. The figure below illustrates these interactions.

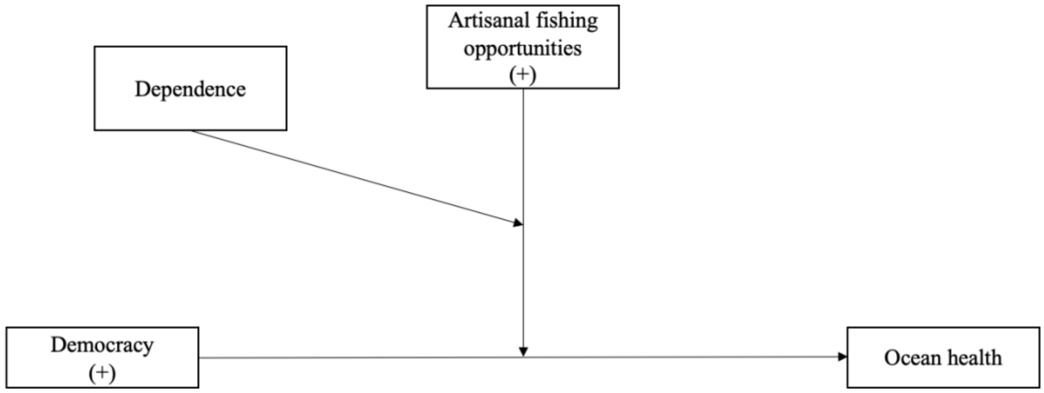


Figure 2. The effect of artisanal fishing and resource dependence in the relationship between democracy and ocean health

From these expectations I derive a set of hypotheses that I put to the test empirically through the regression model.

Hypotheses

Before conducting the analysis to test the proposed theoretical reasonings, and in line with the general expectation that democratic processes are beneficial to achieve positive collective outcomes that result in better marine health, a preliminary hypothesis is suggested to confirm or dismiss this expectation:

H0: Democracy is positively related to marine health.

Based on the reasoning that communities that depend on marine resources to high and very high levels – thus having more to lose from their eventual depletion – will likely be more willing to use democratic processes to collectively determine sustainable profit schemes, while acknowledging their mutual interdependence, my follow up hypothesis is:

H1: The relationship between democracy and marine health will differ depending on the level of dependence towards fisheries, therefore a stronger positive relationship is expected in high-dependence situations.

Because I argue that small-scale fishing groups need to have the appropriate circumstances and opportunities to perform their economic activities in a way they perceive fair thus inducing better levels of cooperation, I hypothesize that:

> H2a: Artisanal fishing opportunities positively influence the way democracy is beneficial for environmental outcomes, therefore the interaction between artisanal opportunities and democracy will have a positive effect in marine health.

In this same line I theorize that the levels of dependence (measured through levels of development) of artisanal fishing groups towards the resource might shape their relationship towards its sustainability, thus I hypothesize that:

> H2b: The effect of artisanal fishing opportunities on the relationship between democracy and marine health will differ depending on how developed a country is considered, used as a proxy to measure dependence on marine resources.

Methods

To test my hypotheses, I develop a regression model using a global sample of coastal countries. The dependent variable is a measure of ocean health.

I use panel data in a global sample, meaning that the same measurements are made yearly in a period. An advantage of this type of design is that the same units of analysis are recorded over a time dimension, meaning that, although it is only observational data, it is more difficult to rule out causality than with non-time-variant observations that occur in cross-section data (Mehmetoglu & Jakobsen, 2022).

There are limitations to time-series data analysis on a cross-sectional sample. When each country has more than one observation as the data is nested, it is not possible to assert that those observations are independent of each other, thus providing the analysis with intraclass correlation and breaching assumptions of homoscedasticity and no autocorrelation

(Ibid, 2022). These problems are addressed within the regression diagnostics. On the other hand, this investigation is limited by a panel that is quite restricted by the number of observations. Ideally a time-series analysis would take up over 10 years in observations, but the variables incorporated in this model allow it to take a maximum period of eight years. These constraints related to the number of observations inevitably limit the power to make conclusions based on the analysis, so the results should be handled with care, and instead could be considered as a steppingstone for future research whenever more data becomes available on the subject.

The sample is divided into two groups to test how the variables of interest behave depending on the level of human development; this method known as split sample analysis works like an interaction that affects all the variables in the model. One limit of this approach is that it becomes unreasonable to make inferences about whether the effects of an independent variable on the dependent variable in one sample is significantly different from that same effect in the other sample, this is because the covariates are different across the two samples. Splitting a sample produces the same outputs as if the variable that measures human development had interactions with all the explanatory variables in the model, otherwise known as a fully interacted regression. Another potential methodology to test how human development affects the variables of interest is to perform a three-way interaction regression model, where in this case I would interact artisanal opportunities with democracy, human development with democracy, artisanal opportunities with human development, and the three variables together[2]. This method gives more power to the interpretation and comparison of the coefficients, as well as the differences in their significance.

Variable selection

Dependent variable

Region-based Marine Trophic Index (coded my_rmti). The mean trophic levels of fisheries catches is considered by the Convention on Biological Diversity as an index of the biodiversity of large fishes (Kleisner et. al., 2015). It measures the health of a country's

[2] The equation for a three-way interaction model looks as follows: $RMTI = \alpha + \beta_{X\ dem} + \beta_{Z\ ao} + \beta_{V\ hdi} + \beta_{XZ\ dem*ao} + \beta_{XV\ dem*hdi} + \beta_{ZV\ ao*hdi} + \beta_{XZV\ dem*ao*hdi} + \epsilon$

fishing stock based on expected catch and changes over time. More specifically, the index measures the degree to which a country is depleting species at higher trophic levels and fishing down the food web. The larger fishes near the top of the hierarchical marine food chains tend to decline faster than smaller fishes when overfished, which results in a gradual reduction in the size and trophic levels of exploited fish, a phenomenon known as "fishing down marine food webs" (Kleisner et. al., 2015). The literature overall awards this index a consideration of being an adequate measure of ecosystem health and stability, however being a catch-based measure, some say that it does not reflect the real dynamics of marine ecosystems, questioning the capacity of trophic levels as measure of ecosystem health and stability (Sjöstedt & Jagers, 2014). Negative trends in the index are considered a proxy for overfishing and that "fisheries are not being sustainably managed" (Sea Around Us, 2011). The Region-based Marine Trophic Index aims to correct for the geographic expansion of fishing fleets over time, whose movements away from the shore to broaden their reach for fish previously biased the measurements of marine trophic levels. I have manually gathered the data from the Sea Around Us data page, by capturing coast by coast and year by year the levels of Region-based Marine Trophic Index. For those countries that have more than one coast, I elaborated a yearly average to assign only one single level of the index per country. The index varies from 2 to 4.5, measuring lower to higher marine trophic levels, and in this case the data I collected ranges from 2012 to 2019.

Independent variable

Deliberative democracy: Deliberative Component Index (coded v2xdl_delib in the v-dem dataset) answers the question: To what extent is the deliberative principle of democracy achieved? "A deliberative process is one in which public reasoning focused on the common good motivates political decisions—as contrasted with emotional appeals, solidary attachments, parochial interests, or coercion" (V-dem, 2023). It measures the extent to which political elites give public justifications for their positions on matters of public policy, justify their positions in terms of the public good, acknowledge and respect counterarguments; and how wide the range of consultation is at elite levels (Coppedge et. al., 2015).

Green political theories have advocated that deliberative democracy is an effective system in generating solutions to environmental problems, however Povitkina and Jagers's

(2022) study finds that deliberative features of democracy have weak association with environmental commitments' success. Despite this, I consider accounting for collective decision-making processes as an important aspect of democracy to be incorporated in the study, as it might be more effective in reflecting local deliberations regarding management of natural resources.

The variable is continuous, and ranges from low to high (0-1). This is based on the discussion in the literature review about the effects of democracy in environmental outcomes. Because the existing literature is ambiguous as to which characteristics of democracy become relevant in the causal chain that tries to explain environmental outcomes, this paper is attempting to be more precise in this theoretical endeavor by focusing more precisely on its deliberative component. In this sense, the positive effect of democracy is thought to be closely linked with fishing communities' opportunities to perform their economic activities. The theory is that this capacity of profiting from marine resources granted by existing institutions allows them to participate in the processes that define management schemes around the resource, and therefore, through democratic processes, sustainable use of the resource can be achieved. The hypothesis is tested by generating an interaction term between democracy and artisanal opportunities. It is expected that the effects of democracy on marine health will be conditioned by artisanal opportunities.

Conditional variables

The two variables presented in this sub-section are interesting for the aim of this study on how they might condition or moderate the effects of democracy on marine health. Artisanal fishing opportunities is incorporated into the model as a moderator by interacting it with the variable deliberative democracy. Human Development Index is also used as a conditional variable by using its categories to divide the global sample into two sub-samples.

<u>Artisanal fishing opportunities:</u> (coded ao_status from the OHI dataset). This variable measures the opportunity for small-scale fishers to supply catch for their families, members of their local communities, or sell in local markets. It is a function of need for artisanal fishing opportunities and whether the opportunity is permitted and/or encouraged institutionally and done sustainability. This variable accounts for the governability features that favor the path

for small-scale fishing groups to be able to perform their economic or subsistence fishing when they need to in a sustainable way (OHI, 2022). The Ocean Health Index makes a yearly assessment of oceanic health for 220 coastal countries and territories since 2012. It measures how well countries are sustainably managing the resources that they want and need from the ocean. The study evaluates the performance of countries based on 10 goals for ocean ecosystems that represent a whole of benefits that humans need from the ocean. It ranges from 0 to 100 (100 being the closest to the goal), it has data from 2012 to 2022.

Dependence: Human Development Index (undp_hdi in the QoG standard dataset). The United Nations Development Program's measurement was created to emphasize that people and their capabilities are more important criteria of development levels rather than economic growth alone. The HDI measures averages in key dimensions of human development: long and healthy life, being knowledgeable and having decent standards of living. Although this measure is a more holistic approach towards development, it fails to capture inequalities, poverty, human security, and empowerment (UNDP, 2022). However, for the purpose of the arguments of this work, it is considered a better measurement than economic variables like GDP per capita or economic growth.

This variable is used as a proxy to measure to what extent a country can be dependent to fish as a source of nutrition, as stated by OHI (2022) as one of the main sources of nutrition for populations that struggle with their living conditions. It is also used to divide the global sample into two sub-samples following the methodology of the United Nations Development Program (UNDP) that categorizes them in different levels of human development. The methodology of UNDP categorizes countries into low HDI if they score lower than 0.550, medium between 0.550 and 0.699, high between 0.699 and 0.799, and very high for countries with scores over 0.800. I simplify this categorization into low for countries under or equal to 0.7 and high for countries with scores higher than 0.7, for the purpose of keeping samples that are large enough.

Control variables

Political corruption: (coded v2x_corr in the v-dem dataset). Answers to the question: how pervasive is political corruption? Corruption can hinder any effort to sustainably manage a resource, through the malversation of resources towards clientelism and patronage that are more profitable for some of those in power in the short term. This variable ranges from less corrupt to more corrupt (0-1), and it includes measures of six types of corruption that cover different areas and levels of the political realm, distinguishing between executive, legislative and judicial corruption (McMann et. al., 2016).

