COMPARISON OF TERRITORIAL USE RIGHT FISHERIES WITH OTHER CONVENTIONAL RIGHT-BASED FISHERIES MANAGEMENT

by © Ezgi Cakmak A (Major Project) submitted

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ABSTRACT

This major project comprehensively examines Territorial Use Rights for Fisheries (TURFs) and their implications within right-based fisheries management. The study encompasses an in-depth analysis of TURFs from an institutional perspective, discussing the categories of access rights and withdrawal/harvest rights associated with these management systems. The definition, structure, and various types of TURFs are explored, along with their historical development and evaluation.

Additionally, the policy implications of TURFs are examined, considering their relationship with other conventional rights-based management systems. This includes an exploration of Individual Transferable Quotas (ITQs) and Co-Management, Harvester Cooperatives (CO-OPS) as alternative approaches. The synergies between TURFs and other systems, such as TURFs combined with ITQs or integrated with Marine Reserves (No Take Zones), are also investigated. The paper presents case examples of TURFs implemented in different countries, explicitly highlighting examples from Japan, Chile, and Mexico. The analysis delves into these TURF systems' specific characteristics and outcomes, providing valuable insights into their practical application and effectiveness.

In conclusion, this research underscores the significance of TURFs as a management tool within the broader framework of right-based fisheries management. It highlights the potential policy implications of TURFs and their interactions with other systems, shedding light on their role in promoting sustainable fisheries and effective resource governance. This comprehensive examination of TURFs contributes to the existing knowledge base and provides valuable insights for policymakers, practitioners, and researchers in fisheries management.

Contents

1. INTRODUCTION

Fisheries have great importance in providing livelihoods, income, and food all over the world. In 2016 the total fish production reached 171 million tonnes, of which humans consumed approximately 151 million tons (88%) (FAO, 2018). Also, diverse economic activities from the fisheries and aquaculture sector support the livelihoods of over 200 million people. The primary sector engaged 59.6 million people in 2016 alone (FAO, 2018).

Historically, the first exploitation of fish occurred under purely open-access conditions, which led to biological overexploitation, as stated in "Tragedy of the Commons" by Garett Hardin (Hardin, 1968). However, before that, Gordon (1954), in his article, discussed that under open access conditions, overexploitation of resources continues until economic rents vanish. According to Gordon (1954), it was more a problem of the lack of property rights than a tragedy. Rights-Based Fisheries Management (RBFM) was a management system to solve the race-to-fish, intended to give the impetus to fish sustainably (Cancino, Jose p., et al., 2007). Individual Transferrable Quotas (ITQs), Territorial Use Rights Fisheries (TURFs), and fishing cooperatives are three well-known forms of RBFM.

This major project's primary focus is the TURFs which allow access to the resource within a specific geographical area as an alternative to other RBFM regimes. This paper delves into the historical origins, institutional frameworks, and legal structures of TURFs. It further examines successful fisheries in Japan, Chile, and Mexico managed through TURFs, showcasing the accomplishments that can be attained through this approach. By taking a comparative approach, the project aims to shed light on the distinctive features of TURFs in relation to other property rights regimes, providing a comprehensive understanding of their effectiveness.

2. INSTITUTIONAL PERSPECTIVE

Over the years, there have been different fishery management regimes. With open access regimes, fishing operations have no regulations or barriers. Open access regimes lead to the depletion of fish stocks and economic inefficiency, such as rent dissipation due to too many harvesting inputs. The traditional management approach to fix the problem is the “command and control" system, in which the government designs and enforces regulations for the whole fishery, from gear restrictions to seasonal closures. In this system, if the entry and exit are free, it is called "regulated open access," and it is called "limited entry" when the entry is restricted by license. There is a common perception in the scientific world that these traditional management schemes are limited and have failed in many instances (Uchida, 2003).

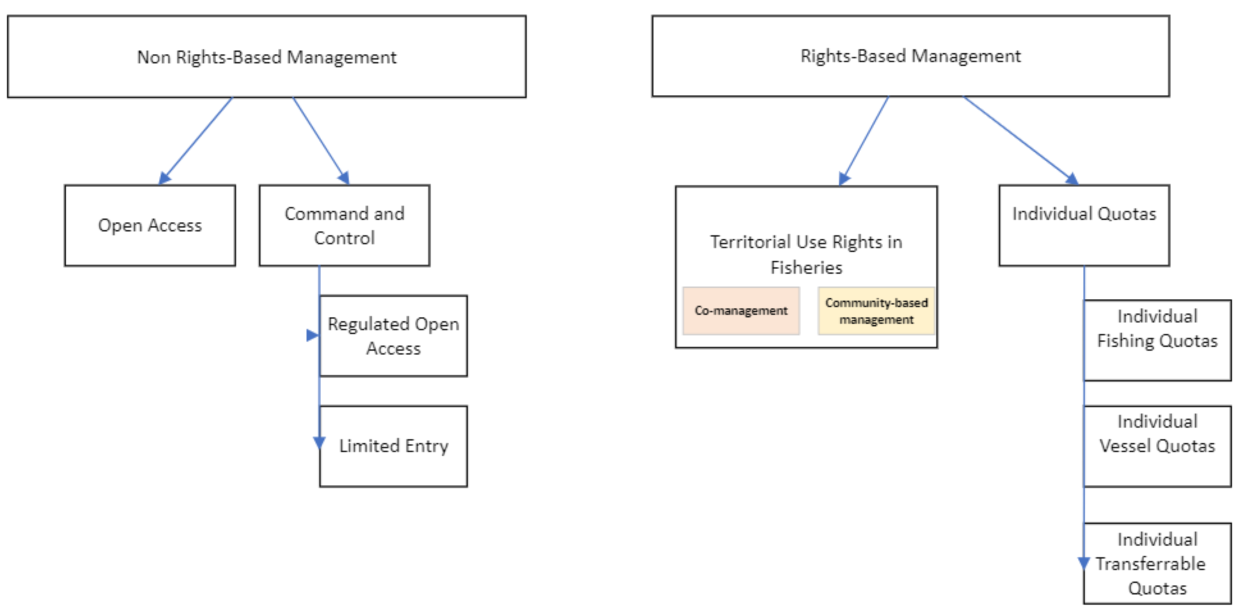

Figure 1 Rights-based vs non-rights-based management systems. Adapted from (Uchida,2003)

2.1. Right-based fisheries management

RBFM, also known as catch shares, appoints tenure rights to individuals, companies, governments, and communities. When there is a restriction in the fishery, such as how much fishing effort the fishers are allowed to use, how much catch they can take from water, who can participate in fishing, or where fishing is allowed, we can say there are user rights (the rights to use) applied (Charles, 2001).

When carefully designed and effectively used, RBFM can be considered an answer to the open-access problem and define who is affected by the management. Two main design elements of RBFM are the allocation of spatial rights to harvest resources, like in TURFs, or the allocation of a portion of total allowable catch as it is in ITQs. Both elements can work with individuals, groups, cooperatives, or communities (Bromley, 2016).

There is an array of use rights in fisheries management, and it is crucial to specify that use rights refer to the right to "use" the fishery and should not be confused with property rights of the resource itself. Property rights are various forms of ownership of an individual or a group, such as a fishing boat or a license to fish. Four types of property ownership can be applied in fisheries:

1-Non-Property: Lack of property rights is called non-property if no one can be identified as the owner of the fish stock. In this situation, no one can allege ownership or prohibit others from fishing.

2-Private Property: If a water resource is on private land, that water body with its fish belongs to the property owner. Similarly, whenever a fish is caught by a fisher and brought to the deck, the fish becomes the fishermen's property.

3-State Property: All the fish in the oceans within a state's EEZ belong to that state's citizens. They are managed by the government on their citizens' behalf and are called "state property." Furthermore, all fish stocks in inland waters in state lands are also state property.

4-Common Property: When a group of people, such as a coastal community or an indigenous tribe, owns in common the fish in the sea, the fish is called "common property." The term "common property" is often used as belonging to the whole nation instead of state property.

In most cases, the fish becomes property only after it is caught. It is the case with many other natural resources sectors, such as oil and gas, forestry, and mining, where governments loan/ lease the area to the companies to extract/harvest the resources for a certain period of time (Cochrane & Garcia, n.d.).

There are several potential benefits of use rights:

- Help management to identify the stakeholders correctly, especially in complex and uncertain management systems.
- Provides the participants with some overfishing security inputs, harvesting a certain quantity of fish, or access to fishing areas. Fishers and communities can manage their fishing activities more efficiently for conservation and fishing output when use rights are well established.
- When the rights are secure and long-term, fishers may be more willing to adopt conservation measures and responsible fishing practices.
- Right-based fisheries have two main categories; *access rights* attribute to entry into the fishery or specific fishing grounds, whereas *withdrawal* rights grant rights to a specific fishing effort or specific catch.

2.1.1.Categories of Access Rights:

Regulating the entry (access) to a fishery or into a specific fishing ground is the main principle of access rights and is one of the critical fisheries management elements to deal with open access problems.

Territorial User Rights Fisheries (TURFs) and Customary Marine Tenure: Rights to a fishers' group or community within a specific spatial area. The nature of the rights changes from case to case. The most common types are the right to have access to fishing and the right to exclude others. Christy (1982) stated that "as more and more study is given to the culture and organization of fishing communities, there are indications that some forms of TURFs are more pervasive than previously thought to be the case, in both modern and traditional marine fisheries."

Limited entry licenses: To limit participation in fisheries, the right to fish is assigned through licensing. Some fisheries allow license holders to generate significant profits, but more is needed to solve the race to fish (to get the fish first) or capital stuffing (increasing vessel capacity to the point that it is not efficient for the whole fishery) problems. Nevertheless, limited entry licenses combined with other mechanisms, such as allowable catches, can be very effective (Charles, 2001).

2.1.2. Categories Withdrawal/Harvest Rights:

Withdrawal/harvest rights is permission to extract a certain amount of output from the fishery or administer a certain fishing effort level.

Input/Effort Rights: Allocating a certain amount of input criteria to fishing groups, communities, or an individual fisher, such as the amount of gear, fishing time, or vessel size. Input/Effort

Rights are not adequate alone because they are often subject to "technology creep," whereby the effectiveness of inputs will increase over time.

Output/Catch rights: Output rights designed to take a certain amount of resources include catch shares, which are the proportion of total allowable catches given to groups or individuals. Individual quotas (IQs) and ITQs are output controls, as well. Output rights suffer from technology creep, but they are prone to other conservation problems and social concerns, such as discarding low-value sizes to get more "high-grade" catches or not reporting the catches adequately (under-reporting).

Harvest/Withdrawal rights require stock assessments to predict the appropriate level of catch or effort per year, whereas access rights may only need to address who has permission to fish in a dedicated area. In community-based management systems, traditional rules often reveal fisher behaviors and technical details more than effort controls and quantitative quotas, despite the governments' limits, targets, and quotas due to the difficulty of law enforcement in monitoring fishing activities.

In Environmental Defense Fund's (EDF) Catch share design manual (Bonzon et al., 2012) describes six basic types of catch shares (Table 1):

Table 1 Catch share types (Bonzon et al., 2010, p.12)

	ALLOCATED TO	***QUOTA OR AREA-BASED***
Individual Quota	Individual	Quota-based
Individual Transferable quota	Individual	Quota-based
Individual Vessel Quota	Vessel	Quota-based
Cooperative	Group	Quota-based or area-based
Community Fishing Quota	Community	Quota-based

Territorial Use Rights for Fishing	Individual, group, or community	Area-based and, in some cases, area-based and quota-based

Retrievedfrom:http://fisherysolutionscenter.edf.org/sites/catchshares.edf.org/files/CSDM_Vol1_A_Guide_for_Managers_and_Fishermen.pdf

User rights are great tools for aligning conservation measures with fishers' long-term interests. Their rights are more compatible with regulations and can support responsible fishing if carefully designed. Excluding some parties from public resources is a controversial part of user rights. The possibilities in the user rights systems are vast, so it is challenging to find the right combination. For example, the cost of applying ITQs may be prohibitive to start with, but it can be recovered by applying user fees to license holders (Hoggarth et al., 2006).

Choosing the rights systems heavily depends on the fishery itself and the desired outcomes for the fishery in question. It is impossible to have one type of use right that successfully fits every fishery (Hoggarth et al., 2006). For example, allowable catch among nations could be a good solution for migratory fish, whereas a TURF system may be better for a sedentary stock. Harvest rights might be a better solution for fisheries using different gears, while input rights would be better for fisheries with uniform technology (Charles, 2001). (Figure 4)

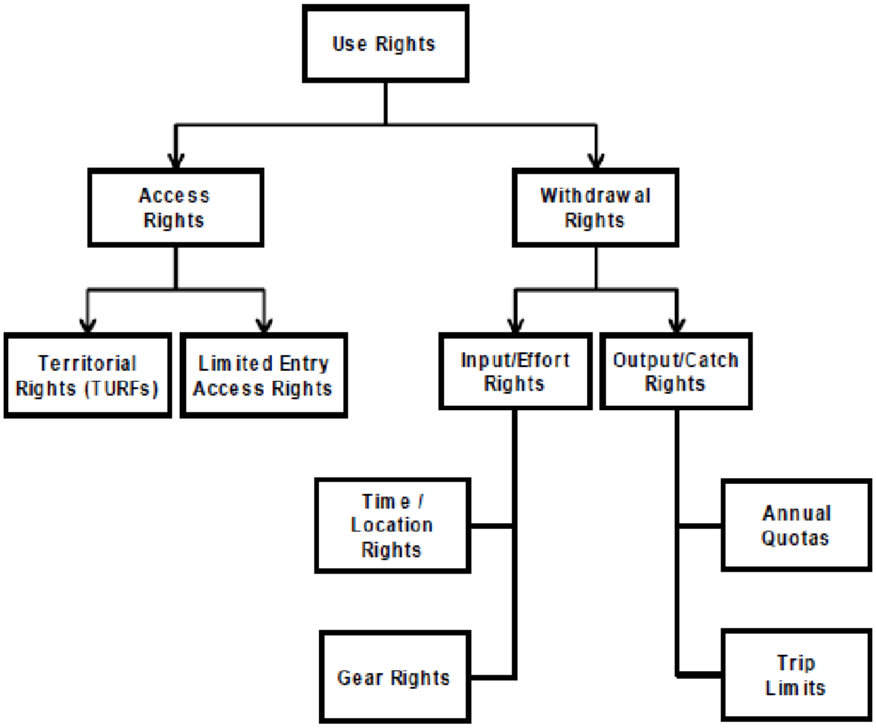

Figure 2Figure 2 A framework of Fishery User Rights, from "Use Rights in Fishery Systems" by A.T. Charles, 2000, IIFET Proceedings, available at: https://ir.library.oregonstate.edu/downloads/6q182k99c

Some people implement use rights in any fishery while others don't, which is a policy-level decision. For example, the government decides the license holders in limited entry licensing, while in an indigenous fishery, the chief may decide who can access the fishery. One essential question is whether to assign user rights to the collective (community or fishers' cooperatives, associations) or individual level. The answer depends on the fishery in question, the objectives of the fishery, and its historical context. The community can have resource stewardship that allows communities to manage the fishery more efficiently and implement local enforcement tools where the community rights already exist, or the conditions to introduce this management type are suitable. As they have more rights in the fishery, they could adapt the measures according to the community's needs, such as allocating rights to crew members and boat or license owners. If there is community cohesion, spatial clarity of the community and management capacity, community use rights fisheries can be successful, but they will not work in every fishery. On the other hand, if the fishery is relatively new and more focused on industry, an individual use rights system might be more suitable (Charles, 2001).

Some other benefits of the use of right systems or catch shares:

- Increase the economic benefits of the fishery (Grafton et al., 2011)
- Assure participants obey catch limits (Branch, 2009) and stabilize landings and catch limits (Essington et al., 2012)
- Prevent and reestablish collapsed fish stocks (Costello et al., 2008)
- Reduce discards and bycatch (Essington et al., 2012; Branch, 2009)

To successfully implement or improve a use rights system, it is crucial to carefully evaluate and adhere to the specific historical and cultural context, financial and human resources available within the fishery, and the prevailing policy objectives. There is no universally applicable solution, and each case requires thorough consideration and alignment with these factors.

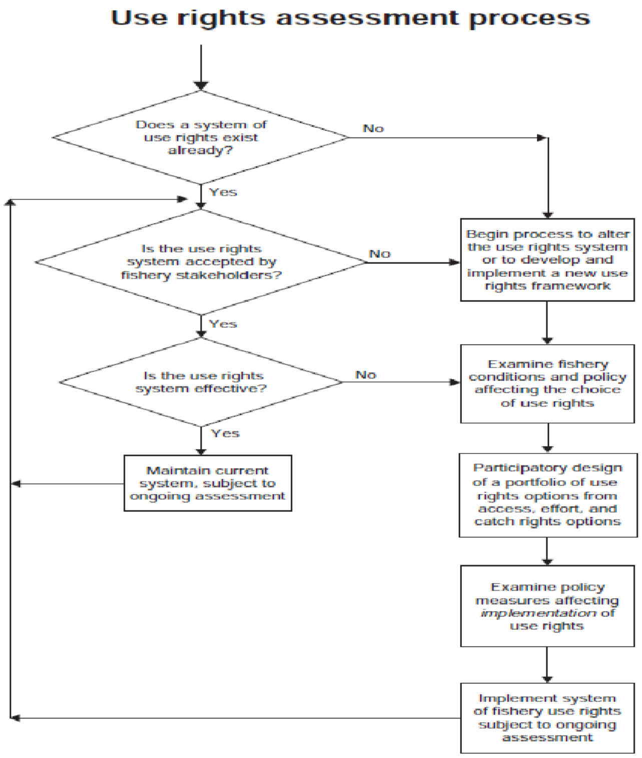

Figure 3 Flowchart for assessing and developing user rights system. Retrieved from "A Fishery Manager's Guidebook" by Cochrane, L.Kevern, Garcia, M.Serge, 2009 page: 279

3. DEFINITION, HISTORICAL DEVELOPMENT, AND EVALUATION OF TURFs

3.1. Definition and structure of TURFs

RBFM is formed by allocating rights on a species-specific basis or to a single population. License holders are granted a share of catch from the total allowable catch (TAC) deployed on biological criteria. This biologically driven approach is known as the legacy of fisheries management systems. After World War II and the single-species population approach, famous fisheries scientists like Schafer, Beaverton, and Holt introduced maximum sustainable yield (MSY), quickly becoming the target of many fisheries managers. Creating and measuring individual population models was quite challenging. The single-species management approach remained dominant in fisheries management institutions despite the well-known fact that individual populations live in prey and predator systems.

Applying regulations over one area for populations confined to a single Exclusive Economic Zone (EEZ) is easier. Still, applying uniform or harmonized regulations and enforcement for the species that can travel between different EEZs is challenging. As a result of this ambiguity, EEZs gradually evolved into rights-based frameworks assuming that sub-populations identified with specific spatial regions can be considered a whole population. The heterogeneity of the population would almost certainly lead to a different right-based management structure based on a more distinct disparity of rights over land (Wilen et al., 2012).

TURFs are property rights in which certain groups or individuals have fishing rights or privileges within a designated spatial area, generally but not necessarily, based on typical usage (long-standing traditions) (Christy, 1982). A spatial privatization system gives various rights to a group of resource users, such as withdrawal, access, exclusion, alienation, and management. TURFs offer a distinct advantage over conventional fisheries management systems by providing fishers with strong incentives to adopt more sustainable resource management practices. TURFs grant fishers increased control over resource access, utilization levels, and the ability to trade access rights. Moreover, TURFs effectively eradicate the concept of the "race to fish," which often leads to overexploitation. This advantage highlights how TURFs empower fishers to proactively approach sustainable resource management, leading to more balanced and responsible practices (Gelcich & Donlan, 2015).

On the other hand, Allison et al. (2012) stated that delegating management responsibilities to communities will not end the "race to fish" problem without adequate financing. It is essential to realize a strong correlation between the benefits to the stakeholders and the sustainability and effectiveness of using resources. The shift to self-management of communities will not eradicate the role of the government. Governments should continue to provide legislation, fisheries policies, and support to facilitate success. Allison et al. continued, "The shifts towards self-management by communities, coupled with economic rationalization and tenure reform, could provide a better framework for fisheries management than the top-down subsidy-driven model it seeks to replace, particularly for small-scale fisheries in the least developed countries where the state has been unable or unwilling to support their interests."

3.2. TURF Types and Design Elements

Auriemma et al.(2014) describe four different TURF regimes. The first is the Classic TURFs consisting of an area with well-defined borders accessed by one user group for one marine resource (Figure 1a). However, in this TURF type, it is possible to have multiple fishing grounds, target multi-species, or have the area accessed by multi-user groups. However, the third volume of the Catch Shares Design Manual of the Environmental Defense Fund (EDF) describes four "TURF types" based on social and biological functional units (Poon & Bonzon, 2013). All four types (see Figure 2) that were described in those documents fall under Regime 1 in "A global assessment of Territorial Use Rights in Fisheries to determine variability in success and design" (Auriemma et al., 2014). Regime 2 is called Divided TURFs, in which the main TURFs area is divided into smaller TURFs, and fishers are not allowed to perform their activities in between TURFs. Regime 3 is called ITQ TURFs; the writer argues that even though ITQs are assigned only to individuals and not to areas, they can still be considered TURFs as some species are limited to a specific area due to their biology; therefore, the fishery exists within well-defined boundaries. Regime 4 is called Taboo TURFs because no fishing activities are allowed in those areas except under extraordinary circumstances; in most cases, the area *around* taboo TURFs is open to fishing (Auriemma et al., 2014).

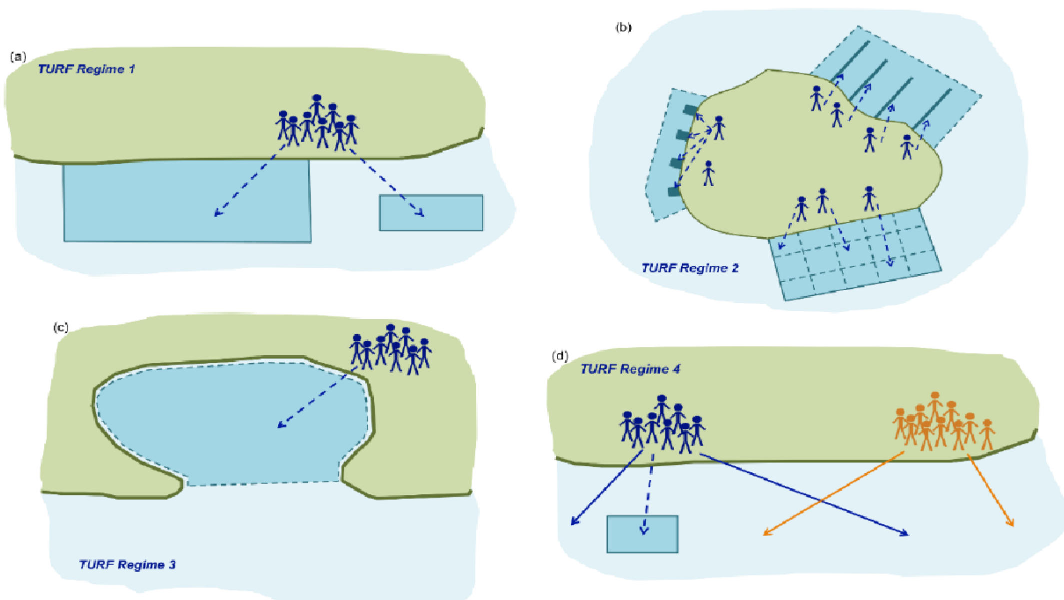

Figure 4 TURF REGIME TYPES (a) TURF Regime 1-Classical TURFs (b) TURF Regime 2-Divided TURFs (c) TURF Regime 3-ITQ TURFs, (d) TURF Regime 4-Taboo TURFs. The dark blue areas represent the TURFs. Solid TURF boundary lines indicate firm, well-established boundaries as dictated during the creation of the TURF; dotted TURF boundary lines indicate soft boundaries that occur by virtue of how the system is operated but are not established as a formal boundary during TURF implementation. Dark blue fishers represent the user group with exclusive access to the TURF. Arrows extending from fishers indicate where the users have access to resources; dotted lines indicate exclusive access, while solid lines indicate unrestricted access. Multiple arrows

from the same user group indicate that the fishers can move freely within the TURF area(s). TURF regime 2 (b) displays the three different ways in which a divided TURF can operate; they are drawn on the same figure for presentation purposes only (Auriemma et al., 2014) Retrieved from: https://bren.ucsb.edu/media/1783

On the other hand, the third volume of the EDF Catch Shares Design Manual (Poon & Bonzon, 2013) describes four "TURF types" based on social and biological functional units, which differ from the definitions above. The biological functional unit refers to the stock or sub-stock of fish in a spatial range that can be managed efficiently. A social functional unit (user group) is defined as a group of people, mostly in cooperative form, who can participate in fishery management.