Trade as percentage of GDP (coded wdi_trade in the QoG standard dataset). It measures the sum of exports and imports of goods and services measured as a share of gross domestic product (World Bank, 2022). This control variable can provide information on the presence of foreign capital and how much a country's economy depends on its exchanges with the world. The more open it is, the more political decisions around the environment can be influenced by potential buyers or investors from outside. Povitkina et. al. (2015) use this variable as part of a debate in environmental politics where some argue that the presence trade encourages higher environmental standards as well as innovations. However, it can also be that competitiveness –especially among developing countries—might lead to the dismantling of environmental protections to attract investments.

Population density measured in people per square km of land area: (coded wdi_popden in the QoG standard dataset). Countries with higher population densities might represent more pressure on fisheries as a source of nutrition, especially developing countries (FAO, 2022). This might generate negative impacts on the health of coastal ecosystem as the priority is to feed the population.

Fish caught by trawling: (coded epi_fct in the QoG environmental dataset). This variable measures the percentage of a country's fish caught by bottom or pelagic trawling (Wendling, 2020). Due to the lack of available data of large-scale fishing fleets, I suggest this variable as a proxy to measure how much fish catch has been made with more aggressive technologies. By using this variable, it is also possible to test the different effects that fleet sizes have in marine health through the theory developed earlier in the paper regarding dependence towards the resource and other users and mobility of the boat.

The full model is specified as follows:

$$RMTI_{it} = \alpha_i + \beta_1 Dem_{i,t-1} + \beta_2 AO_{i,t-1} + \beta_3 Corruption_{i,t-1} + \beta_4 HDI_{i,t-1} + \beta_5 Trade_{i,t-1} + \beta_6 Pop.den_{i,t-1} + \beta_7 Trawling_{i,t-1} + \varepsilon_{it}$$

Datasets

To perform the analyses that test my hypotheses I have merged the Quality of Government standard and environmental indicators datasets, the Varieties of Democracy dataset, and two separate sets that I created, one with the variable artisanal fishing opportunities, which I got from the Ocean Health Index dataset, and the other with the Region-based Marine Trophic Index, which I manually generated from the Sea Around Us data page. I performed the merge creating a "key" variable, that I generated in all datasets, by combining the country names with the years, so I would not get repeated time observations.

Because there were many datasets merged, large parts of the information were lost, mostly in terms of time, as in the final sample I obtained data ranging from 2012 to 2020. However, although this period might be considered short for a time-series analysis, the nature of fisheries and the recovery rate of fish being seasonal, I consider this timespan as enough to conduct a relevant analysis. Appendix 2 contains a table with descriptive statistics of the variables.

Results

This section presents the results and interpretations from the statistical analyses performed to test the previously formulated hypotheses.

Before engaging with the statistical regressions, a preliminary exploration of the data is a good introduction to get a visual overview of the way it behaves, to better understand what is under study and get an insight on what is expected. The correlation matrix and descriptive statistics table in Appendixes 1 and 2 display a summary of the main characteristics of the variables of interest as well as their potential relationships. Appendix 3 provides the histograms of the main variables of interest in this study, from their distribution I see no need to make transformations, as they would not improve their distributions.

Marine health decline

The figure below shows in a graph the mean levels of RMTI from 2012 to 2019. Globally, the marine trophic levels show a steady decline between 2012 and 2018, with a slight recovery in the last year. However, the performance of the index varies greatly between regions (See Appendix 4): Western Europe and North America see a positive trend, as well as Eastern Europe and post-Soviet Union, and the Pacific. But the rest of the world has either clear negative trends or mixed results.

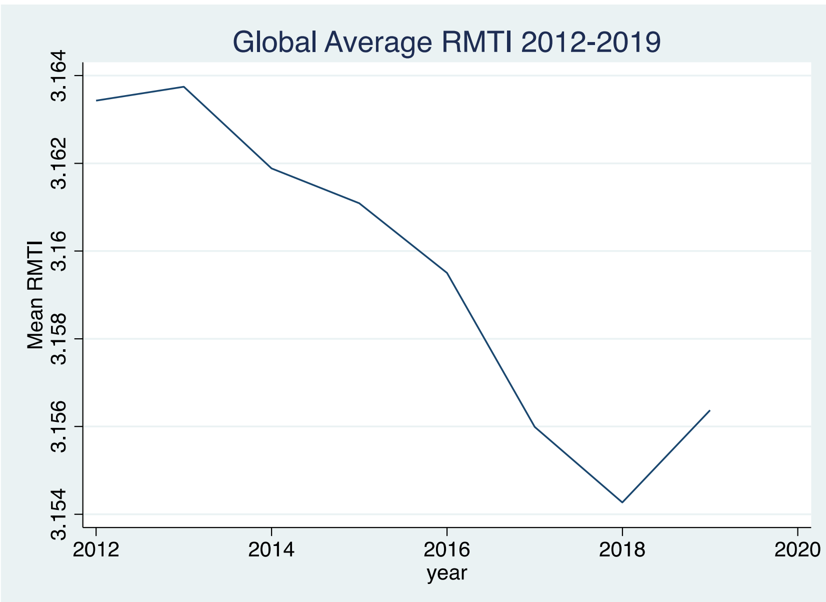


Figure 3. The evolution of average RMTI

Democracy and marine health

The two figures below show the bivariate cross-sectional relationship between RMTI and deliberative democracy at the beginning and at the end of the period under study in a global sample. The slope of the fitted line is slightly positive in both periods, partially supporting the hypothesis that expects a positive correlation between deliberative democracy and marine health.

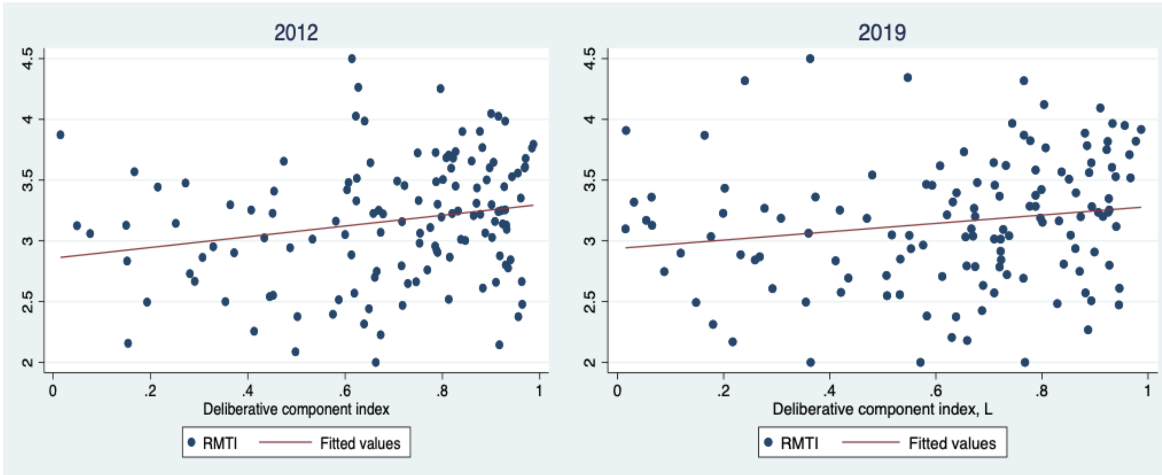


Figure 4. Democracy and marine health cross-sectionally

However, when dividing the global sample into countries that score high or low on HDI (see figures below) in the most recent observable year, the sign of the slope changes to negative for countries with lower levels of human development. This shift suggests something changed in that relationship for the group of countries that struggle with different aspects of development. This partially sustains the hypothesis that the level of development of a country matters when studying the mechanisms that favor or affect environmental outcomes.

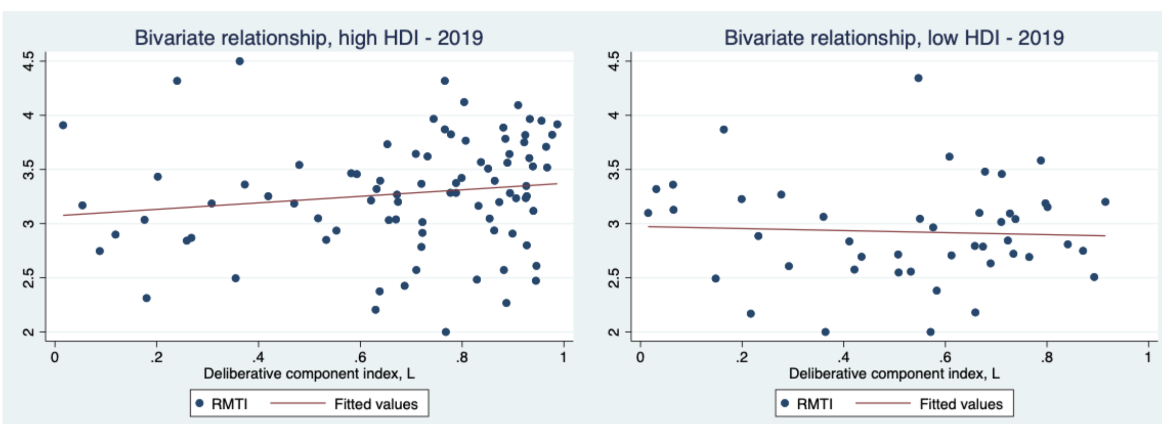


Figure 5. Democracy and marine health in split sub-samples

Finally, the figure below provides a more general overview of the relationship between both variables, taking their mean levels through the period under study. The positive correlation is still present. This scatterplot illustrates the presence of important variation between countries when time-variance is not incorporated, suggesting that the between variation of the variables is something to look deeper into.

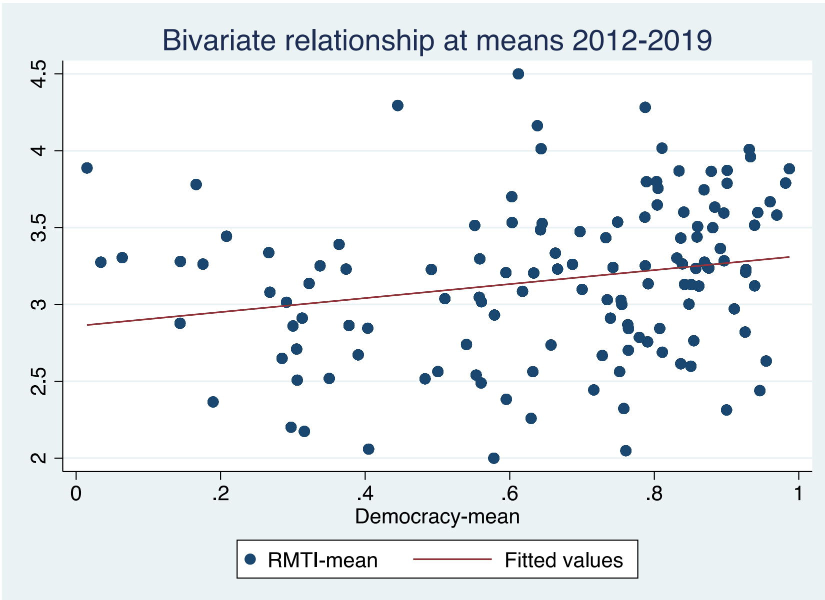


Figure 6. Democracy and marine health at mean levels

The scatterplots presented in appendix 5 show the bivariate relationships between deliberative democracy and marine health at the beginning and ending of the period studied, but also separating the global sample in countries with high and low HDI scores.