TURF TYPE 1: This is one of the basic TURFs in which biological functional units and social functional units are aligned (one social unit for one biological unit) and mainly for sedentary species.

TURF TYPE 2: In this type of TURF, one group manages multiple species with an overlapping range. The potential scenario for this type of TURFs is when a single social functional unit fishes in a big and isolated area with species somewhat less mobile/localized; therefore, it is not a common type.

TURF TYPE 3: Multiple communities or groups harvest one biological functional unit in this type. In this type, either the TURF covers all fishing areas and is shared between different communities, or fishing can be divided into three different TURFs, and each community performs in its TURF. Alternatively, the biological unit can be split into different TURFs. Still, a regional governing body oversees the whole stock by assigning individual targets and biological targets. Simultaneously, multiple groups are assigned to their TURF but can move in between, depending on the regional governing body.

TURF TYPE 4: This type technically consists of many species overlapping with different groups or communities. As this type of TURF is very complex, several design possibilities exist.

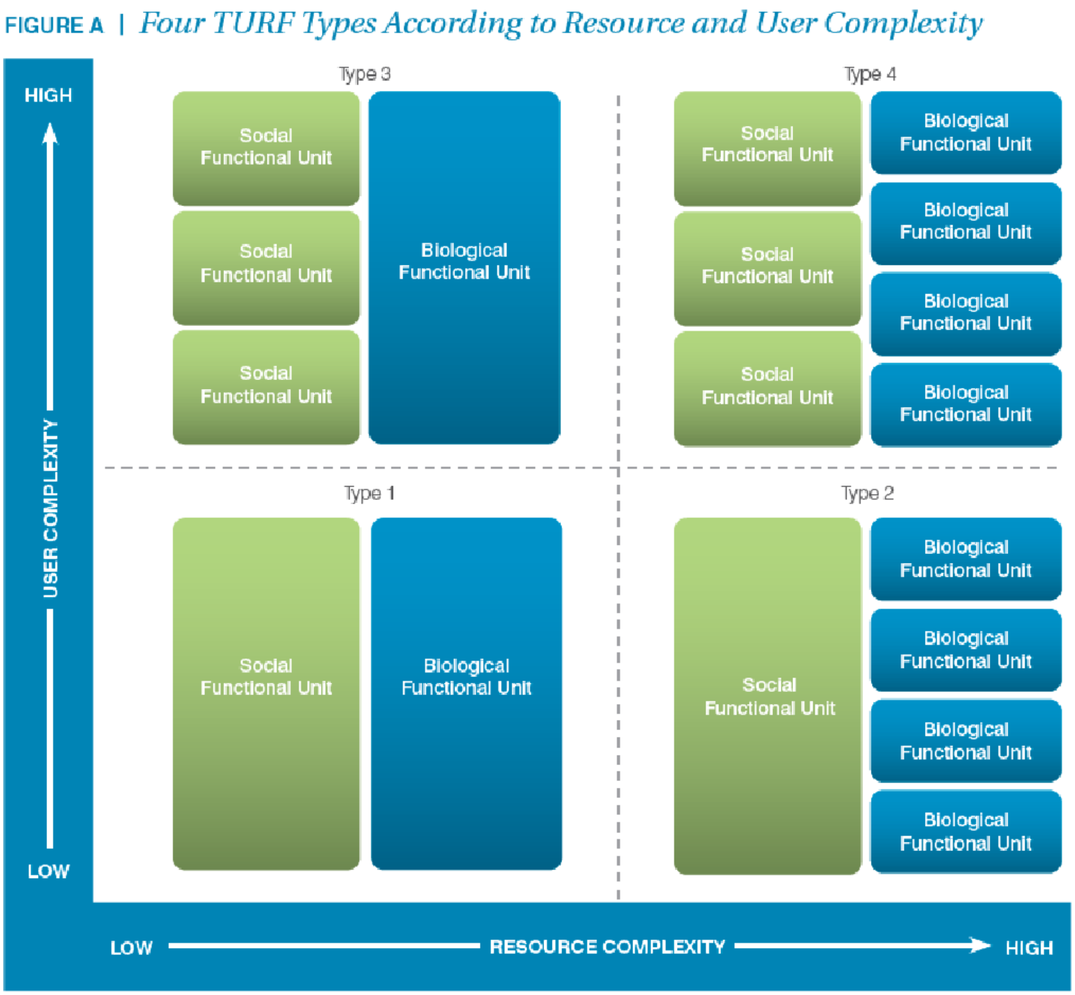

Figure 5 Four types of TURFs according to Resource and User Complexity (Poon & Bonzon, 2013 p15)" Catch Share Design Manual Volume 3: Territorial Use Rights for Fishing" Retrieved from http://fisherysolutionscenter.edf.org/sites/catchshares.edf.org/files/3-CSDM_Vol3_TURFs.pdf

Biological/ecological and economic outcomes often measure the fishery's success. For a fishery to thrive biologically and ecologically, stocks should be abundant with no signs of overexploitation. There should be minimal or no bycatch, and the habitat should be well protected. Economic success can be achieved when financial objectives such as increased profits, reduced costs, and job creation are realized (Poon & Bonzon, 2013).

TURFs are considered successful when the fishery's objectives are met. Nevertheless, Christy (1982) stated that some TURFs' objectives are not necessarily aligned with the fishery's goals. In some TURFs, the aim is to maximize economic gains, while others strive to maximize social benefits, such as more employment in the community (Christy,1982).

Although TURFs have received more and more attention over the years, the factors contributing to their success are relatively unknown. In literature, there are common design elements and conditions that contribute to the success of TURFs:

1. TURF Size

Fishers should have exclusivity and security of access within TURFs to achieve optimal social benefit and sustainable harvest practices. This exclusivity depends on the ratio of the TURF size to the mobility of targeted species; therefore, TURF size affects biological and social outcomes (Aceves-Bueno et al., 2017).

The appropriate size of TURFs should be determined by considering the specific characteristics of the fishery. Factors such as the abundance and distribution of the target species, their habitat needs, and the fishing methods utilized all play a role in determining the suitable size of TURFs (Aceves-Bueno et al., 2017).

It is essential to have a comprehensive understanding of the ecological dynamics of the fishery to establish the spatial extent necessary for effective resource management.

TURFs should be designed to consider the ecological needs of the target species and habitats. This involves understanding the movement patterns, migration routes, and habitat requirements of the fish species involved. If the species have a large range or migrate across larger areas, TURFs might need to be larger to encompass these movements and ensure effective management (Castillo et al.,2008). TURFs large enough to cover the whole geographic life span of targeted species are more likely to be successful, especially if the TURF covers the larval stage; there is less risk of diminishing the stocks. If the targeted fish swim beyond the boundary, this might cause overharvesting before leaving the TURF boundaries, as the TURF members would try to get most of the stocks. Because when fish move away, they will be available to fishers not part of the TURF. Therefore, TURF members benefit from harvesting over sustainable levels -not necessarily the benefit that extends to fish stocks- reducing the loss of fish to others (White & Costello, 2011). Overall, considering the connectivity between various habitats and fishing grounds is crucial when designing TURFs. Fish populations frequently migrate between different areas throughout their life cycles, and these movements have significant implications for their long-term sustainability (Auriemma et al., 2014).

Taking into account the spatial connectivity between habitats when establishing TURFs helps maintain the ecological balance of the fishery and enables effective resource management across different areas. By accounting for these movement patterns, TURFs can be designed to align with the natural dynamics of the fish populations and support their healthy functioning. Large TURFs, covering the fish's spatial dispersal, will decrease the spillover of fish (both adults and larvae) to adjacent areas. The resource will be better managed as there are more significant incentives for TURF owners to take actions to sustain yields. On the other hand, in larger TURFs, it can be more challenging to ensure meaningful stakeholder engagement and participation (Halpern et al., 2009). As the geographic area expands, it becomes more difficult for all affected stakeholders, including fishing communities, to participate in decision-making processes actively (Halpern et al., 2009). This can lead to a lack of representation and potentially hinder effective management and compliance. Enforcing regulations and monitoring fishing activities can be more complex in larger TURFs. The larger the area, the more resources and efforts are required to monitor fishing practices and enforce rules and regulations effectively. Inadequate monitoring and enforcement can lead to illegal fishing activities, unsustainable practices, and a failure to achieve the intended conservation and management objectives. Likewise, undersized TURFs can lead to insufficient resource protection.

TURFs may not adequately protect and manage the targeted fishery resources when they are too small. The limited spatial extent may result in overfishing or unsustainable harvesting practices, as the fishing pressure cannot be effectively controlled within the small area. This can lead to declining fish populations, habitat degradation, and ecosystem imbalances (Auriemma et al., 2014). Small TURFs may lack the ecological resilience necessary to withstand environmental fluctuations and disturbances. A small-scale management approach may not provide enough buffer against external factors such as climate change, pollution, or natural disasters (Aceves-Bueno et al., 2017). This can increase the vulnerability of fishery resources and hinder their long-term sustainability. Again, with small TURFs, exclusivity can be compromised because ocean habitats are highly linked systems where fish can escape the TURFs (a process known as spillover) and be caught in neighboring fishing grounds (Aceves-Bueno et al., 2017). According to a hypothetical scenario, spillover can significantly impact fishers' behavior if spillover results in higher expected losses from the TURF, which prompts a fishing race and overfishing (White & Costello, 2011). The development of partial cooperation schemes among TURFs may be the explanation for the unexpected success of small TURFs with high spillover levels. Two TURFs will effectively function as a single, more significant TURF by entirely coordinating their harvests and sharing benefits, reducing the incentives to race (Kaffine & Costello, 2011). Partial inter-TURF cooperation has emerged as benefit-sharing (unitization), joint monitoring and compliance, or mutual grab marketing in several TURFs in Japan, Mexico, and Chile (Uchida & Baba, 2008; Cancino et al., 2007; Hirotsugu, 2017; Costello & Kaffine, 2010).

At the same time, coordination among TURFs in Chile does not address spillover problems. The spillover in Chile is mainly caused by larval export. The pattern of dispersal trends is difficult to classify, making it difficult to identify other fishing groups with whom cooperation should be established to address the spillover issue. Also, most Chilean TURFs are surrounded by open access zones, discouraging collaboration because activities reduce the payoffs in the surrounding areas (Aceves-Bueno et al., 2017). Moreover, these factors limit the opportunities for face-to-face contact among TURF owners who share the same resources, which is critical for creating cooperative relationships.

It is important to acknowledge that finding the ideal TURF size is context-specific and may require ongoing evaluation and adjustments over time. A combination of scientific understanding, stakeholder engagement, adaptive management, and collaborative approaches can help navigate the challenges associated with TURF sizes and promote sustainable fisheries management.

2. Group Size

When managing fisheries, the size of the TURF group, which refers to the number of individuals or fishing entities included within a TURF, is one of the essential and very challenging design elements for the overall success of the TURFs. Determining whether a small or large group size is better in Territorial Use Rights for Fisheries (TURFs) depends on various factors and considerations. There is no one-size-fits-all answer, as the optimal group size can vary depending on the specific context, goals, and characteristics of the fishery.

Viana et al. (2019) stated that TURFs with few members might benefit management. Small groups are more likely to be composed of participants with similar social characteristics, making communication, tracking, and compliance easier (Agrawal & Goyal, 2001; Cancino et al., 2007). This could be problematic since TURFs must have direct access rights to be effective (Agrawal & Goyal, 2001; Cancino et al., 2007). If TURFs are primarily composed of participants with similar social characteristics, it may lead to exclusion and limited access for other individuals or communities who do not share those characteristics. This can result in social inequality and hinder the equitable distribution of benefits from fisheries resources (Viana et al., 2019). The exclusive nature of small groups with similar social characteristics can discourage participation from individuals or communities outside that group. This reduces diversity in decision-making processes and may result in limited perspectives, potentially undermining the effectiveness and legitimacy of management efforts (Aceves-Bueno et al., 2017).