Regression analysis

After obtaining a visual idea of how the data looks, the regression analyses provide a deeper look into the relationships between the variables, allowing to accept or reject the hypotheses presented by this paper.

In panel data, different regression estimators are available to better fit the type of data under study. Some of the most used estimators are Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects (FE) and Random Effects (RE). The theory under which this paper wants to study the focal relationships aims to detect the effects that the variables of interest have on marine health through time, but also how the differences between countries in those independent variables affect the marine environment. Thus, a RE estimator is judged as a better fit, as it allows for a within and between approach.

In the random effects model, the regression coefficients are interpreted as an average of when the independent variable changes by one point within and between units (countries), weighted by each coefficient's precision. This interpretation assumes that the independent variable is not correlated with the unit-specific effects. The RE estimator incorporates the estimated variation of unit-specific effects across countries into the estimation of standard errors of the coefficient estimates. Therefore, through these regression models, it is possible to observe if the marine health of countries improves (or declines) when the variables of interest improve (or decline) through time, and whether countries that score better (or worse) levels in the variables of interest also score good (or bad) levels in marine health.

Deliberative democracy, dependence, and marine health

The regression table below provides the Random Effects estimation that tests whether deliberative democracy has a positive effect on RMTI, first in a bivariate regression, then gradually adding control variables.

Although the coefficients are positive in models 1 to 6, we can observe that in no model democracy has a statistically significant effect on RMTI. The p-values are bigger than 0.05, meaning that there is a high probability that the observed coefficients are random, therefore the null hypothesis stating that the coefficient may take a value of zero is accepted on the global sample. The preliminary hypothesis (H0) that democracy is beneficial for marine health is thus not supported on a global sample.

Likewise, the variable artisanal opportunities presents no statistical significance in its relationship to marine health, same as corruption and HDI. However, in models 6 and 7 there is a slight positive and statistically significant relationship between population density and marine health. The positive effect of population density goes against the expected result that countries with population pressures would negatively affect marine ecosystems. This result could be due to the presence of outliers in the sample, something that will be handled further ahead. Trawling has a negative and statistically significant effect of -0.00217 on RMTI. To better grasp what this coefficient means for RMTI in terms of percentage, the coefficient means that holding all other variables constant at 0, for one additional unit of trawling, RMTI decreases in around 0.06 percent. The impact of this variable on the dependent variable is thus considered very small.

The lack of statistical significance in the variables of interest throughout the model could be due to a few reasons, such as a lack of time variation in the variables, mismeasurements of some variables, the presence of confounding variables that are related to both the dependent and independent variables but that are not incorporated in the model, or because of a certain degree of random variation in the data. More of this will be considered in the discussion.

Random Effects regression on RMTI

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	0.0353	0.0352	0.0415	0.0494†	0.0428	0.0442	-0.00743
	(0.0239)	(0.0240)	(0.0258)	(0.0266)	(0.0276)	(0.0275)	(0.0292)
Artisanal Opportunities		0.0000405	0.00000626	0.000286	0.000287	0.0000325	-0.000720
		(0.000831)	(0.000834)	(0.000849)	(0.000885)	(0.000883)	(0.000939)
Corruption			0.0321	0.0379	-0.00201	-0.00355	-0.0576
			(0.0519)	(0.0547)	(0.0579)	(0.0576)	(0.0565)
HDI				0.183	0.0398	-0.0607	-0.134
				(0.148)	(0.157)	(0.158)	(0.183)
Trade					-0.0000883	-0.0000436	-0.000360
					(0.000192)	(0.000192)	(0.000232)
Pop. density						0.000181***	0.000145**
						(0.0000501)	(0.0000514)
Trawling							-0.00217**
							(0.000730)
Constant	3.136***	3.133***	3.116***	2.954***	3.083***	3.130***	3.424***
	(0.0468)	(0.0772)	(0.0818)	(0.151)	(0.164)	(0.163)	(0.196)
R2	0.0428	0.0411	0.0215	0.1406	0.0870	0.0641	0.0347
Observations	924	924	924	903	844	844	467
Countries	132	132	132	129	122	122	68

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: All independent variables except trawling were run with one-year lags.

Regression table 1

Because my theory (and H1) suggests that the effects of the variables of interest may differ in size and even in direction considering how dependent a country's population is towards fish resources, I performed the same regressions after dividing the global sample into two groups according to the UNDP Human Development Index methodology, where countries that score a level higher than 0.7 are considered as high or very high level of human development, and countries who score under that threshold are considered as low or medium level of human development (UNDP, 2022). This division into sub-samples attempts to capture dependence to marine resources according to data by FAO (2022) suggesting that fish represents an important source of nutrition and economic activities to disadvantaged populations. Thus, countries belonging to the developed group are expected to be less dependent on marine resources than developing countries.

With this division the results get interesting, as in the group of countries with higher HDI scores (considered developed), the relationship between deliberative democracy and RMTI remains statistically insignificant in all models.

Random Effects regression on RMTI – Developed countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	-0.000363	-0.00235	-0.00340	0.0129	-0.0103	-0.0107	-0.00539
	(0.0329)	(0.0330)	(0.0358)	(0.0375)	(0.0407)	(0.0405)	(0.0323)
Artisanal opportunities		0.000936	0.000932	0.00137	0.00140	0.00104	-0.00109
		(0.00106)	(0.00106)	(0.00108)	(0.00112)	(0.00112)	(0.00104)
Corruption			-0.00715	-0.0155	-0.109	-0.108	-0.0849
			(0.0825)	(0.0842)	(0.0917)	(0.0910)	(0.0757)
HDI				0.345	0.128	-0.0140	0.162
				(0.236)	(0.254)	(0.257)	(0.248)
Trade					-0.000469	-0.000400	-0.000852**
					(0.000292)	(0.000291)	(0.000326)
Pop. density						0.000155**	0.000102*
						(0.0000518)	(0.0000515)
Trawling							0.00135
							(0.00124)
Constant	3.283***	3.215***	3.219***	2.898***	3.160***	3.254***	3.342***
	(0.0591)	(0.0970)	(0.105)	(0.241)	(0.265)	(0.265)	(0.256)
R2	0.0254	0.0010	0.0001	0.0343	0.0045	0.0918	0.1520
Observations	575	575	575	554	529	529	341
Countries	86	86	86	83	80	80	52

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression table 2

Nevertheless, in the group of countries with lower human development scores, deliberative democratic processes are positively correlated with marine health with statistical significance in models 1 to 6. To better grasp the effect of democracy on RMTI, taking for example model 6 the coefficient of 0.122 means that, when holding all other variables constant, one unit increase in democracy leads to a 3.6 percent increase in RMTI. The variable democracy (as well as all other independent variables) was lagged one time-period, to avoid endogeneity and try to better capture potential causal mechanisms. Therefore, even when adding control variables, deliberative democracy seems to positively influence marine health in countries that depend to a larger extent on fish resources, suggesting that the presence of functioning institutions that allow collective decision-making is very important in countries that still struggle with some aspects of development. Going back to the theory on resource dependence as a precursor for cooperation around resource use, this condition of lower development/higher dependence is consistent with my first hypothesis (H1).

On the other hand, artisanal opportunities is lacking statistical significance in models 1 to 6, and in model 7 has a slight negative significant relationship with marine health. Contrary to the theorized positive effect that giving access to small scale groups would lead them to better incorporate sustainable practices and decisions, it appears that the access to the resource is detrimental to its health.

The subsequent models will further explore artisanal fishing opportunities and its potential moderative effect in the relationship between deliberative democracy and marine health through different levels of resource dependence.

Random Effects regression on RMTI – Developing countries							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	0.0893*	0.0898*	0.118**	0.108**	0.116***	0.122***	-0.0253
	(0.0351)	(0.0351)	(0.0370)	(0.0367)	(0.0352)	(0.0350)	(0.0676)
Artisanal opportunities		-0.00144	-0.00164	-0.00216†	-0.00250†	-0.00257†	-0.00413*
		(0.00132)	(0.00131)	(0.00131)	(0.00134)	(0.00133)	(0.00208)
Corruption			0.150*	0.0884	0.0808	0.0823	-0.0425
			(0.0655)	(0.0679)	(0.0666)	(0.0660)	(0.0955)
HDI				-0.621**	-0.776***	-0.985***	-0.925**
				(0.209)	(0.213)	(0.230)	(0.354)
Trade					0.000124	0.000161	0.000190
					(0.000233)	(0.000231)	(0.000334)
Pop. density						0.000635*	0.000195
						(0.000284)	(0.000342)
Trawling							-0.00391***
							(0.000820)
Constant	2.855***	2.963***	2.859***	3.301***	3.394***	3.425***	3.718***
	(0.0662)	(0.120)	(0.127)	(0.196)	(0.204)	(0.203)	(0.349)
R2	0.0008	0.0064	0.0105	0.0047	0.0026	0.0053	0.0170
Observations	349	349	349	349	315	315	126
Countries	53	53	53	53	48	48	19

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression table 3

The moderating effect of artisanal fishing opportunities

The following section tackles the proposition that providing small scale fishing groups with the opportunities to access the resources when they find need for it (either for nutrition purposes, or for their economic activities of commercializing with their catch), will generate optimal conditions of cooperation for deliberative democratic processes to successfully result in management configurations that maintain the health of the marine ecosystem. Additionally, this conditional relationship is explored through different levels of resource dependence.

The results of this analysis involving an interaction between artisanal opportunities and democracy are limited, as seen in the previous section, by the non-significant effects of those variables of interest in the dependent variable.

From the table below we can observe that the interaction term between democracy and artisanal fishing opportunities does not display the previously hypothesized results (H2a). It was expected that artisanal fishing opportunities would empower deliberative democratic processes that resulted in healthier marine ecosystems, however in the global sample, no statistically significant effect can be observed.

Regarding the fourth hypothesis (H2b), which suggested that the beneficial effect of artisanal opportunities on democracy's relationship with marine health would be also conditioned by resource dependence, the results were ambivalent. In the sub-sample of countries that are the least developed, the interaction term between artisanal opportunities and democracy presented no statistical significance, implying that the theoretical expectation would not be met.

Nevertheless, in the sample of countries with high scores of HDI, the moderative effect of artisanal fishing opportunities on democracy is negative and statistically significant, although with a very small coefficient. This relationship can result in an interesting discussion, as it suggests that in countries that have high and very high levels of human development, the effects of empowering artisanal fishing groups to access the resources may have a negative impact in how democracy and marine trophic levels are related, perhaps through a lack of dependence that undermines the necessity to care for the resource, which would align with the expected effect of resource dependence on the relationship between democracy and ocean health (H2b). More of this will be tackled in the discussion section below.

Random Effects regression with moderating effects of Artisanal Opportunities on Democracy's relationship with RMTI

	Global		Low HDI		High HDI	
Democracy	-0.0372	0.207	-0.289	-0.0993	0.383†	0.218
	(0.141)	(0.139)	(0.243)	(0.417)	(0.199)	(0.166)
Artisanal opportunities	-0.000555	0.00124	-0.00368†	-0.00458	0.00472*	0.00125
	(0.00141)	(0.00156)	(0.00193)	(0.00352)	(0.00220)	(0.00199)
Dem*Art. Op.	0.000891	-0.00267	0.00436	0.000868	-0.00497*	-0.00288
	(0.00171)	(0.00169)	(0.00277)	(0.00465)	(0.00253)	(0.00209)
Corruption		-0.0630		-0.0370		-0.0611
		(0.0565)		(0.0996)		(0.0773)
HDI		-0.132		-0.904*		0.116
		(0.183)		(0.357)		(0.249)
Trade		-0.000386†		0.000194		-0.000870**
		(0.000232)		(0.000350)		(0.000325)
Pop. density		0.000145**		0.000163		0.000105*
		(0.0000515)		(0.000330)		(0.0000519)
Trawling		-0.00225**		-0.00384***		0.00103
		(0.000729)		(0.000836)		(0.00125)
Constant	3.181***	3.271***	3.160***	3.745***	2.921***	3.197***
	(0.121)	(0.220)	(0.172)	(0.434)	(0.178)	(0.277)
R2	0.0451	0.0360	0.0298	0.0176	0.0081	0.1405
Observations	924	467	349	126	575	341
Countries	132	68	53	19	86	52

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression table 4

The conditional effects, seen in the following graphs allow better exploration of the moderating effect of artisanal opportunities on democracy.

The margins plot from the global sample, with 132 countries, confirms no moderating effect of artisanal fishing opportunities on how democracy affects region-based marine trophic levels.

However, in the sample including only countries with high HDI, which includes 86 countries, it is possible to observe a slight negative marginal effect of artisanal opportunities on how democracy affects marine trophic levels: in developed countries, higher scores of artisanal opportunities negatively moderate deliberative democracy's relationship with marine health.

If dependence is in fact the link between small-scale fishing groups taking on democratic processes to find sustainable measures to protect marine environments, then lack of dependence towards fisheries seen in high HDI countries might explain that their involvement in fishing practices is detrimental to the relationship between democracy and a healthy stock of fish.

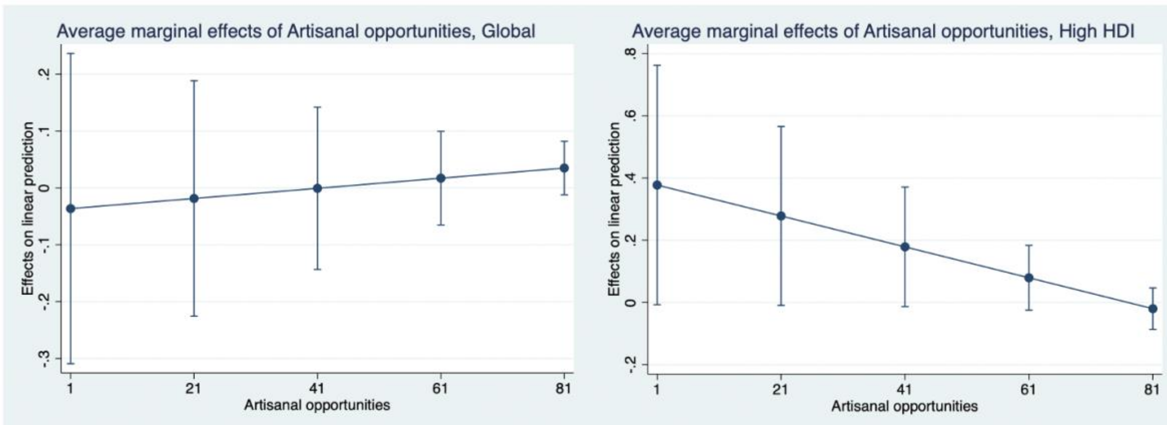


Figure 7. Marginal effects of artisanal opportunities on democracy's relationship with ocean health

Robustness checks

To confirm that a Random Effects estimation is appropriate given the data available, I performed a Breusch-Pagan Lagrange Multiplier test post-estimation (see appendix 6); with a p-value of 0.000 I can reject the null hypothesis that random effects are insignificant, and therefore accept the model as appropriate.

To test the robustness of the statistical models using random effects estimator, I ran the bivariate and full models using Pooled Ordinary Least Squares (Pooled OLS) and Between Effects estimators. A Pooled OLS estimation, although very intuitive and easy to interpret does not signal whether variations happen across time or between units. On the other hand, the Between Effects estimation measures the country's mean RMTI with all other countries' mean RMTI, therefore measuring the different effects between countries, but does not count as longitudinal analysis.

The results are presented in the table below, where we observe statistically significant positive relationships between deliberative democracy and RMTI in both bivariate models, something that was not present in the Random Effects estimation for the global sample. These two estimations do not account for the variations over time of panel data, in this sense the positive coefficient explains a relationship in terms of differences between countries but does not reflect improvements over time. In the multivariate model, Human Development Index also presents a positive relationship with the health of marine environments, and opposite to the expected results, more presence of trawling is slightly associated with better scores in RMTI, which could suggest problems with data, or that perhaps the presence of industrialized fishing also includes tighter environmental measures.

Regression on RMTI with Pooled OLS and Between Effects estimators in global sample

	Pooled OLS		Between Effects	
Democracy	0.422***	-0.215	0.455*	-0.330
	(0.0658)	(0.143)	(0.181)	(0.439)
Artisanal opportunities		0.000165		0.000102
		(0.00131)		(0.00364)
Corruption		-0.119		-0.142
		(0.127)		(0.363)
HDI		2.314***		2.432***
		(0.227)		(0.619)
Trade		-0.00107†		-0.00113
		(0.000550)		(0.00155)
Pop. density		0.0000774*		0.0000731
		(0.0000300)		(0.0000833)
Trawling		0.00581***		0.00641*
		(0.00103)		(0.00278)
Constant	2.881***	1.583***	2.859***	1.588*
	(0.0464)	(0.270)	(0.127)	(0.760)
R2	0.0428	0.374	0.0463	0.387
Observations	924	467	924	467
Countries			132	68

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression table 5

The table below checks for potential relationships in the Pooled OLS and Between Effects estimators separating the samples according to HDI levels.

Regression on RMTI using POLS and BE estimators, sample divided into high and low Human Development Index scores

	POLS – high HDI		POLS – low HDI		BE – high HDI		BE – low HDI	
Democracy	0.325***	0.200	0.0519	-0.694**	0.357	0.162	0.0128	-0.911
	(0.0840)	(0.187)	(0.101)	(0.255)	(0.236)	(0.576)	(0.275)	(0.922)
Artisanal opportunities		-0.000653		-0.00105		-0.00148		-0.00126
		(0.00151)		(0.00303)		(0.00411)		(0.0101)
Corruption		0.392*		-0.666*		0.470		-0.778
		(0.183)		(0.263)		(0.523)		(0.904)
HDI		3.797***		2.755***		4.511**		3.379
		(0.578)		(0.764)		(1.473)		(2.708)
Trade		-0.000592		-0.00360*		-0.000785		-0.00499
		(0.000595)		(0.00154)		(0.00164)		(0.00557)
Pop. density		-0.0000203		-0.000147		-0.0000367		-0.000194
		(0.0000361)		(0.000168)		(0.0000991)		(0.000573)
Trawling		0.0128***		0.00131		0.0146**		0.00166
		(0.00170)		(0.00146)		(0.00432)		(0.00492)
_Constant	3.076***	-0.180	2.883***	2.347***	3.028***	-0.724	2.899***	2.297
	(0.0635)	(0.589)	(0.0619)	(0.483)	(0.177)	(1.602)	(0.171)	(1.510)
R2	0.0254	0.295	0.000767	0.163	0.0264	0.372	0.0000422	0.187
Observations	575	341	349	126	575	341	349	126
Countries					86	52	53	19

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression table 6

The use of different estimators sheds ambivalent results versus the random effects estimator used. Therefore, I proceed with regression diagnostics to identify potential problems with the data.

Appendix 7 shows the Random Effects regressions on RMTI with clustered standard errors to correct for potential problems with autocorrelation, which often leads to biased estimations of coefficients by violating the assumption of independence of errors. When clustering standard errors to correct autocorrelation, the regression coefficients might lose statistical significance as the interval covered by the standard errors becomes bigger. In the global sample and high HDI sample, the focal relationships remain statistically insignificant, and in the low HDI sample, the positive effect of democracy on RMTI remains statistically significant in models 3 to 6.

Appendix 8 presents the trend checks, looking for potential problems with stationarity, however, the panel being small, there is not enough timespan to definitively detect them. Appendix 9 detects outliers for variables trade and population density, the regression models were performed excluding the observations that could have been biasing the estimations, resulting in population density losing its positive sign and statistical significance. This result is more in line with the expected negative effect of dense populations putting pressure on fishing practices as a source of nutrition, rather than the previously positive statistically significant effect of the variable on RMTI. In appendix 10, the Variance Inflation Factors measure whether multicollinearity increases the variance of regression coefficients. With all VIF levels below 5, no problem of perfect multicollinearity is detected in the model. Finally, in appendix 11, a Breusch-Pagan/Cook-Weisberg test for heteroscedasticity in the Pooled OLS estimator suggests a problem with the distribution of errors, I ran the regression models using robust standard errors to correct. The results of the regressions remain in line with the original random effects models.

A note on causality

Although the different methods used by regression analysis and lagging of variables lead to quite accurate estimations of the effects that explanatory variables may influence on the dependent variable, it is not fully possible to establish a full causal relationship through regression analysis alone. There might be many other variables influencing the outcomes, either as stand alone, or by exerting some interactive effect on other variables. The R-squared statistics throughout all the statistical models suggest that the variables proposed only account for very limited explanations in the overall variation of Region-based Marine Trophic Index. It is therefore important to handle all these results with care, as they do not pretend to be the sole explanation for marine health.

Discussion

Recapping the first preliminary hypothesis suggested at the beginning of the analysis, the regressions performed at the global sample do not provide evidence to accept a positive relationship between democracy (at least its deliberative component) and marine health (at least measured by its trophic levels, the first hypothesis of this thesis is thus not rejected.

The second hypothesis suggests differences in the relationship between democracy and marine health related to the level of resource dependence of countries. This hypothesis was supported after splitting the global sample into two sub-samples differentiated by a proxy (HDI) that captures how potentially dependent to marine resources a country is. Through this, it was possible to observe a positive significant relationship between deliberative democracy and marine health in countries that score lower levels of Human Development Index. This suggests that in those scenarios, where countries struggle with different social, political, and human aspects, the presence of solid democratic institutions allows them to achieve better environmental results, in line with the case of African fisheries studied by Sjöstedt and Jagers (2014). These results align with my theoretical expectation that more resource dependence (measured by proxy as low development) leads to deliberative democratic processes to succeed in marine conservation efforts.

Through these first hypotheses the traditional emphasis put on democracy by the environmental politics literature is thus challenged by the results of this paper, which suggests that although democracy has an inherent value for countries all over the world, it should not be considered homogenously as a *one fits all* solution for environmental issues as some papers have previously suggested.

Regarding the second two hypotheses, the theorization about the relationship involving dependence towards fish as a source of nutrition and the basic access to economic activities with how groups manage to organize through deliberative democratic processes with the goal of protecting marine resources could only achieve partial support.