On the other hand, Ostrom's book "The Drama of the Commons" (Ostrom, 2002) suggests that when the group size in a commons-based system becomes too large, individual contributions tend to decrease, and transaction costs such as enforcement and communication tend to increase. Additionally, a larger group size introduces more diversity among users, which can potentially lead to increased conflicts during decision-making processes. This, in turn, can result in a reduced capacity for enforcement and an increased likelihood of free-riding behavior. Viana et al. (2019) stated that an increase in member size causes challenges for collective action and might reduce the capacity to achieve efficient outcomes.

The group size of TURFs has significantly impacted their performance, specifically regarding resource dispersal and collective action. According to McCay et al. (2014), smaller scales and scopes of TURFs have been identified as critical design elements for successful community-based management. This suggests that smaller TURF group sizes can enhance the effectiveness of resource management within a localized area.

Additionally, Christy (1982) emphasized that the smaller size of TURFs can foster a stronger sense of ownership among the members of the TURF. When the group size is smaller, individuals may have a more personal and direct connection to the resource, leading to a heightened sense of responsibility and stewardship. This sense of ownership can contribute to more effective conservation efforts and the implementation of sustainable fishing practices within the TURF.

Ultimately, finding the optimal group size in TURFs requires careful consideration of the specific context, goals, social dynamics, ecological characteristics, and cultural factors of the fishery:

- Communication and Coordination: Small groups have an advantage in efficient communication, while larger groups may require more structured communication channels to ensure effective coordination.
- Representation and Inclusivity: Large groups offer the potential for diverse representation, but efforts must be made to ensure that all stakeholders' voices are heard and that power dynamics are addressed.
- Decision-Making Efficiency: Small groups tend to make decisions more swiftly, while larger groups may require more time for consensus-building and deliberation.

Enforcement and Compliance: Small groups may find it easier to enforce rules and ensure compliance due to stronger social connections, while larger groups may require more robust enforcement mechanisms (Aceves-Bueno et al., 2017; Agrawal & Goyal, 2001; Cancino et al., 2007)

3. Boundary

A TURF's well-defined boundary is another factor in its success, as the territory can be easily identified and monitored (Christy,1982). Boundaries can be publicly announced and marked by buoys or distinctive land features. Offshore boundaries may require additional investment to monitor large TURFs as they cannot be visible from the shore (Wilen et al., 2012). On the other hand, TURFs located between distinctive land features such as lagoons, bays, and coves make monitoring and enforcement easier than those found along open coastlines (Auriemma et al., 2014).

4. Exclusivity

Exclusivity of access is another feature that contributes to TURFs' success. In practice, this means members of the TURFs should receive benefits that non-members do not. Even with the proper exclusion of non-members, well-established property rights do not guarantee more significant benefits to its members. For member fishers to maximize direct benefits from the resource in the short and long term, adequate incentives should be implemented. When there is an apparent privilege, the resources within TURFs will be managed more efficiently (Uchida et al., 2012). A group of fishers will act as the only resource owner once they have secure property rights to the fishery (Costello & Kaffine, 2008).

5. Tenure Duration:

TURFs with property rights assigned for extended periods are more likely to be successful. When tenure rights are granted for a significant duration and allow fishers to have adequate returns from their investments, they are more likely to encourage sustainable fishing (Nguyen Thi Quynh et al., 2017; Poon & Bonzon, 2013). In other words, a longer tenure period allows fishers to absorb the long-term advantages of sustainable fishing techniques and encourages them to follow legislation meant to achieve fisheries management objectives. Despite the disadvantages, the majority of TURF case studies highlighted in the literature assigned short-term usage rights of fewer than three years (Auriemma et al., 2014; Aswani, 2005; Society & Applications, 2017). It is worth noting that territorial use rights can be given in various ways. Individuals or groups, such as fishing cooperatives or associations, might be awarded the right to harvest in a certain region. Perpetual rights, in either scenario, provide the most security. On the other hand, governments typically hesitate to give a region complete authority or ownership in perpetuity and commonly provide concessions or leases for a set duration of time (Auriemma et al., 2014).

The tenure duration can differ when primary and secondary tenure rights are assigned in one TURF. Primary rights can be granted for a territory in the form of concession or lease or vested in the form of permissions or licenses from a management authority. In some TURFs, the government gives primary rights to a group, such as harvester cooperatives. The co-op assigns secondary rights, such as licenses, to individual fishers. As a result, while the cooperative may acquire a 20-year concession, individual fishers may only have annual access to the region. There are some TURF systems where short tenure durations may benefit the user. For example, in Malta (Consortium, 2007) and the Languedoc-Roussillon area of France (Auriemma et al., 2014), fishermen are assigned a specific zone, in both circumstances, based on an annual lottery. Some fishing places will be more productive than others due to natural variance in species distribution within a landscape. In the event that a fisher is assigned to a low-productivity region in a lottery, the user will profit from a brief stay. As a result, while a cooperative may be granted a 20-year concession, individual fishermen may only be assured access for a limited time (Regional et al., n.d.).

A TURF's tenure duration is generally determined by the degree to which the government involvement is directly engaged in the management and governance and the age of the TURF. If the government is highly involved in managing the TURF, it may have more control over decisions regarding tenure duration. The level of government involvement can vary, ranging from active participation in setting and enforcing rules to more passive oversight and monitoring (St. Martin,2003). A TURF that is more than 100 years old has a greater likelihood of adopting short tenure lengths over a TURF that is younger. This may indicate that TURFs implemented more recently may be designed with a focus on secure property rights, which can lead to longer tenure lengths (Auriemma et al., 2014). According to one study (Auriemma et al., 2014), there is a significant correlation between the degree of government involvement in TURFs and short tenure lengths, which is counter-intuitive, as governments are often very hesitant to assign long-term rights to groups. Government institutions may have growing awareness about the advantages of secured access rights.

6. <u>Species Mobility:</u>

TURFs are more suitable for fisheries with more sedentary species, such as shellfish. Limited movement of adult fish that stay within TURF boundaries can benefit fishers that employ sustainable fishing practices (Poon & Bonzon, 2013). Also, selecting sedentary species for TURF implementation provides greater security over the resource as TURFs can cover more of the range of the species (White & Costello, 2011). Contrarily, fish stocks with high mobility are unpredictable; therefore, it is difficult to set accurate harvest rules and manage stocks beyond the border of TURFs. The transboundary stocks in TURFs are incomplete property rights as outside the TURF boundaries might be “free for all”; competing for fish can be very destructive to fish stocks (Costello et al., 2008). In other words, the TURF may have established rights and regulations for fishing activities within its defined area. However, outside of those boundaries, there may be an absence of clear rules or restrictions. This situation creates a scenario where fishing activities outside the TURF boundaries can become unregulated, often leading to destructive competition for fish resources. This destruction can be prevented by expanding the size of TURFs to encompass the entire spatial range of the fish stock. However, achieving coordinated harvesting practices across such large areas would be challenging (Holland, 2004). Therefore, a network of TURFs can be an excellent solution to manage transboundary species that meet conservation targets. Also, methods such as output controls on fishing and full coordination across TURFs are suggested alternative solutions (White & Costello, 2011). To achieve biological targets, assigning TACs for each TURF within a network seems to be an efficient solution; however, it does not address coordination difficulties. Fujita and Bonzon (2005) stated that setting TACs for individual TURFs in a network is highly complex. It is difficult to find an optimum TAC that everybody agrees on and discourages race-to-fish behavior.

7. <u>Enforcement:</u>

TURFs have effective enforcement, which secures the user rights more successfully as there is less resource violation (Villena & Chavez, 2005). The enforcement can be done by the government or by the members of TURFs. The latter is more efficient as there is self-interest in complying with all the rules (Christy,1982).

8. <u>Co-management:</u>

TURFs managed together by governments and fishers seem to be more successful as they provide a combination of the government's institutional and legal capacity with the local knowledge and engagement of the fishers (Christy,1982; Gutiérrez et al., 2011). Merging local knowledge with the government's power is a critical factor for the successful implementation of TURFs (Costanza et al., 1998; Ostrom, 2009). Co-management (resource management in which fishers are allowed to participate in decision-making) is utilized in many TURFs worldwide. Governments often set biological targets in these systems, and the communities or cooperatives manage simple fishing activities, such as the implementation of season closures, gear restrictions, and size limits. It is not a surprise to see many applications of co-management within TURF systems, considering co-management is often related to improved fish stocks because of increased ownership, knowledge, compliance, and monitoring among fishers (Gutiérrez et al., 2011).

9. <u>No-take Zones:</u>

No-take zones around the TURFs most likely increase their success as stock abundance increases within the protected area. The TURF adjacent to those areas might benefit from spillovers (a mechanism that defines the movement or migration of fish or other marine organisms from within the boundaries of a TURF to areas outside of the TURF). On the other side, when there is little or no coordination between users, strategically placed no-take zones decrease the spatial externalities and conflicts while increasing the economic gains and stock abundance (Halpern et al., 2009)

Overall, TURFs can have unique design elements such as input controls, catch limits such as TACs and Individual Transferrable Quotas (ITQs), rotation, and revenue pooling systems to determine how resources can be exploited. Socio-economic peculiarities of local institutional arrangements and fishers and contextual elements such as fishery types cause a significant variation in TURFs' features. For instance, Chile, Spain, South Africa and Korea are using

TURFs with catch limits (Jentoft & McCay, 1995; Ovando et al., 2013; Romero & Melo, 2021; Ueyonahara, 2012; Yandle, 2003), whereas TURFs which evolved historically, such as those in Japan and Sri Lanka, are using more input controls in conjunction with TURFs (Cinner, 2005; H. Uchida, 2003). The use of TURFs with other systems will be explained in more detail in the upcoming sections.

3.3. Historical Development

Despite intense efforts to manage global fisheries, the overexploitation of more than one-third of the assessed nearshore and offshore fisheries (FAO, 2010) leads to the establishment of many traditional and ecosystem-based management strategies. These strategies may increase species' biodiversity and abundance but lack enough incentives to stop the "race to fish" problem. Among fisher and gatherer communities, dividing the coastal fishing sites into territories has been customary practice as a tool to conserve fishing areas, rotate harvests, and assign access privileges. Rules permitting exclusive fishing rights to communities or individuals have existed since prehistoric times in the form of marine tenure systems. In 1982, the Senior Fishery Planning Officer Francis T. Christy from the Food and Agriculture Organization of the United Nations (FAO) developed and utilized the acronym TURF.

The origins of TURFs were the local communities with pre-existing and informal (traditional) fishing rights that enabled their establishment. Fishing rights are assigned to the communities through TURFs according to historical, local, communal, customary, or indigenous rights by governments. The other origin of TURFs was the deliberate introduction of TURFs as a new management system, by governments, when traditional fishing rights were lacking. This more modern development of TURF systems focuses on economic efficiency with the expectation that social equity and sustainability will be the automatic outcomes. This second form gives exclusive fishing rights to cooperatives or communities and is often considered an alternative to ITQs. Even though 1945 to 1958 can be referred to as a period of construction of fisheries management, a significant change took place in fisheries management history in 1975 when many countries accepted exclusive economic zones of 200 miles, in which 95% of the most valuable fisheries was brought under the jurisdiction of coastal nations (Food and Agriculture Organization, 2014). Simply, the United Nations Convention on the Law of the Sea (UNCLOS) granted ownership rights to territorial waters and resources to coastal countries. Despite the significant effort and fisheries management success associated with the establishment of the EEZs, fishing in the open sea remained unregulated; vessels from every nation were still able to fish in the open sea, except in narrow territorial seas. These policies made little to no sense for individual nations that would like to restrict fishing while others do not (Doremus, 2013). Fish populations in an EEZ of a single country are relatively easy to manage. When populations travel across multiple EEZs of different nations, attempts are made to harmonize regulations. Over time, this led the management of EEZs into right-based systems; the most common application was to set spatial boundaries over a given population.

Meanwhile, considering populations consisting of meta and sub-populations has become more important as scientists have begun to understand population processes better. This new comprehension of populations` spatial heterogeneity guided rights-based management to design and differentiate rights more finely over a space(Wilen et al., 2012).

3.4. Evaluation of TURFs

TURFs have been traditionally used around the world. One of the earliest studies on TURFs was "Native possessory rights" by Goldschmidt and Haas (1946), followed by Anthropologist

Johannes in the South Pacific Islands (1977) (Ruddle, 2017), Territorial Fishing Rights (Acheson,1977), Sea Tenure (Alexander,1977), and Customary Fishing Rights (Lawson,1984). In some cases, TURFs have been used in freshwater lakes and rivers with adjacent lands.

Some TURFs evolved slowly over centuries in countries like Japan, India, Mexico, Sri Lanka, Indonesia, and Indo-Pacific countries, while Latin America, Taiwan, Chile, Spain, Vietnam, Ecuador, Korea, and South Africa have only been hosting TURFs in recent decades after research had shown promise (Nguyen et al., 2017).

TURFs are often associated with small-scale fisheries in developing areas. There are quite a few cases in developed regions, such as coastal Japan, where spatial rights have been practiced for centuries for mussels, oysters, clam, and kelp fisheries (Wilen et al., 2012). Like in the Philippines, Malaysia, Indonesia, Vietnam, and South Korea, their management systems are based on traditional/customary tenure or community-based management.

TURFs usually evolve from the bottom-up over the long term within traditional tenure systems, yet some TURFs are initiated in a top-down manner via innovative policies and legislation, for example, the benthic fisheries in Chile and the abalone fishery of South Africa.

4.TURFs` POLICY IMPLICATIONS AND OTHER CONVENTIONAL RIGHTS-BASED MANAGEMENT SYSTEMS

4.1 Policy Implications of TURFs

Regarding fisheries management and governance, scientists and economists often diverge their opinions. While social scientists argue that institutionally embedded use rights in communities can be socially and economically efficient, economists promote market-based or wealth-based approaches (Foley et al., 2015).

There are two dominant fisheries management approaches with respect to institutional arrangements. The first one is the market-based approach, whereby the marketplace determines the allocation of rights through selling and buying. Fishers sell and buy use rights, and fisheries managers decide participation, use rights, and allowable catches. Who buys or sells the rights varies from situation to situation. In some cases, the parties have more financial capital to purchase the rights, whereby more efficient parties buy out the rights of less efficient parties. The market-based approach may be a very cost-efficient institutional tool to handle transactions, but it prevents governments from changing their policies quickly because it is hard to take back rights that have been previously given. Governments often need to compensate when there is a need for policy change; for example, if there is a need to favour a new fishing gear over a destructive fishing gear in order to protect the environment. Market-based rights (such as ITQs) are often considered for individual fishers, but they could also be at a corporate or community level (Cochrane & Garcia, n.d.).

The second institutional arrangement is called multi-objective strategic planning based on rights determined by government decisions, institutional history of the fishery, traditional and informal rules, and legislation performed by institutions. It can be national, regional, or community-based.

This approach encourages the participation of stakeholders in the decision-making process. In economies where market forces hold significant influence, implementing a market-based approach is more feasible, while a strategic planning approach aligns better with the needs of small-scale or artisanal fisheries. Additionally, adopting a strategic approach becomes more appropriate when there is a strong tradition of fishing activity (Charles, 2001).

Understanding the power of traditions and existing use rights is essential because reinforcing pre-existing use rights and having them adopted by fishers is simpler than bringing in completely new regimes and contexts. Fisheries are complex socio-ecological systems that include institutions and must be addressed as a whole rather than extracting fisheries problems from their socio-economic context. It is vital to search for the right approach both to benefit fishing communities and fish stocks (Wandira, 2017).

Even if fish prices increase, supply is ecologically constrained. Therefore, many academics maintain that fisheries cannot be considered industrial production (Copes, 1986). Also, in a market-based approach, community development and socio-economic objectives are not considered to be the primary drivers. Some hybrid solutions can be considered, "individual-based, non-market schemes, such as a community quota that is managed cooperatively, but with sub-divisions into non-transferable individual quotas or a local trap fishery on a sedentary species is managed through collectively developed policy but individual (trap limit) input rights. Such approaches may best balance the desirability of individual rights with the benefits of social and community stability" (Charles, 2001).

There needs to be an agreement on what mechanism, such as market-based or community-based, or what scale, such as individual, community, or collective level, should be utilized for the implementation of user rights. Berkes (1986) stated that individual market-based rights might be the most appropriate solution for offshore, large-scale fishing. In contrast, the community-based approach aligns better with small-scale fisheries' objectives.

4.2. TURFs and other right-based systems

The two pillars of economic efficiency, widely known in the literature, are growing capital and specialization in production (Scott, 2008). Furthermore, both need to have property rights to be fully realized. Trade, exchanging property rights between individuals, is necessary to achieve optimum production levels. Moreover, there is no incentive for people to build capital without property rights, as there is a danger that others can capture it. With property rights in place, economic efficiency can be reached via capital growth and specialization in production. Also, trade will influence markets so that market prices will lead to optimal allocation of resources (Scott, 2008).

From an economic perspective, property rights are multidimensional with the following characteristics (Arnason, 2012):

1)Exclusivity means that the property right holder can use the property as he/she wishes and prevent others from using it.

2)Durability is the duration or the life span of the property right.

3)Security is the ability to protect property rights against government expropriation, other dispositions, or theft.

4)Tradability is the feature that enables property holders to sell or lease his/her property.

In fisheries, unlike farming, it is hard to set high-quality property rights as it is impossible to keep the fish enclosed or identify the owner of a single fish. TURFs, IQs or ITQs and Harvester Cooperatives are the most common property rights, even though they are far from perfect While these property rights systems are not without their flaws, TURFs, in particular, aim to address the core issues contributing to overfishing, such as the lack of well-defined property rights. They are designed to tackle unsustainable fishing practices effectively and foster responsible resource management within their designated territories. By granting exclusive access and management rights to specific user groups or individuals, TURFs incentivize long-term stewardship and encourage practices that ensure the sustainability of fishery resources. Several papers have proposed TURF systems' biological, economic, and social potential (Charles, 2001; Gelcich et al., 2007; Hilborn, 2007; Ueyonahara, 2012). However, it is worth noting that not all research supports the notion that implementing a TURF scheme alone guarantees the long-term viability of fisheries. Some studies suggest that additional factors, such as effective governance, enforcement, adaptive management, and stakeholder participation, are necessary for ensuring the success and sustainability of TURFs in fisheries management (Aburto et al., 2013; Aburto et al., 2014; Orensanz et al., 2013).

The argument here is not only about the TURF's performance but also about how it relates to other rights-based management tools like ITQs. ITQs are not exactly property rights in terms of the fish stocks or aquatic habitat as they are the rights to harvest a share of fish stocks. ITQs are not enough alone to set socially acceptable total allowable catches, but ITQ holders can have complementary applications to maximize resource use as they provide individual incentives (White & Costello, 2011).

Some think that ITQs surpass TURFs to reach management goals because ITQs are efficient in managing migratory species such as southern bluefin tuna (Campbell et al., 2000). The mobility of resources decreases the effectiveness of TURFs; therefore, they are only applicable to sedentary species (Afflerbach et al., 2014; Auriemma et al., 2014; Holland, 2004; White & Costello, 2011). TURFs must be very large to enclose mobile species, or additional coordination is required. That is why most TURFs are established around relatively sedentary species (Costello et al., 2008; White & Costello, 2011).

As mentioned earlier, TURFs are a form of property rights designed to commonly give area access to a group of fishers and rarely to individuals (Wandira Ayu Bertin, 2017). TURFs, in contrast to conventional management systems, eliminate the overharvesting incentives inherent in open access schemes by allocating exclusive and secure access to marine resources (Costello 2012). Such rights encourage TURF users to take more environmentally responsible management steps because they guarantee that potential gains from such actions are protected for TURF owners. When fishers have acquired rights to a fishery, they can control the resource as sole owners and maximize long-term economic benefits (Costello & Kaffine, 2008).

4.2.1. Individual Transferrable Quotas (ITQs)

ITQs are catch shares that an individual (or a vessel) is given a right to catch or transfer (buy, sell or lease a share) a portion of the total allowable catch annually (Pinkerton, 2013).

ITQ is a right-based fishery management model where (Eythórsson, 1996):

- There are established property rights for individuals, which create incentives to harvest fish resources sustainably in the long term.
- Transferability of the quotas will lead to an economic equilibrium in which the most efficient vessels buy out the less efficient ones to reach optimum fishing capacity.
- Efforts are reduced to an optimum level, and stocks are building up; resource rent from the fisheries will be much larger than open access regimes. In over a thousand fisheries, ITQs have been adopted worldwide for many decades (Arnason, 2012). The Netherlands' flatfish fishery (1976) and Iceland's herring fishery (1976-1979) were the first introductions of ITQs in ocean fishery. Since then, many countries, such as the United

States, Canada, Peru, Chile, New Zealand, Iceland, Norway, Namibia, Russia, and several others, have been using ITQs as a significant block of their fisheries management system (Arnason, 2012).

The speedy expansion of ITQ systems globally shows that they have successfully reduced common property problems and have also reduced capital use and excessive fishing effort in overexploited fisheries (Consortium, 2007). Costello, Gains, and Lynham (2008) stated that in some ITQs, the long-term decline of fish stopped or was reversed. Improved financial results and stock improvements under conservative TACs are reasonable outcomes of ITQ systems (Arnason, 2012).

ITQs are accepted and often preferred as a management approach that encourages stewardship of the resource, reduces race-to-fish (Branch, 2009), reduces the environmental impacts of fishing by reducing race-to-fish (Branch, 2009; Grimm et al., 2012), and better reaches management targets (Branch, 2009; Grimm et al., 2012; Melnychuk et al., 2012) and Grafton (1996) listed the economic incentives for implementing ITQs as such: increased profits, reducing inefficiencies caused by race-to-fish, and overcapitalization (Grafton, 1996) The market value of ITQ rights increases with fishing; therefore, there are incentives for ITQ holders to maximize overall fishing benefits. By contrast, the race to fish continues to be a problem among fishers within a TURF, even more so when the TURF's internal management is ineffective, as was the case with race-to-fish behavior in some of Chile's TURFs (Wilen, 2006).

There have been many critiques since the introduction of ITQs, but Copes' (1986) critiques of high grading, data fouling, and black-market off-loading are possibly the most cited. Those critiques were proven wrong over time because of ITQs' increased economic efficiency and sustainability compared to other regimes.

ITQs' success in generating favourable resource rent and net economic profit allowed its application on many highly valued fish stocks in different countries, such as New Zealand and Iceland (Arnason, 2005). However, ITQs are considered unsuitable for some species, such as some prawns, as they are short-lived and annual stock abundance varies widely based on environmental factors. It is, therefore, challenging to set an accurate TAC; if possible, it will undoubtedly be costly. Defining an appropriate TAC has significant economic importance as overestimating a TAC causes rent dissipation, and an underestimation will lead to economic losses due to missing fishing opportunities (Coglan & Pascoe, 2015). Furthermore, it is challenging to meet biological targets via ITQs for complex multispecies fisheries, especially in the presence of non-target species (Arnason, 2012; Holland & Schnier, 2006).

One of the limitations of ITQs is that they cannot address the spatial heterogeneity, which may emerge from spatial productivity variance, initial patchiness of the resource, and differences in spatial profits (Cancino et al., 2007). Fish populations are not dispersed homogenously over physical space, although most of the species-based regulations essentially assume this. The modern perspective is that fish populations are distributed as sub-populations or metapopulations. The generic incentives of ITQs are to maximize the value; therefore, the most profitable patches may be overexploited. For instance, if a spatially undifferentiated ITQ is applied to a population that consists of several subpopulations over a coastline, some sub-populations will most likely be over-fished due to the convenience (e.g., sub-populations close to shores, more productive patches). This problem could be overcome by spatial tax instruments or ITQs that are spatially differentiated (Wilen et al., 2012). Another challenge associated with population heterogeneity is that ITQ licenses are primarily designed to manage aggregated biomass rather than effectively addressing sub-stock distribution across a specific area with varying cohorts. This limitation arises because ITQ systems typically focus on managing the overall stock as a whole without considering the distinct characteristics and dynamics of sub-populations within the fishery. As a result, the effectiveness of ITQ licenses may be reduced when dealing with fisheries that consist of sub-stocks distributed over a wide area, each with its own unique attributes and population dynamics. To make the fisheries optimal, consideration of all the different characteristics of biomass is necessary (Christopher & Deacon, 2007). Adjusting TACs by areas, sub-stocks, and cohorts may resolve this problem, yet it is not a common practice as it increases the cost of research, enforcement, and monitoring. Therefore, license holders are most likely to fish for more profitable areas, which is not always ideal as it might be biologically detrimental (Arnason, 2012).