Hypothesis H2a proposed that the relationship between democracy and marine health could be positively conditioned by providing local fishing groups with opportunities to access the resource, however no moderative effect was observed in the global sample.

Hypothesis H2b dug deeper into this possibility that artisanal fishing opportunities could be enabling in democratic processes aimed towards sustainability by involving the theoretical argument regarding resource dependence. It was expected that countries that could have higher dependence towards marine resources would see a positive impact of artisanal fishing opportunities in the deliberative processes around the conservation of fisheries. However, no significant moderative effect was detected in the low HDI sub-sample containing countries that were theorized to be more dependent on marine resources. Nonetheless, the other side of this argument was in fact supported, by a negative moderating effect of artisanal opportunities in the effect of democracy on marine trophic levels in countries with high scores of HDI. In this group of countries, the empowerment of small-scale fishing groups was detrimental to the relationship between deliberative democracy and marine health. This sheds light on a series of potential explanations, and in line with the dependency argument, might suggest that as developed countries are less dependent to marine resources, the provision of opportunities for small-scale fishing leads them to arrive democratically to schemes that are detrimental to the marine environment. This could be explained by the fact that the fishing groups have alternative economic activities available if marine ecosystems get depleted, thus confirming that less dependency leads to less care. Other potential explanations for this result are the use of more advanced equipment or more presence of industrialized fishing techniques.

These assertions are limited by the split sample method used to incorporate HDI as an intervening variable within the main relationships under study, as the differences in relationships between variables can be explained by covariates that are ignored when splitting the global sample into smaller sub-samples, thus suggesting that these results should be taken with skepticism. The use of HDI as proxy to measure dependence, and trawling to measure industrial fishing necessarily limit the results and potential interpretations that might be drawn from these models, as they do not operationalize with full fidelity the concepts that were theorized about previously.

Conclusion

This thesis explores the position that environmental problems, especially at the local level, should be addressed as social problems that could be considered part of the theory linking democratic principles' relationship to environmental outcomes. Empirical studies on the subject have not yet fully taken on the task of researching this connection between the social and the environmental on a global scale. This paper has done so by trying to answer questions regarding the relationship between democracy and marine health; if resource dependence can intervene in this theorized relationship; and whether local conditions like the opportunities for fishing groups to perform their economic activities when in need have a decisive effect on the deliberative processes that affect marine health.

Artisanal fishing opportunities was considered as a potential arrangement to preserve marine health by promoting the activities that rely on fisheries. The expectation was that it would represent a favorable condition in democracy's relationship with marine health, and that this would also be conditional to the dependence of fishing groups towards the marine resources.

On the road to testing the hypotheses presented, there were hurdles that have limited the dependability of the results. Regarding the availability of data, performing a panel data regression on a sample that has less than 10 years is constraining, especially when in this short period, the variables of interest do not present obvious changes. On the other hand, perhaps the measurements chosen as operationalizations to test the relationships are not as precise as desired, which would explain results that are sometimes non-significant, and sometimes opposite to those expected. This calls for a more in-depth research effort for the future, through more ambitious data gathering purposes directly from the local sources.

One of the main comments of this paper regarding the methods most used to study environmental problems is the generalization of the behavior in the relationships between variables like institutions and environmental outcomes, where they are expected to have similar results regardless of the region. Through the separation of the global sample into two different groups that differ in dependence towards fish as a resource, measured through proxy as different human development levels, I have been able to support my critique by providing statistically significant evidence that resource dependence matters when considering the relationship between democratic processes and environmental outcomes. In this sense one of the main contributions of this paper is the suggestion that academia needs to make more sensible decisions when establishing the assumptions of how the world is expected to behave.

As discussed previously, the results of this research are limited in power due to a lack of broadly available data, limiting the number of observations in the models. The conclusions reached through the analysis should remain open, and in the future, more deep research can be done on the same subject with better-quality data.

Some suggestions for future research arise from this paper, the first being a thorough methodological effort to capture as best as possible the conditions of coastal waters from the presence of fishing groups. Collecting data to perform multi-level analyses will give a much clearer image of the dynamics that lead to sustainable profit from fisheries. Another research recommendation is to look deeper into the local socioeconomic and institutional conditions of fishing groups and communities, globally, emphasizing local perspectives to better understand their organization around resources to avoid assuming country-level factors are the sole variables affecting environmental outcomes. Finally, to better make sense of how artisanal fishing opportunities may impact the perceptions of fishing communities towards the resources when their livelihoods rest on their health.

The policy implications of the results obtained in this analysis are limited by its empirical power as discussed previously, but also by the limits in the operationalization of the measurements of my interest, which is another motivation for further research to be more applicable. An important notation nonetheless is that industrial fishing, captured in this analysis as fishing by trawling is an undeniable threat to the survival of marine ecosystems. Large fishing fleets that supposedly operate under the principle of maximum sustainable yield, with the motivation to maximize their catch without bringing fish resources to extinction, should modify these behaviors, and this should be promoted through stricter regulations that do not put fish populations under such stress. Trophic levels can only recover if the fish are allowed to grow to their expected size, which should be achievable by limiting industrialized fishing practices in coasts and the high seas.

Bibliography

Agrawal, A. (2001). Common Property Institutions and Sustainable Governance of Resources. World Development, 29(10), 1649-1672.

Agyeman, J., Schlosberg, D., Craven, L., & Matthews, C. (2016). Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities. Annual Review of Environment and Resources, 41(1), 321-340.

Allison, E.H. & Ellis, F. (2001). The livelihoods approach and management of small-scale fisheries. Marine Policy, 25, 377–388

Barnaud, C., Corbera, E., Muradian, R., Salliou, N., Sirami, C., Vialatte, A., . . . Antona, M. (2018). Ecosystem services, social interdependencies, and collective action: A conceptual framework. Ecology and Society, 23(1), 15.

Berkes, F. (1986). Local-level management and the commons problem: A comparative study of Turkish coastal fisheries. Marine Policy, 10(3), 215-229.

Biermann, F., & Gupta, A. (2011). Accountability and legitimacy in earth system governance: A research framework. Ecological Economics, 70(11), 1856-1864.

Cinner, J., Daw, T., & McCLANAHAN, T. (2009). Socioeconomic Factors that Affect Artisanal Fishers' Readiness to Exit a Declining Fishery. Conservation Biology, 23(1), 124-130.

Coppedge, Michael, John Gerring, Carl Henrik Knutsen, Staffan I. Lindberg, Jan Teorell, David Altman, Michael Bernhard, Agnes Cornell, M. Steven Fish, Lisa Gastaldi, Haakon Gjerløw, Adam Glynn, Sandra Grahn, Allen Hicken, Katrin Kinzelbach, Kyle L. Marquardt, Kelly McMann, Valeriya Mechkova, Anja Neundorf, Pamela Paxton, Daniel Pemstein, Oskar Rydén, Johannes von Römer, Brigitte Seim, Rachel Sigman, Svend-Erik Skaaning, Jeffrey Staton, Aksel Sundström, Eitan Tzelgov, Luca Uberti, Yi-ting Wang, Tore Wig, and Daniel Ziblatt. (2023). "V-Dem Codebook v13" Varieties of Democracy (V-Dem) Project.

Dawson, N., Coolsaet, B., Sterling, E., Loveridge, R., Gross-Camp, N., Wongbusarakum, S., . . . Rosado-May, F. (2021). The role of Indigenous peoples and local communities in effective and equitable conservation. Ecology and Society, 26(3), 1.

FAO. (2022). The State of the World Fisheries and Aquaculture (SOFIA). Rome, FAO.

Ferse, S., Máñez Costa, M., Máñez, K., Adhuri, D., & Glaser, M. (2010). Allies, not aliens: Increasing the role of local communities in marine protected area implementation. Environmental Conservation, 37(1), 23-34.

Janssen, M., Anderies, J., & Joshi, S. (2011). Coordination and cooperation in asymmetric commons dilemmas. Experimental Economics : A Journal of the Economic Science Association, 14(4), 547-566.

Kleisner, K., Mansour, H., Pauly, D. (2015). The MTI and RMTI as tools for unmasking the fishing down phenomenon. Sea Around Us. www.seaaroundus.org.

Kushardanto, H., Jakub, R., Suherfian, W., Subarno, T., Ansyori, A., Sara, L., . . . Campbell, S. (2022). Household finances and trust are key determinants of benefits from small-scale fisheries co-management. Marine Policy, 145, 105284.

Mbatha, P. (2022). Unravelling the perpetuated marginalization of customary livelihoods on the coast by plural and multi-level conservation governance systems. Marine Policy, 143, 105143.

McMann et al. (2016), V-Dem Working Paper Series 2016:23

Mehmetoglu, Mehmet & Tor Georg Jakobsen (2022). Applied Statistics Using Stata. A Guide for the Social Sciences. London: Sage Publications Ltd

Milinski, M., Semmann, D., & Krambeck, H. (2002). Reputation helps solve the 'tragedy of the commons'. Nature (London), 415(6870), 424-426.

Ocean Health Index. 2022. ohi-global v2022.1: Ocean Health Index 2022 global assessment. National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara.

Olson, M. (1965). The logic of collective action : Public goods and the theory of groups (Harvard economic studies, 124).

Ostrom, E., & Gardner, R. (1993). Coping with Asymmetries in the Commons: Self-Governing Irrigation Systems Can Work. The Journal of Economic Perspectives, 7(4), 93-112.

Ostrom, E. (1999). Coping with tragedies of the commons. Annual Review of Political Science, 2(1), 493-535.

Ouréns, R., Melnychuk, M., Crowder, L., Gutierrez, N., Hilborn, R., Pita, C., & Defeo, O. (2022). Linking small-scale fisheries performance to governance attributes: A quantitative assessment from stakeholders' perceptions in the Americas and Europe. Marine Policy, 136, 104876.

Pauly D, Zeller D, and Palomares M.L.D. (Editors) (2020) Sea Around Us Concepts, Design and Data ().

Pickering, J., Bäckstrand, K., & Schlosberg, D. (2020). Between environmental and ecological democracy: Theory and practice at the democracy-environment nexus. Journal of Environmental Policy & Planning, 22(1), 1-15.

Povitkina, M. (2018). Necessary but Not Sustainable? The Limits of Democracy in Achieving Environmental Sustainability.

Povitkina, M., & Jagers, S. (2022). Environmental commitments in different types of democracies: The role of liberal, social-liberal, and deliberative politics. Global Environmental Change, 74, 102523.

Povitkina, M., Jagers, S., Sjöstedt, M., & Sundström, A. (2015). Democracy, development and the marine environment - A global time-series investigation. Ocean & Coastal Management, 2015, Vol. 105, Pp. 25-.34, 105, 25-34.

Sea Around Us. (2011). Sea Around Us Project. Fisheries, Ecosystems & Biodiversity. Available at: http://www.seaaroundus.org

Sjöstedt, M. (2010). Enforcement and Compliance in African Fisheries, QoG Conference, Marstrand, 2010.

Sjöstedt, M. (2013). Horizontal and vertical resource dilemmas in natural resource management: The case of African fisheries. Fish And Fisheries, 2013, Vol. 14, Iss. 4, 14(4), Fish And Fisheries, 2013, Vol. 14, Iss. 4.

Sjöstedt, M., & Jagers, S. (2014). Democracy and the environment revisited: The case of African fisheries. Marine Policy, 43, 143-148.