In non-differentiated ITQ systems, a proportion of the TAC is allocated or given to different individual users or entities involved in the fishery. In this context, "non-differentiated" means that the ITQs are not allocated based on specific user characteristics or differences. Instead, a portion of the TAC is divided among the users without considering their individual circumstances, such as fishing history, capacity, or ecological impact. Furthermore, this feature of ITQs is potentially expected to solve the over-exploitation problem. However, it does not address the management problem of when and where to harvest. As TACs are set at discrete intervals, mostly per year, fishers decide when to harvest their quota, which means an infinite number of biomass paths, some of which will be sub-optimal (Arnason, 2012). Also, fish has different values over time and space because it grows and moves. There are still incentives to concentrate on more productive patches and large aggregation grounds, resulting in fishing effort congestion. It can be solved by either creating individual rights that specifically describe when and where the harvest will occur or by adding design features that help coordination and cooperation. For example, a regulatory body can give use rights to cooperatives rather than individual fishers, and cooperatives can internally manage where and when to harvest. The cost of the first solution might be very high due to the higher transaction and enforcement costs (Type & Materials, 2021).

Individual fishing operations are organized to increase the overall fishing effort's effectiveness, known as effort coordination. This coordination involves eliminating race-to-fish, congestion at fishing grounds, and possible damage and loss of fishing gear. Fishing ground rotations or assignments, rotating fishing days, joint search/assessment of fish stocks and, in some cases, joint ownership of vessels and fishing gear are common strategies used to achieve these goals (Uchida, 2003). In TURFs, to prevent congestion in hots spots, some Japanese Fishery Cooperative Associations (FMOs)controls fishing effort to distribute inefficient fishing effort over space by rotating access to fishing areas daily or some other timeframe determined by the FMO. Alternatively, fishers take turns fishing in some TURFs with too many members (Cancino, Jose p. et al., 2007). Rotation and effort coordination aims to optimize the spatial distribution of effort, but it may cause variance in catches among cooperative members. Japan has two distinctive solutions: periodically rotating the fishing effort into hot and cold zones, pooling all the income generated by fishing, and distributing that income to the members. For example, in Hokkaido, Japan, the pollock fishery has a very complicated three-layer rotation system that gives members an equal chance of harvesting in any area within TURF (Cancino et al., 2007). Similarly, Chilean Management and Exploitation Areas of Benthic Resources (MEAs) also allocate TAC to their members in different ways. The first one is dividing TAC into production units which consist of a vessel, two crew members, one captain, and fishing gear. Some MEAs manage the effort collectively and distribute gains to members by pooling arrangements. The second one allows production units to fish wherever they want with their TAC allowance, but they pay a commission for their harvest at the end. Both two methods are aligned with individual quota systems that eliminate race-to-fish incentives. Also, some MEAs use the pooling system to share the gain, especially when there is no TAC allocation, generally a rotating system used to distribute effort in those schemes (Cancino et al., 2007).

In some cases where more extensive spatial scale effort coordination is required, FMOs can coordinate with other FMOs or even merge, especially for species with different life cycles in different FMOs. For example, small pink shrimp move from south to north between two Japanese Fishery Cooperative Associations (FCAs), gaining weight and economic value. To prevent southern fishers from harvesting pink shrimp before reaching the optimum size, the two FMOs merged in Suruga Bay, Japan. After the merger, most of the harvest occurs on the north side, where the resource's economic value is maximized.

Some researchers are adamant that, in some cases, it would be better to build TURFs rather than ITQs (Cancino, Jose p. et al., 2007; Wilen et al., 2012). According to some scholars, ITQ systems are poorly suited to multispecies fisheries due to the difficulty in considering the many different species interactions and the lack of capacity for fishers to target particular species (Cancino, Jose, Hirotsugu Uchida, 2017; Wilen et al., 2012). An ecosystem is a functional unit consisting of various prey-predator linkages between populations and interconnected food webs (Staples & Funge-Smith, 2009). ITQs cannot address externalities caused by species interactions because most ITQs are designed for single species (Cancino, Jose p. et al., 2007). In this context, it is essential to consider the benefit of catching fish against leaving it as prey for another fish (Hannesson & Herrick, 2010; Wilen et al., 2012). Theoretically, it is possible to consider prey-predator relations through adapted TACs determinations, yet no ITQ system directly addresses these interactions. Capelin, herring, and cod's prey-predator relations are among the most studied globally; still, there is no concerted effort to address these linkages even though fishers in Nordic countries like Norway, Russia, and Denmark have been fishing them for a long time. In principle, it is also possible for ITQ holders to bargain among themselves over multispecies linkages, but it requires organization. For example, a group of fishers may decide to purchase licenses for prey species to regulate the impact on predator species stocks and their respective harvest. The idea behind this approach is to ensure that the economic costs associated with the last fish harvested from the prey species are compensated for by the benefits derived from the predator species. Achieving this balance is a challenging task that typically requires collective action rather than individual efforts (Wilen et al., 2012). For the reasons above and more, ITQs might not be the best option for complex, multispecies fisheries, especially when unwanted catches are dominant.

Nevertheless, the pacific coast of Canada and the United States have ITQ systems for some groundfish fisheries that depend on monitoring stocks, catches against quotas, and complex administrative systems such as performing and tracking trades (Arnason, 2012; Copes, 1986). In TURFs, however, these multispecies linkages are better addressed. For instance, in some Chilean MEAs, low-value species are managed to benefit high-value species. For example, in the high-value Concholepas concholepas (Bruguière), commonly known as “loco” fishery, sea squirts, a favoured prey item, are fully protected or are harvested in very controlled amounts (Cancino, Jose p. et al., 2007).

While ITQs can contribute to sustainable fisheries management by ensuring that the total catch remains within sustainable limits, another shortcoming of conventional ITQs is that they are not inherently designed to address environmental concerns or provide explicit protection for marine ecosystems (D. Holland & Schnier, 2006). Gears such as scallop dredges and trawls negatively impact marine habitats because of their design and use in the marine environment. Scientists and environmentalists put significant effort into reducing their negative impact on the seafloor by modifying the fishing gear (e.g., altering rollers). Even if the ITQ system is well-designed to focus on target species and ensure sustainable harvesting, the absence of explicit measures or incentives for environmental protection means that the negative impacts on marine habitats may not be adequately addressed (Wilen et al., 2012).

Another argument against ITQs is the lack of fairness inherent in the exclusion of some fishers in the initial allocations and in failing to distribute the wealth fairly to the original participants (Wilen, Cancino, & Uchida, 2012). Social goals are fundamental motivations for TURF establishment; for example, the communities benefit from sustainable fisheries, especially those whose livelihoods heavily depend on fishing. TURFs provide stabilized incomes for communities, creating more job opportunities and marketing power for their products.

Beyond fishing, there are other uses of the marine environment, such as mining, conservation, tourism, and recreational fishing. Fishing often conflicts with these alternative uses, and resources should be allocated equitably to maximize the total benefits from other uses. ITQs are very limited in terms of their property rights and only control fishing activity; therefore, they cannot play a part in the allocation of other marine uses. Limiting the user discussion to fishing, the conflict between commercial and recreational fishers can be solved by putting those two activities under one ITQ system. This is logical as the same biomass is subject to extraction in both cases. Nonetheless, monitoring and enforcement might be more difficult for recreational fishing (Arnason,2012).

Over time, ITQ regimes have had many supporters as well as detractors.

4.2.2. CO-Management, Harvester Cooperatives (CO-OPS)

Property rights have recently attracted attention, primarily because assigning individual rights helps align fishers' incentives with management objectives. When fishers benefit personally, they are more likely to resolve fisheries problems that the government might otherwise resolve. Assigning rights to a well-defined group is a form of RBFM and attracts less attention than other RBFM types, such as ITQs and TURFs. Appointing rights to groups rather than individuals promotes coordination and collective action (Deacon, 2012). Fishery cooperatives existed historically to manage fisheries, and in developed countries, they formed to gain market advantage and lobby the industry's interest to govern fishers. This type of co-op (only to gain market power) is excluded in this section. Herein the harvester/fishery cooperative is used to describe parallels to Deacon's definition. An association is formed by fishermen to engage in fisheries management collectively, even though it does not satisfy the legal requirements of a co-op (Deacon, 2012).

Recent evidence suggests that co-management has more significant potential to promote sustainable fisheries (Nguyen, 2019). It is essential to understand that fishery co-management may be a better scheme because it is commonly used. It may be a feasible option for many developing countries where the government is incapable of centralized control, and market infrastructures are inadequate to adopt market-based solutions such as quotas (Hart, 2004). Deacon (2012) describes cooperative behaviors by the economic theory of the firms that the co-op is formed like a hierarchical firm with top management who makes decisions. Fishers give away their rights to the firm on how the effort will be deployed, and in return, they will get the benefits of collective action that the cooperative gained. When the economic gain goes to the users who make management decisions, the incentive to maximize resource use is at its highest

(Deacon, 2012). The firm's owner decides how the resources will be assigned, and in return, all the profits generated go back. This relationship between the coop and its members is similar to that between the firms and their workers. For instance, if the government is corrupt, assigning enforcement to the government might have resulted in bribery and ineffective enforcement; therefore, giving policing tasks to users might be much more effective (Deacon & Ovando, 2013). In a self-enforcement situation, coordination costs are relatively low, and the facilitation of fisheries management activities is more manageable due to the information flowing from bottom to top (Deacon, 2012).

Coordinating members’ fishing activities helps maximize short- and long-term benefits, such as optimal economic return or sustainable fish stocks and effective compliance. Often cooperatives are formed by fishers who have things in common, such as being from the same community, same fishing area, gear type, or same target species. Sharing the same goal among members is the key feature of a successful cooperative (Poon et al., 2013).

The primary function of a Cooperative is to coordinate members' fishing activities to ensure compliance with their collective quota and to maximize benefits—both in the short term (e.g., optimizing economic return) and in the long term (e.g., ensuring healthy fish stocks for future fishing opportunities) (Poon et al., 2013).

Cooperatives have many benefits when they are well-designed:

- Enhanced stewardship (Deacon, 2012)
- Contentment of management responsibilities such as enforcement or monitoring (D. A. Ovando et al., 2013)
- Increased market power (Deacon, 2012)

- Reduced risk of overharvesting and more minor financial losses from it (D. A. Ovando et al., 2013)
- Avoiding gear conflicts and more effective spatial distribution of effort (D. A. Ovando et al., 2013)

Cooperatives are a type of co-management, an arrangement in which government and users share management responsibilities to a certain extent. Governments can set performance standards whereby users can realize basic management activities to comply with those standards. Decisions can be made by fishery managers, cooperatives, or collectively depending on the institutional agreement between parties.

Many different management structures exist, but the general pattern in cooperative management may be as follows: the government decides total allowable catch, harvester's co-op decides what gears will be used to harvest the fish, and the members of the co-op determine how and where the effort is distributed (R. T. Deacon & Ovando, 2013).

Because fishers work together collectively, it is easier to self-impose rules, use innovative techniques, collect and share data; therefore, it might be an efficient tool to achieve biological targets and reduce bycatch or discards. For instance, fishers share information on non-targeted species' locations to reduce bycatch in some cooperatives (De Alessi et al., 2014).

Cooperatives efficiently provide economic stability for fishers by coordinating harvest timing to catch the most valuable fish, providing optimal timing for product delivery when the market is more favorable, increasing product quality by decreasing race to fish and through better handling and obtaining higher market value certifications. The costs can be reduced within cooperatives by purchasing bulk quantities, sharing information on harvest locations, and sharing equipment or infrastructure (Poon et al., 2013).

Co-management can be used with other property regimes, such as shared or private property. For example, in Japan, co-management is being used with TURFs (Matsuda et al., 2010), in New Zealand with ITQs (Yandle, 2003) and in Vietnam with open-access fisheries (Lai, 2008).