Temple, A., Skerritt, D., Howarth, P., Pearce, J., & Mangi, S. (2022). Illegal, unregulated and unreported fishing impacts: A systematic review of evidence and proposed future agenda. Marine Policy, 139, 105033

United Nations Development Program. (2022). Human development report 2021/2022. https://hdr.undp.org/content/human-development-report-2021-22

Wendling, Z.A. et al. (2020). "2020 Environmental Performance Index". New Haven, CT: Yale Center for Environmental Law and Policy. url: https://epi.envirocenter.yale.edu/

World Bank. (2022). World development indicators. https://databank.worldbank.org/source/world-development-indicators

Appendix

Appendix 1. Correlation matrix

Pairwise correlations

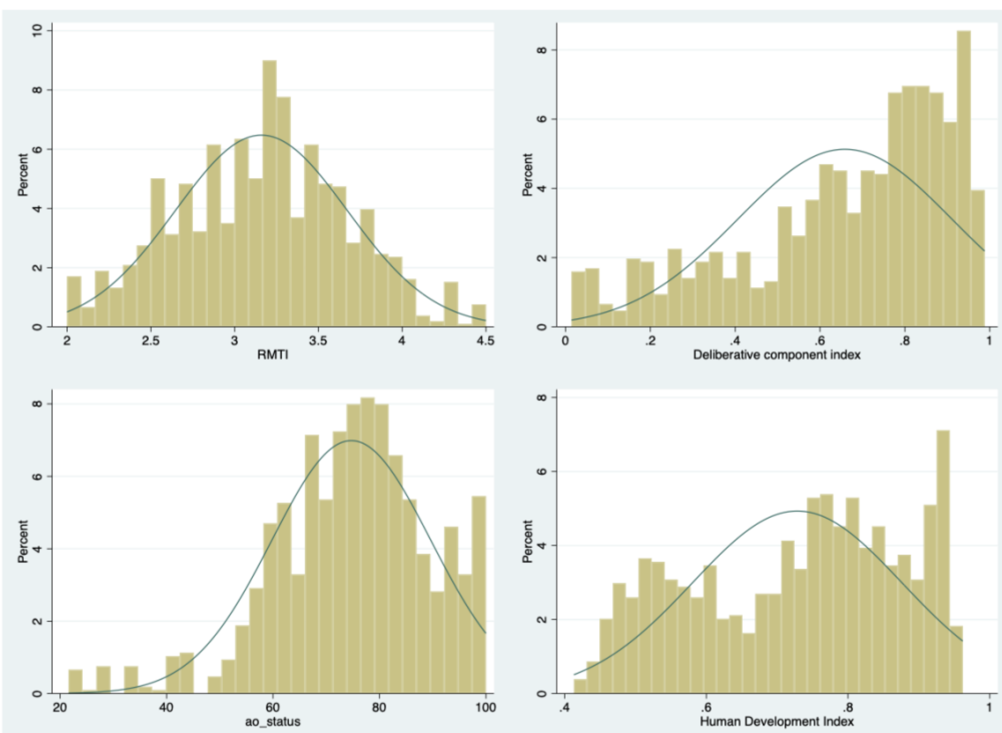
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) RMTI	1.000							
(2) Democracy	0.210	1.000						
(3) Artisanal opportunities	-0.059	-0.058	1.000					
(4) Corruption	-0.354	-0.638	-0.037	1.000				
(5) Trade	0.162	0.053	0.117	-0.248	1.000			
(6) HDI	0.415	0.419	0.006	-0.709	0.243	1.000		
(7) Population density	0.257	0.019	0.112	-0.118	0.501	0.156	1.000	
(8) Trawling	0.172	-0.077	0.184	0.023	0.319	-0.182	0.462	1.000

Appendix 2. Descriptive statistics

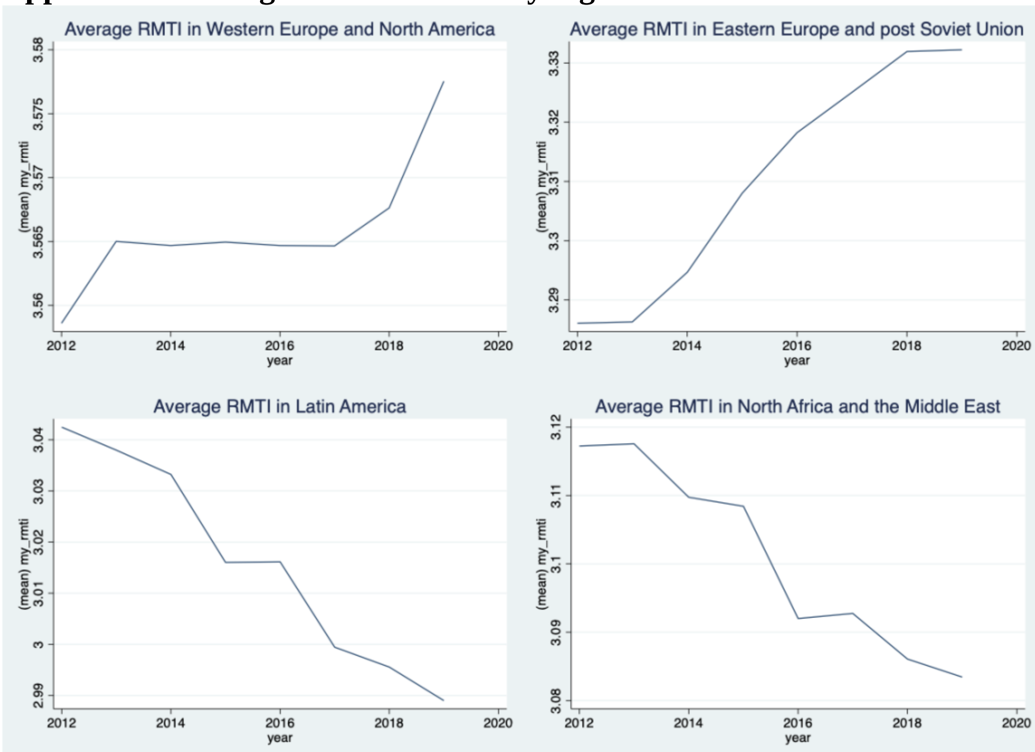
Descriptive Statistics

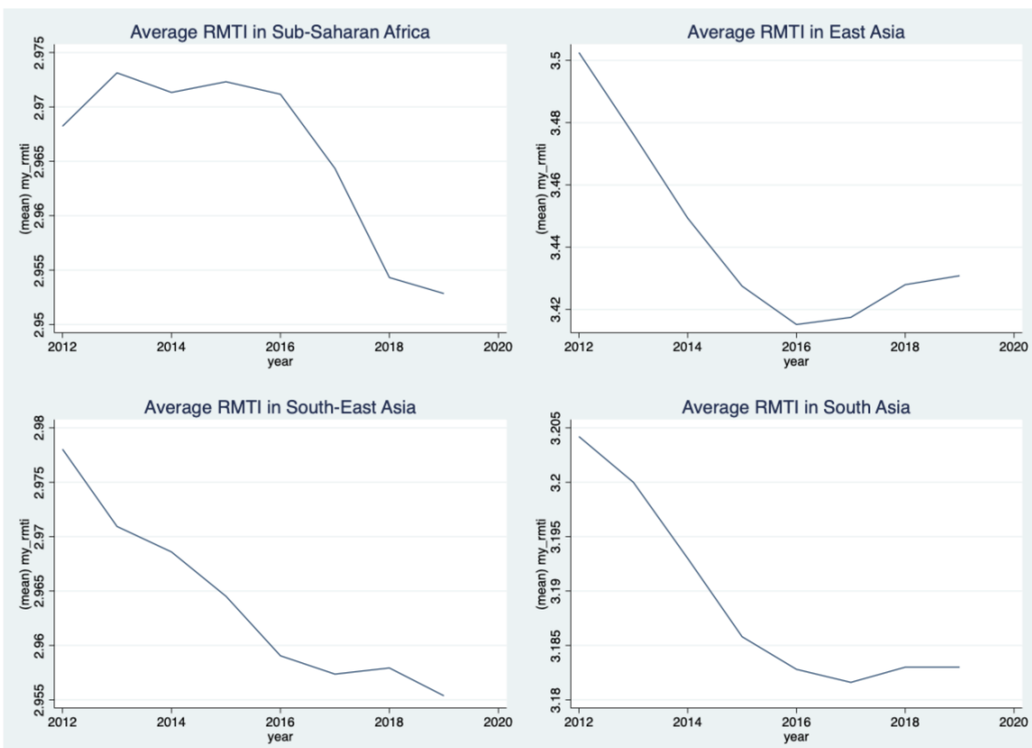
Variable	Obs	Mean	Std. Dev.	Min	Max
RMTI	1056	3.16	.513	2	4.5
Democracy	1064	.659	.252	.014	.988
Artisanal opportunities	1064	74.71	14.923	21.59	100
Corruption	1064	.477	.304	.002	.967
Trade	979	85.707	51.76	1.219	369.213
HDI	1040	.728	.148	.413	.962
Population density	1056	222.772	714.797	2.633	7965.878
Trawling	584	14.505	24.025	0	100

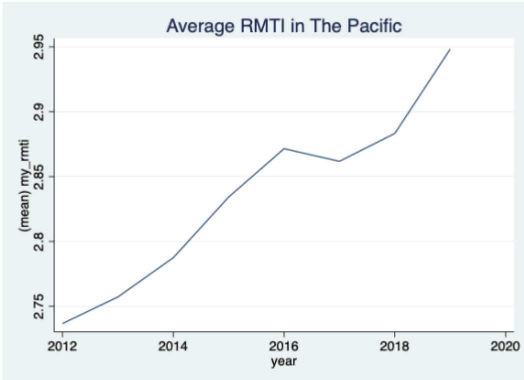
Appendix 3. Distribution of main variables

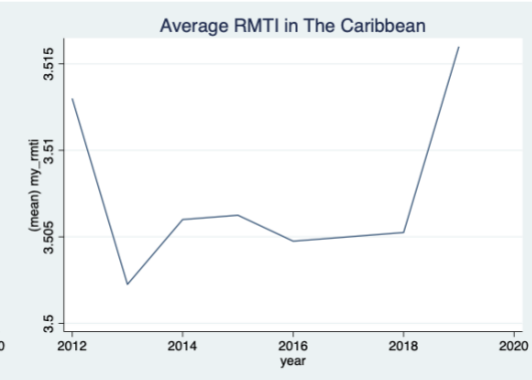


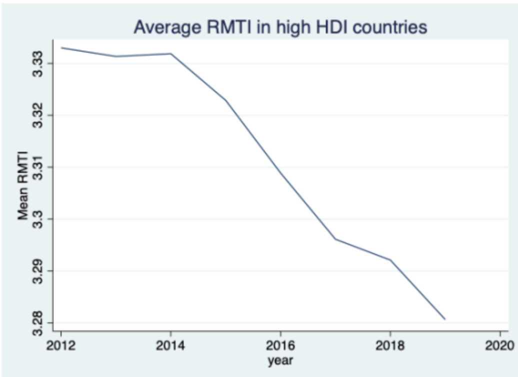
Appendix 4. Average levels of RMTI by region