4.3. TURFs in conjunction with other systems

After looking at crucial design elements that lead to the success of TURFs, and other property rights systems, it is essential to analyze situations where TURFs alone are not efficient:

1- TURFs are not sufficient for addressing transboundary stocks, as sustainable management of the stocks depends heavily on the larval dispersal and the TURF's spatial scale. As it is impossible to control the fish's movement, this mobility problem can lead to race-to-fish behavior among fishers. As discussed earlier, alternative solutions are suggested to overcome this problem, such as increasing TURF size, creating a network of TURFs, setting output controls such as TACs for each TURF in a network, and applying full coordination (Ovando et al., 2017).

2- Profit maximization and optimal harvest are the attributes of the traditional economic gain within TURFs; therefore, coordination is crucial to prevent competitive fishing (Ovando et al., 2017; Uchida, 2007).

Cinner (2005) stated that TURF performance would be improved if the fishers relied on fishing for their livelihoods. Fishers are likely to be more responsible for protecting the resources that they depend on heavily (Jentoft et al., 1998). Fishers' expectations and attitudes toward TURFs are also significant predictors of TURF effectiveness. In Chile, for example, fishers see TURF as a successful compliance, regulation, and authorization system, which means that TURFs seem to have the ability to grow and function efficiently (Gelcich et al., 2008).

Gelcich et al. (2005) stated that some studies had grouped fishers into three categories based on their attitudes toward TURFs: livelihood advocates, commodity conservationists, and environmentalists. Furthermore, their various attitudes influence their responses to the TURF system and thus its performance (Gelcich et al., 2007; Gelcich et al., 2008; Nguyen, 2019). The robust social capital built by the networks between fishery managers and fishers will also contribute to the performance of the TURFs. For instance, if fishers themselves view depletion of fisheries resources as an issue and recognize the adverse effects of non-cooperation with local government, social norms of engagement in fisheries management will be improved. Even though social capital will affect the effectiveness of TURFs, the research that exists is limited to only the effects of social capital on fisher's income. However, it is essential to study further the social networks and norms' impact on social, biological, and economic outcomes of TURFs, such as level of engagement, fish prices, and stock abundance. Another critical factor to consider in building social capital is stakeholder trust (Nguyen, 2019).

4.3.1.TURFs with Co-Management

Although we have been increasingly aware of the catalytic function of co-management, particularly for the success of TURF systems (Gutiérrez et al., 2011; Poon & Bonzon, 2013) and fishing management in general, very few attempts have been made to research the implications of co-management in TURFs. Fishers expect TURFs with a co-management regime to outperform non-co-management regimes, as identified in the study exploring the effects of fishers' involvement in TURF’s success (Uchida et al., 2012). However, this does not indicate that a co-management framework is always advantageous. Moreover, where policymakers are prepared to devolve powers to fishers, it might mean that fishers would be unable to successfully perform their management duties due to the poorly structured fishing community or a lack of expertise and management capability (Chen, 2012; Nguyen Thi Quynh, 2019).

The factors that influence the effectiveness of co-management within TURFs are (Jentoft & McCay, 1995; McCay et al., 2014):

- Transparency in decision-making and leadership
- Number of fishers involved in co-management
- The spatial scale of TURF
- Well-defined TURF boundaries
- Stakeholder involvement
- Sense of Community
- Enforcement

Furthermore, there may be instances where governments refuse to delegate control of fisheries management to local communities, although they are expected to do so. The responsibility for implementing regulations is assigned to fishing communities, but often they do not have the authority to make the regulations. To put it another way, governments assign responsibility to fishers only for applying management rules provided by them, not for directly managing fisheries' sustainability. From the standpoint of political economy, devolution without power can be viewed as an attempt by governments to retain control over resources while lowering management costs. However, no relevant research has been conducted on devolution effects without power on TURFs' success (Nguyen Thi Quynh, 2019).

The benefits of coordination are more apparent when the status quo is an open-access fishery. However, the difference is more subtle when an ITQ system is already in place. ITQs can achieve success without coordination if the economic value is homogeneous for all the stocks.

Nevertheless, if there are heterogeneities, a race to fish to get the most valuable fish is more likely. The causes of the stocks' economic variation could be from the variation of the stocks' proximity to the production facilities or ports, variation in spatial density of the stock, and environmental variations that affect the costs and variations in market conditions (Robert T Deacon, 2012).

Cooperatives can be set up within other regulatory systems. License owners in limited entry fisheries can form co-ops, or ITQ holders can form co-ops to gain coordination benefits without sacrificing the economic gains, or co-ops can be established within TURFs. In New Zealand's southern scallop fishery, 38 quota holders formed a cooperative called "The Challenger Scallop Enhancement Company" (CSEC) that manages most of the fishery functions. For instance, CSEC spatially distributes efforts, reseeds depleted patches after harvests, and keeps the catches below the government requirement while continuously investing in research and stock enhancement. Another well-known example of the ITQ-cooperative management scheme is New Zealand's Abalone fishery. Management Action Committees (MACs) are formed in this fishery to coordinate the effort spatially. MACs more strictly determine size limits than that required by government regulations and train divers to reduce unwanted fishing mortality. FEDECOOP is an umbrella organization formed by nine coops that target abalone, lobster, and other species on the west coast of Baja, California (Mexico) and is an example of cooperatives established within TURFs. Each cooperative has access rights to a specified area along the coastline. The FEDECOOP manages the enforcement, effort, and catch. As the lobster fishery returns multi-million dollars every year, it is safe to say that FEDECOOP is economically prosperous (R. T. Deacon & Ovando, 2013).

To achieve maximum benefits provided by TURF systems, the stocks in these TURFs must be well managed. To avoid rent dissipation and overexploitation, allocating rights to a group is necessary but not 100 % efficient. The internal race-to-fish mentality will continue within the closed group unless the quotas are distributed to individual fishers. In this case, however, TURFs must manage individual internal allocation by internal coordination and enforcement. It is safe to state that ITQs and TURFs are contrasting systems as TURFs include coordinated and collective decision-making while ITQs are assigned to individuals. There are different formulas to integrate ITQs within TURF systems, from leasing out allocations and collection rents to control fishers' behaviour to reach spatial goals and fishery efficiencies (Cancino et al., 2007). In Chile, annual stock assessments to establish harvest levels are conducted by the fishery association and allocated to members (Cancino, Jose, Hirotsugu Uchida, 2017). In Washington State, wild geoduck clam harvest levels are determined by annual surveys with tribes and fishery managers' joint efforts. The state then determines yearly quotas based on these surveys (Costello, 2012). Similarly, the red abalone fishery in California is managed by a harvester cooperative, and the coop then allocates ITQs to its members (Cancino et al., 2017).

4.3.2. TURFs with ITQs

Stewardship and resource conservation are more efficient in cooperatives than with ITQs. Even though ITQs are well-known for motivating fishers into long-term sustainability, still in ITQ systems, there is a race-to-fish problem as few individual harvesters would sacrifice today for the long-term sustainability of the stocks for the future. Whereas harvester cooperatives often invest in research on conservation, invest in habitat protection, and set "no-take "zones to protect spawning and breeding grounds (Deacon, 2012).

Another shortcoming of the ITQ system is that ITQs are mostly granted to single-species fisheries; therefore, they fail to consider species' interactions. Cancino and Uchida (2017) argue that, in practice, it is almost impossible to address prey/predator linkages in ITQs. For example, collectively investing in ecosystem health or habitat protection might be attractive to the ITQ holders but very hard to initiate. On the TURFs side, many Chilean MEAs have strategies to sustain the ecosystem, such as self-imposed closed seasons.

4.3.3. TURFs and Marine Reserves (No Take Zones)

Undoubtedly, the abundance, size, and biodiversity of species (Halpern, 2003), productivity (Palumbi, 2004), and ecological resistance to natural disturbances and climate change (Grafton, 2005) increase inside no-take zones. No-take zones also have the benefit of creating alternative income through tourism (Afflerbach et al., 2014). There are apparent advantages to integrating marine reserves alongside TURFs as many communities benefit from new revenue streams and climate change adaptation (Salas et al., 2007; Villaseñor-Derbez et al., 2019). Additionally, the potential use of marine reserves as a tool for fisheries management indicates another possible reason for introducing no-take zones alongside TURFs (Viana et al., 2019). Marine reserves have been shown to improve local fisheries through larval dispersal and adult spillover of targeted species (Afflerbach et al., 2014). If the fishermen do not have exclusive ownership of the surplus from spillovers, they will not have the full economic benefits. Also, marine reserve effectiveness will be limited without the compliance of fishers and sufficient enforcement (Halpern et al., 2009)(Costello & Kaffine, 2010). That is why some additional management applications, such as exclusive fishing rights through TURFs, are needed in conjunction with marine reserves to improve small-scale fisheries` sustainability (Afflerbach et al., 2014). The potential benefits of combining TURFs with marine reserves to create ‘‘TURF reserves" are becoming more commonly acknowledged (Costello & Kaffine, 2010). Although numerous types of TURF reserves have been introduced worldwide, there is currently no systematic assessment of TURF reserves as a combined strategy of fisheries management and marine conservation (Afflerbach et al., 2014).

Afflerbach et al. (2014), in their study “A global survey of "TURF-reserves," Territorial Use Rights for Fisheries coupled with marine reserves,” collected and synthesized existing knowledge on TURF reserves and provided a preliminary overview of TURF-reserve characteristics through an extensive literature review to understand better the environments and conditions under which they occur. In that study, they determined whether the TURF and marine reserve were usually created concurrently or whether one aspect was more commonly created before the other. Then, to better understand the resource characteristics of TURF reserves, they looked at the species that TURF reserves most frequently cover. Since those species` home range is more likely to be within the delineated TURF, species with restricted mobility, such as benthic or sedentary species, can be handled more effectively by TURFs than more mobile species. Migratory species, such as pelagic finfish that migrate outside of established TURF boundaries, can face threats beyond TURF managers` control, posing a challenge to effective TURF management.

Furthermore, species that grow faster may be better suited for TURF-reserve adoption because fast-growing species allow local fishers to see the advantages of a TURF reserve sooner, which keeps fishers motivated to continue this system. Afflerbach et al. (2014) That is why Afflerbach and his friends hypothesize that species with restricted mobility and high growth rates will succeed more in TURF reserves. Moreover, Afflerbach et al. (2014) conducted a study to explore the involvement of different institutions in establishing TURF reserves. They examined whether these reserves were formed organically within the local community or if external entities like NGOs or governmental bodies significantly influenced their creation. The findings of their research were as follows:

- The majority (85 percent) of sites established the TURF and reserve components sequentially, with 66 percent of all areas initiating the TURF first. The communities are more motivated to sustainably use those resources and implement conservation measures, such as establishing a marine reserve when given property rights.

-The design of examined TURF reserves varied greatly, from prohibiting one species with seasonal marine reserves to managing all species with permanent no-take reserves.

- No evidence is found to support the initial hypothesis that fast-growing and low-mobility species would be favoured for adoption and management under TURF reserves.

- Environmental NGOs that provide technical advice to local communities are deeply involved in both TURF reserves surveyed in Fiji. The presence of numerous foreign organizations is not limited to tropical Pacific TURF reserves; for almost every location in the Philippines, Mexico, Brazil, Spain, and Belize, NGOs participated in the TURF-reserve establishment (Auriemma et al., 2014).

Since there are other ways for a TURF to achieve fisheries and conservation benefits, marine reserves are not always needed. Stock enhancement, complex spatial rotation systems, and targeting seeding efforts that help conserve fragile ecosystems are other ways to achieve similar benefits to those realized by TURF reserves (Auriemma et al., 2014). The costs related to TURF reserves, such as coordination, monitoring, and enforcement, may be higher than the benefits they may bring (Auriemma et al., 2014).

Some TURFs are established within Marine Protected Areas (MPAs). By doing so, fishers will benefit from a larger ecological area (spillovers from no-take zone to TURF area), and as they profit from the MPA, they will preserve it in return (Costello & Kaffine, 2010). However, setting no-take zones with TURFs does not guarantee the success of TURFs (Auriemma et al., 2014).