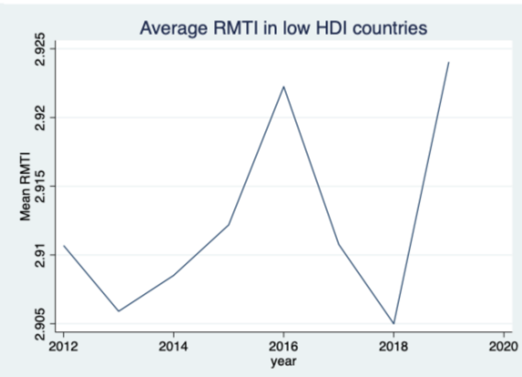




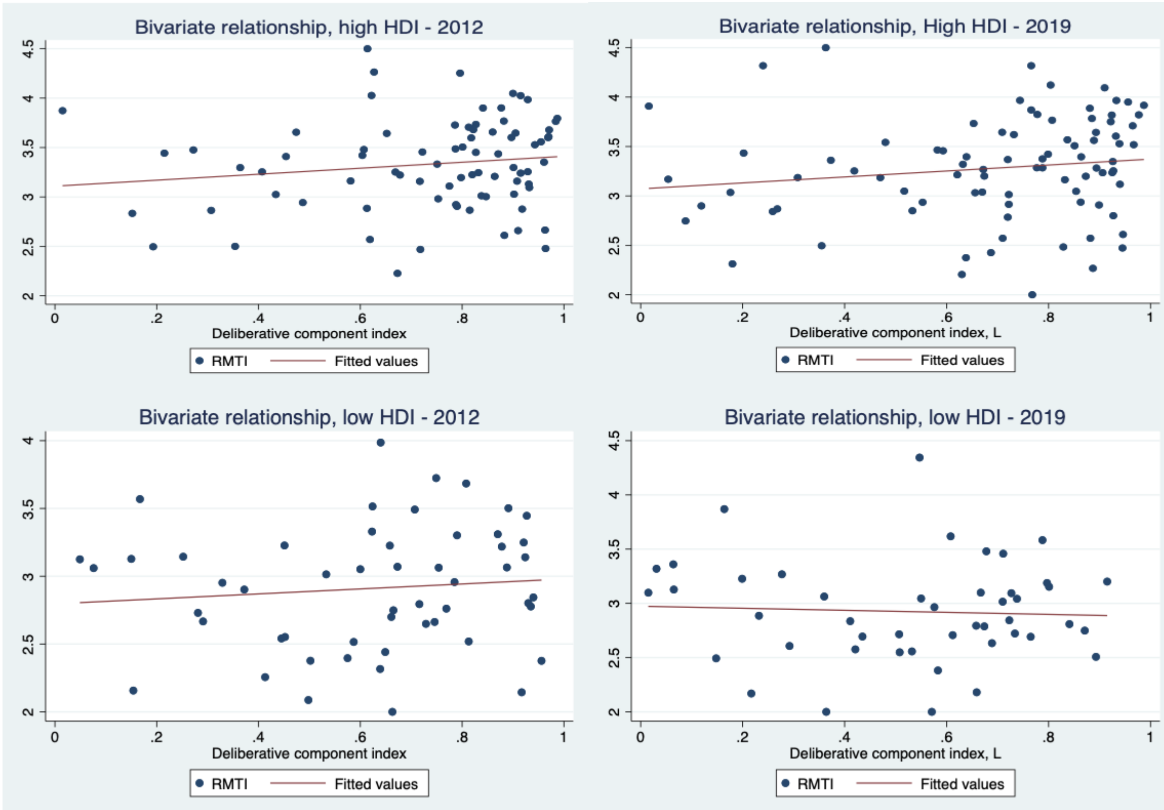








Appendix 5. Scatterplots



Appendix 6. Test for Random Effects

Breusch and Pagan Lagrange multiplier test for random effects

Estimated results	Var	Sd = sqrt (Var)
RMTI	.3056335	.5528413
e	.0012682	.0356119
u	.2106094	.458922

Test: Var(u) = 0
chibar2(01) = 1353.01
Prob > chibar2 = 0.0000

Appendix 7. Random effects regression with clustered standard errors

Random Effects regression on RMTI using clustered Standard Errors, global sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	0.0353	0.0352	0.0415	0.0494	0.0428	0.0442	-0.00743
	(0.0388)	(0.0389)	(0.0400)	(0.0393)	(0.0416)	(0.0428)	(0.0386)
Artisanal opportunities		0.0000405	0.00000626	0.000286	0.000287	0.0000325	-0.000720
		(0.00137)	(0.00135)	(0.00135)	(0.00151)	(0.00151)	(0.00162)
Corruption			0.0321	0.0379	-0.00201	-0.00355	-0.0576
			(0.0722)	(0.0782)	(0.0843)	(0.0841)	(0.0862)
HDI				0.183	0.0398	-0.0607	-0.134
				(0.279)	(0.288)	(0.282)	(0.322)
Trade					-0.0000883	-0.0000436	-0.000360
					(0.000405)	(0.000403)	(0.000339)
Pop. density						0.000181^{***}	0.000145^{***}
						(0.0000458)	(0.0000275)
FCT							-0.00217^{*}
							(0.00102)
Constant	3.136^{***}	3.133^{***}	3.116^{***}	2.954^{***}	3.083^{***}	3.130^{***}	3.424^{***}
	(0.0499)	(0.116)	(0.126)	(0.248)	(0.257)	(0.250)	(0.324)
R2	0.0428	0.0411	0.0215	0.1406	0.0870	0.0641	0.0347
Observations	924	924	924	903	844	844	467
Countries	132	132	132	129	122	122	68

Standard errors in parentheses
$^{\dagger} p < 0.1$, $^{*} p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

Random Effects regression on RMTI using clustered Standard Errors, high HDI countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	-0.000363	-0.00235	-0.00340	0.0129	-0.0103	-0.0107	-0.00539
	(0.0441)	(0.0446)	(0.0415)	(0.0486)	(0.0439)	(0.0447)	(0.0411)
Artisanal opportunities		0.000936	0.000932	0.00137	0.00140	0.00104	-0.00109
		(0.00175)	(0.00176)	(0.00168)	(0.00193)	(0.00193)	(0.00188)
Corruption			-0.00715	-0.0155	-0.109	-0.108	-0.0849
			(0.150)	(0.145)	(0.158)	(0.157)	(0.149)
HDI				0.345	0.128	-0.0140	0.162
				(0.475)	(0.542)	(0.541)	(0.499)
Trade					-0.000469	-0.000400	$-0.000852^{\dagger}$
					(0.000760)	(0.000755)	(0.000470)
Pop. density						0.000155^{***}	0.000102^{***}
						(0.0000415)	(0.0000247)
Trawling							0.00135
							(0.00181)
Constant	3.283^{***}	3.215^{***}	3.219^{***}	2.898^{***}	3.160^{***}	3.254^{***}	3.342^{***}
	(0.0597)	(0.145)	(0.169)	(0.394)	(0.468)	(0.462)	(0.498)
R2	0.0254	0.0010	0.0001	0.0343	0.0045	0.0918	0.1520
Observations	575	575	575	554	529	529	341
Countries	86	86	86	83	80	80	52

Standard errors in parentheses
$^{\dagger} p < 0.1$, $^{*} p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

Random Effects regression on RMTI using clustered Standard Errors, low HDI countries

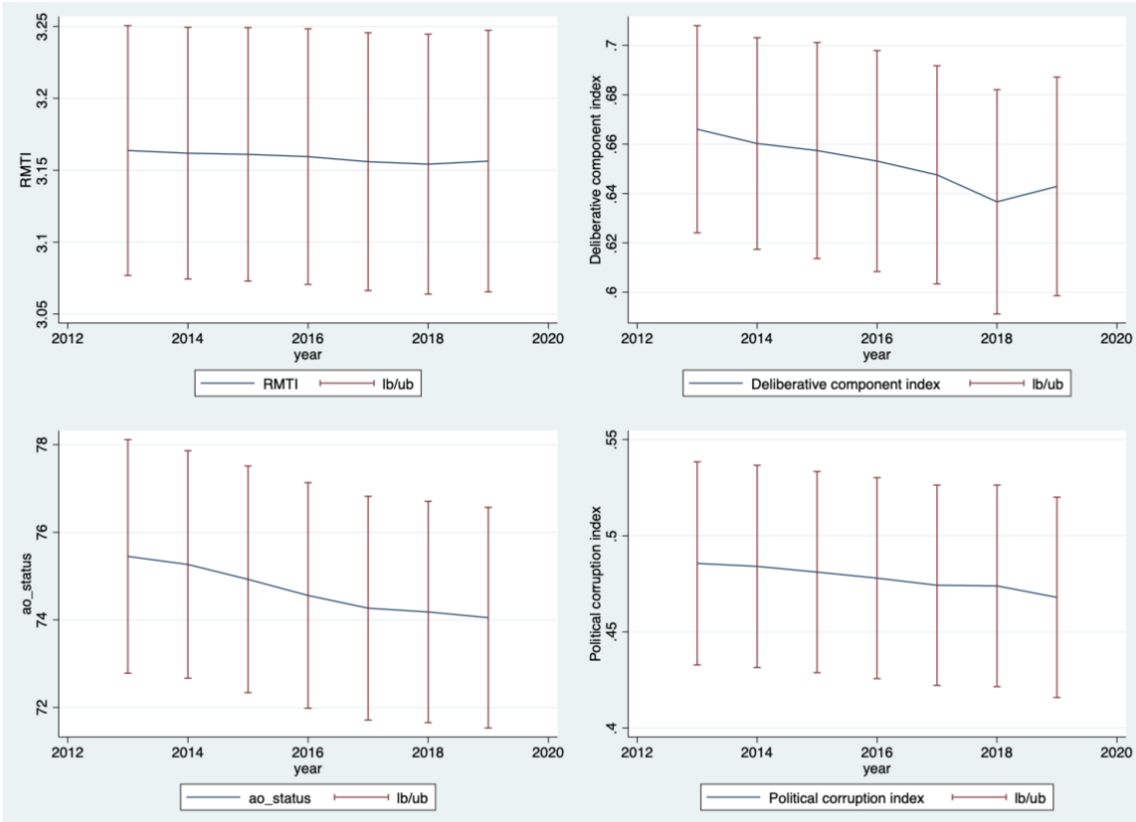
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	0.0893†	0.0898†	0.118**	0.108*	0.116*	0.122*	-0.0253
	(0.0484)	(0.0487)	(0.0441)	(0.0490)	(0.0506)	(0.0541)	(0.0355)
Artisanal opportunities		-0.00144	-0.00164	-0.00216	-0.00250	-0.00257	-0.00413
		(0.00211)	(0.00202)	(0.00198)	(0.00231)	(0.00225)	(0.00330)
Corruption			0.150*	0.0884	0.0808	0.0823	-0.0425
			(0.0625)	(0.0881)	(0.0881)	(0.0906)	(0.0758)
HDI				-0.621	-0.776*	-0.985***	-0.925**
				(0.408)	(0.357)	(0.297)	(0.317)
Trade					0.000124	0.000161	0.000190
					(0.000311)	(0.000329)	(0.000405)
Pop. density						0.000635	0.000195
						(0.000742)	(0.000279)
Trawling							-0.00391***
							(0.000372)
Constant	2.855***	2.963***	2.859***	3.301***	3.394***	3.425***	3.718***
	(0.0667)	(0.181)	(0.182)	(0.351)	(0.343)	(0.321)	(0.355)
R2	0.0008	0.0064	0.0105	0.0047	0.0026	0.0053	0.0170
Observations	349	349	349	349	315	315	126
Countries	53	53	53	53	48	48	19

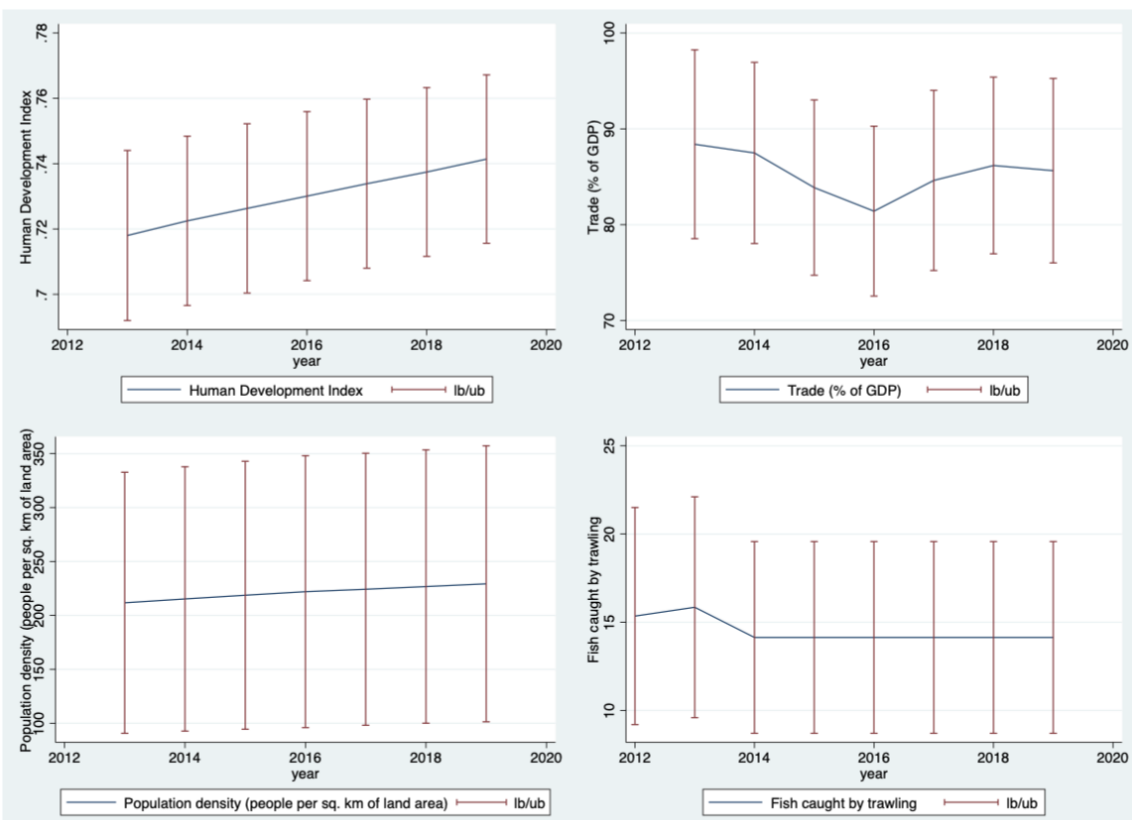
Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The positive effect of deliberative democracy on region-based marine trophic index lost some statistical significance in models 1 to 6, however it keeps its statistical significance with a p-value smaller than 0.05 in models 3 to 6.

Appendix 8. Trend checks

The following graphs show averages of a single outcome measured at several points over time, to check for stationarity. The panel is very short, so even though some problems could be detected, if mean and variance are not constant, it is not possible to state this as a problem with the estimation of the model.


RMTI
year
RMTI
lb/ub
Deliberative component index
year
Deliberative component index
lb/ub
ao_status
year
ao_status
lb/ub
Political corruption index
year
Political corruption index
lb/ub


Human Development Index
year
Human Development Index
lb/ub
Trade (% of GDP)
year
Trade (% of GDP)
lb/ub
Population density (people per sq. km of land area)
year
Population density (people per sq. km of land area)
lb/ub
Fish caught by trawling
year
Fish caught by trawling
lb/ub

Appendix 9. Checks for extreme observations and regression results without outliers

By using the Grubbs test, or extreme studentized deviate test to detect outliers with a 95 percent confidence, I detected problems with observations in the variables trade and population density.

Outliers in variable Trade

Country name	Freq
Djibouti	6
Ireland	1
Malta	8
Singapore	8
Total	23

Outliers in variable Population density

Country name	Freq
Bahrain	8
Bangladesh	8
Maldives	8
Malta	8
Singapore	8
Total	40

I proceeded to run the full model excluding these observations to see if the results were changed regarding those variables. By excluding the countries affecting the effect of population density on region-based marine trophic index, the variable lost its positive sign and statistical significance, a result more in line with the expected relationship between both variables.

Regression on RMTI with and without outliers

	Excluding outliers	Full sample
Democracy	-0.00250	-0.00743
	(0.0301)	(0.0292)
Artisanal opportunities	-0.000542	-0.000720
	(0.000956)	(0.000939)
Corruption	-0.0583	-0.0576
	(0.0577)	(0.0565)
HDI	-0.0151	-0.134
	(0.199)	(0.183)
Trade	-0.000591^{*}	-0.000360
	(0.000258)	(0.000232)
Pop. density	-0.00000663	0.000145^{**}
	(0.000382)	(0.0000514)
Trawling	-0.00233^{**}	-0.00217^{**}
	(0.000741)	(0.000730)
Constant	3.338^{***}	3.424^{***}
	(0.205)	(0.196)
R2	0.0139	0.0347
Observations	448	467
Countries	65	68

Standard errors in parentheses
† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 10. Multicollinearity test

The independent variables in the model should not be perfectly correlated among them, as they might steal explanatory power from each other.

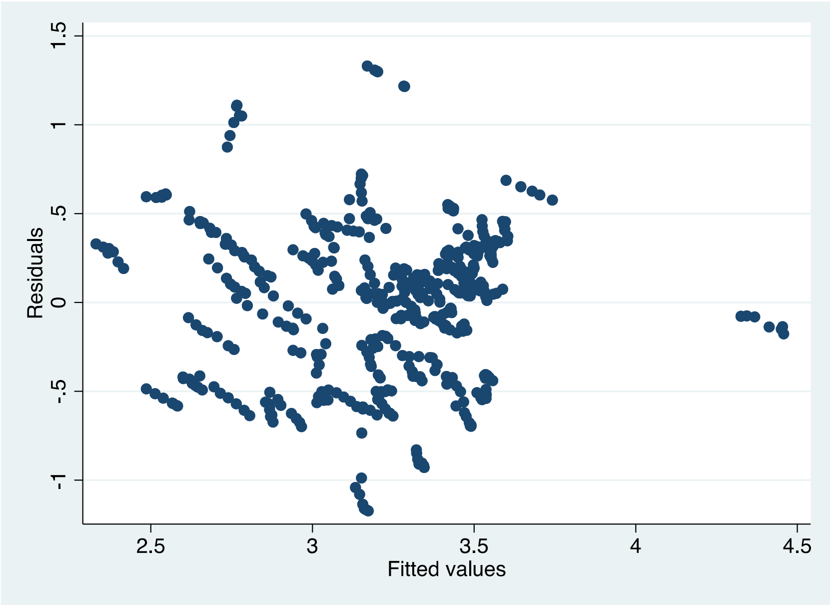
All the VIF values are below the limit of 5, therefore the variables present no problem with multicollinearity.

Multicollinearity test

Variable	VIF	1/VIF
Corruption	3.75	0.267
Democracy	2.69	0.372
HDI	2.38	9.419
Pop. Density	1.98	0.505
Trade	1.75	0.570
Trawling	1.46	0.684
Artisanal opportunities	1.05	0.953
Mean VIF	2.15	

Appendix 11. Heteroscedasticity test

The assumption is that errors are normally distributed throughout all levels of the dependent variable to guarantee homoscedasticity. Therefore, there should be no pattern in the distribution of residual terms of the regression.



Breusch-Pagan/Cook-Weisberg test for heteroskedasticity after running the Pooled OLS estimator.
H0: Constant variance
Chi2(1) = 12.22
Prob > chi2 = 0.0005

This indicates a sign for some degree of heteroscedasticity, which I correct by running the regression models with robust standard errors.

Random Effects regression on RMTI using robust standard errors, global sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	0.0353	0.0352	0.0415	0.0494	0.0428	0.0442	-0.00743
	(0.0388)	(0.0389)	(0.0400)	(0.0393)	(0.0416)	(0.0428)	(0.0386)
Artisanal opportunities		0.0000405	0.00000626	0.000286	0.000287	0.0000325	-0.000720
		(0.00137)	(0.00135)	(0.00135)	(0.00151)	(0.00151)	(0.00162)
Corruption			0.0321	0.0379	-0.00201	-0.00355	-0.0576
			(0.0722)	(0.0782)	(0.0843)	(0.0841)	(0.0862)
HDI				0.183	0.0398	-0.0607	-0.134
				(0.279)	(0.288)	(0.282)	(0.322)
Trade					-0.0000883	-0.0000436	-0.000360
					(0.000405)	(0.000403)	(0.000339)
Pop. density						0.000181^{***}	0.000145^{***}
						(0.0000458)	(0.0000275)
Trawling							-0.00217^{*}
							(0.00102)
Constant	3.136^{***}	3.133^{***}	3.116^{***}	2.954^{***}	3.083^{***}	3.130^{***}	3.424^{***}
	(0.0499)	(0.116)	(0.126)	(0.248)	(0.257)	(0.250)	(0.324)
R2	0.0428	0.0411	0.0215	0.1406	0.0870	0.0641	0.0347
Observations	924	924	924	903	844	844	467
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Random Effects regression on RMTI using robust standard errors, high HDI countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Democracy	-0.000363	-0.00235	-0.00340	0.0129	-0.0103	-0.0107	-0.00539
	(0.0441)	(0.0446)	(0.0415)	(0.0486)	(0.0439)	(0.0447)	(0.0411)
Artisanal opportunities		0.000936	0.000932	0.00137	0.00140	0.00104	-0.00109
		(0.00175)	(0.00176)	(0.00168)	(0.00193)	(0.00193)	(0.00188)
Corruption			-0.00715	-0.0155	-0.109	-0.108	-0.0849
			(0.150)	(0.145)	(0.158)	(0.157)	(0.149)
HDI				0.345	0.128	-0.0140	0.162
				(0.475)	(0.542)	(0.541)	(0.499)
Trade					-0.000469	-0.000400	-0.000852†
					(0.000760)	(0.000755)	(0.000470)
Pop. density						0.000155***	0.000102***
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							(0.00181)
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Artisanal opportunities		-0.00144	-0.00164	-0.00216	-0.00250	-0.00257	-0.00413
		(0.00211)	(0.00202)	(0.00198)	(0.00231)	(0.00225)	(0.00330)
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Pop. density						0.000635	0.000195
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