4.4. SOME TURF EXAMPLES AROUND THE WORLD

4.4.1. Japan

Japanese fisheries management has two institutions: the first one is "fishing rights," which refers to TURFs, and the second one is Fishery Management Organizations. TURFs have been implemented in Japan's coastal fisheries for the last 400 years (originated from the feudal era) and evolved in a bottom-up way (H. Uchida, 2003). Japanese TURFs are administrated and controlled by Fishery Cooperative Associations (FCAs) (H. Uchida, 2003). FCAs are, technically, harvester cooperatives, and their members are either individual fishers or small companies. The FCAs manage the TURF, while the Japanese government grants access (H. Uchida, 2003). So, the TURFs are only granted to FCAs, not individual fishers. FCAs are divided into Fishery Management Organizations (FMOs), the majority of them managed by FCAs, sub-division of FCAs, or other organizations affiliated with FCAs-to manage single-species fisheries within the more significant TURF (H. Uchida, 2003). FMOs are autonomous organizations carrying out co-management for the coastal fisheries of Japan. They are a group of fishers who conduct fishing operations collectively in the same fishery; FMOs manage migratory and sedentary species and cover almost all gear types, from bottom trawls to diving (H. Uchida, 2003).

The Japanese federal government legally operates the TURF management system. It specifies the total allowable catch, minimum size limits, duration of the season, gear prohibitions, and restrictions. Every year, the federal government sets seven annual catch limits for seven species, with individual FCAs and FMOs having the right to set their catch limits. According to the characteristics of fish species and types of fisheries, the traditional fishing right is enforced in Japan by a resource management mechanism that involves input, output, and technical control under the public regulations and fishers' voluntary resource management framework. Prefectural governors issue fishery rights licenses to FCAs; zones of fishing and fishing methods are written on those licenses (Wandira Ayu Bertin, 2017).

Most of the FMOs rotate the access to the fishing grounds to mitigate insufficient allocation of effort over space. Also, some FMOs merge or collaborate with the adjacent FMOs to coordinate the spatial fishing effort. Another advantage is that self-enforcement naturally occurs based on peer pressure both in FMOs and MEAs. Even some FMOs have sanction procedures against violators and may punish them by reducing their distribution shares (Cancino et al., 2017).

The physical boundaries of FMOs are decided according to the TURF area, and often existing TURFs are used because of the cost-efficiency of implementing co-management. However, using TURF boundaries does not always align with the migration patterns of transboundary species such as yellowtail and pollock. FMA manages multiple FCAs to expand management over the targeted species' spatial scale to solve this problem. To become a member of an FMA, one should already be a member of the FCA (H. Uchida, 2003).

Exclusivity is cultivated by FCA members monitoring violators and poachers. Most TURFs are placed along the coastline and next to fishing communities; it is not a highly complex task. However, controlling memberships is harder because Japanese Fishery Cooperative Law prevents FCAs from refusing membership applications without a legitimate reason or applying more demanding conditions. Still, at the same time, to be eligible to become a member, the fisherman must work in the local fishery for a minimum of 90 days. As a person cannot fish without being a member, to achieve their minimum days of practice, that fisherman must be hired as a crew by a member. Hiring someone is purely the fishermen's decision; therefore, they may refuse to hire new people if they think there are enough members. Also, transferring membership is limited to the same conditions; for a non-member to receive a transfer, he must meet the same prerequisites to become a new member. Furthermore, if the transfer is through inheritance, it requires FCA approval. TURFs are property rights granted to FCAs, not individual members; therefore, they cannot be transferred as FCA membership is a status, not a property right (H. Uchida, 2003).

4.4.2. Chile

With a total nautical area of 3,150,739 square kilometers, Chile is one of the world's ten most important fishing countries (Wandira et al., 2017). In 1991 Chile adopted Management and Exploitation Areas for Benthic Resources (AMERB), aka Management areas (MA), to prevent overexploitation of benthic resources such as seaweeds, loco, sea squirt (piure), sea urchin (erizo), machas clam, key-hole limpets (Bonzon et al., 2010) AMERBs are technically TURFs, given to fisher associations by request and application. There were 726 TURFs in Chile, with 31,497 members in 2010 (Ueyonahara, 2012)**.** The TURF systems in Chile cover approximately 2500 miles, but it is necessary to point out that some areas are not operated through them (Wandira Ayu Bertin, 2017). With 86,132 artisanal fishers in 2012, it is safe to conclude that artisanal fisheries are an essential livelihood source for Chilean coastal communities.

Abalone fishery ("el loco" or "loco") is one of the most important fisheries, but the decline in fishing since the 1970s caused two years of full closure in the 1990s. In 1991, the General Fisheries and Aquaculture Law (GFAA) was created. The law obliged fishers to harvest loco in a single location (TURFs). Nevertheless, some scholars think that fisher associations were not given access to management areas until the Regulation on Areas for the Management Undersecretary of Fisheries started to encourage the most optimum harvest area in every port in 1995 (Schumann, 2007).

Chilean fisheries are managed by the Economy, Development, and Tourism Ministry. Fisheries management is a co-management system between the government and fisher associations (Schumann, 2007). There is a long-standing access-rights management system established for the sustainable harvest of benthic resources. A non-formal, voluntary agreement exists for the informal sharing of the total allowable catch among regional associations focused on specific benthic species, involving collaboration between fishers and scientists. Later in 1991, this unofficial, voluntary application was formalized with The Benthic Exploitation Regime (Wandira Ayu Bertin, 2017).

The TURFs in Chile are based on a precautionary approach (Fernandez, 2017). In the face of limited data and uncertainty, a precautionary approach is used to manage risks. It is a very conservative fisheries management approach. The GFAA established a national registry for artisanal fisheries based on species. A fishing organization is typically required to submit an initial baseline study that includes stock assessments, a detailed map of the area, and a secondary species profile, of the claimed site before the TURF application (Ueyonahara, 2012). Independent consultants do baseline assessments and yearly follow-up studies, such as the abundance of target species, annual reports, and management plans. The undersecretary of

Fisheries grants the TURF after receiving the recommendation. The government grants rights to fishery organizations then the organization manages TURFs among its members. They decide internal rules such as entering and exiting, harvesting methods, revenue sharing, social funds, and welfare systems (Gallardo Fernández & Friman, 2011; González et al., 2006; Ueyonahara, 2012). So the overall design of TURFs is catch share co-management (Wandira Ayu Bertin, 2017). The small-scale fisheries have become an essential stakeholder in Chilean Fisheries, where they contribute to management after introducing the MA system (Fernandez, 2017).

The central government determines the requirements of the TURFs for fisher associations and is obliged to comply with those regulations. The government also specifies rules for memberships, such as only licensed fishers can become a TURF member even though they give secure access to groups rather than individuals. Also, fishers cannot become a member of more than one TURF cooperative. Fishing organizations can create additional rules regarding the operations in their TURF area (Bonzon et al., 2010). Chilean TURFs are not transferrable among fisher associations (Schumann, 2007). Furthermore, fishing organizations are obliged to pay annual taxes, and if found not complying with tax requirements, the privileges of MAs can be terminated. Fisher organizations cannot reapply for three years if the MA is terminated (Ueyonahara, 2012).

Despite many challenges, the overall perception of fishers, scientists, legal authorities, and fishers' associations of MAs is primarily favourable (Ueyonahara, 2012). As the TURF system's implementation gives the incentive to protect resources, the stocks are stable in MAs (González et al., 2006). Illegal fishing and poaching continue inside and outside TURF areas; therefore, the depletion of the fish stocks in open access areas might affect the species abundance in MAs in the long term (Gallardo Fernández & Friman, 2011). However, others did not like MAs because of various shortcomings such as infrastructure or access problems and lack of resources, but they still chose to keep their MAs because of the attachment behaviour of fishers (J. Aburto et al., 2013). Fishers who are confined to an exclusive and fixed area with no ability to move are attempting to widen their economic activities to boost the income provided by their daily fishing activities, such as the introduction of services in restaurants and tourism, despite the difficulties and challenges they encountered.

As the seafood extracted from MAs is mainly exported, the earnings significantly depend on international market conditions. Prices have trended lower since the 2000s, yet the cost of operating MAs is considered to be relatively high (Gallardo et al., 2011; Ueyonahara, 2012). TURFs originated and succeeded in central Chile. This model was then copied to other areas along the coastline. However, this one-size-fits-all approach was not suitable for other areas. Local characteristics such as traditional customs, accessibility to the fishing ground, and resource availability vary greatly. For instance, some areas were more abundant in biological resources than others; therefore, some MAs had a significant advantage over others (Ueyonahara, 2012). Traditionally, the harvesting method for benthic resources was diving. With the implementation of TURFs, any fishing organization is applying for it without considering if they are members or if the members live in the area. As a result, many non-divers can harvest benthic resources, and traditional divers are forced to share (J. Aburto et al., 2013).

Nonetheless, each fishing association in Chile is unique; some are prosperous, while others are struggling. Although the government initially narrowed the use of TURFs to harvesting declared resources, extra activities such as fishing or harvesting other resources, aquaculture practice, and even business services such as tourism and catering seem to be permitted and encouraged. Some of these actions occur within the fishing organizations' permitted zones, while others occur outside the TURFs. MAs seem to be changing from fishing-oriented to diversified economic activities.

4.4.3. Mexico

Fishing is essential to the local economy in many parts of Mexico, as most fisherfolks live in isolated, small coastal communities. In 2001, there were 268,727 people employed in the fishing industry, and there were 100K registered fishers. Although fisheries contribute only a small portion of Mexico's GDP (0.8%), more than a million people's livelihoods depend on Mexico's fisheries (Food and Agriculture Organisation, 2014).

The federal government makes administrative and operational decisions that have severe consequences for cooperatives and local fisheries. The research division of National Fisheries Agencies (CRIP) conducts scientific monitoring with the collaboration of cooperatives. TURF systems were designed originally for Baja spiny lobster, though other species such as abalone, sea cucumber, and turban snail, have been introduced over time (Cunningham, 2013). In 1992, the Mexican government established nine TURFs along the remote west coast of Baja California. Additionally, in 2000, another TURF was established further south, currently managed by 13 cooperatives representing ten villages in the area. Because these villages rely heavily on fisheries and active collaboration in maintaining the TURFs, a federation dedicated to fisheries management in Mexico, the Regional Federation of Fishing Industry Cooperatives of Baja California (FEDECOOP), was established (Cunningham, 2013). FEDECOOP manages the TURF system jointly with the National Fisheries Science Institute (INAPESCA) and National Commission on Aquaculture and Fisheries (CONAPESCA). FEDECOOP`s function is coordinating cooperatives across TURFs, lobbying for cooperatives' benefits, and coordinating market activities (Cunningham, 2013).

Even though the federal government has supreme decision-making authority, cooperative entities have considerable autonomy and self-regulation in managing natural resources and fisheries; that is why Mexican cooperatives can be considered to have both co-managed and self-managed governance systems (McCay et al., 2014).

The government of Mexico gives rights to groups under the TURF scheme. Fisheries cooperatives typically formed by fishing communities are expected to pay a fee each year to renew their membership, and then each coop decides on member fees within the co-op. Fishers are obliged to have a valid fishing permit issued by Mexico's National Aquaculture and Fishing Commission (CONAPESCA). Furthermore, cooperatives can determine the number of licences, allocate them to members, and establish access laws, requirements, and eligibility criteria. Fishers can come together and form a new cooperative and join FEDECOOP. Then FEDECOOP decides if the application complies with the related law and votes to accept new group members at their annual general meeting. When they became members, cooperatives generally had fishing privileges for twenty years. After CONAPESCA determines the permitted fishing efforts for each cooperative, the cooperative then distributes these efforts among its members. (Cunningham, 2013).

Moreover, cooperatives can be similar or different in terms of leadership, administration, and bylaws. Cooperatives monitor, record, and enforce fishing and landing activities. Enforcement also includes surveillance of marine reserves against illegal fishing (Cunningham, 2013).

The FEDECOOP TURF represents a management approach for small-scale fisheries. The cooperatives achieve their biological objectives by adhering to effort and catch limits for valuable species within their respective TURFs and enhancing coordination on shared stocks across multiple TURFs. This collective effort contributes to the overall success of the system. In recognition of its accomplishments, the catch share program has received certification from the Marine Stewardship Council (MSC) as a sustainable initiative (Cunningham, 2013).

The adaptive co-management framework has permitted FEDECOOP Cooperatives to evolve and enhance program efficiency over time. Many cooperatives voluntarily established Some no-take zones to increase larval production and stock density (McCay et al., 2014).

Some indigenous groups, such as the Seri Exclusive Fishing Zone, are receiving fishing concessions. In these cases, the benefit is given to society in due course (perpetuity). As indigenous peoples have little potential for enforcing TURF boundaries, there is also dispute and illegal fishing by fishers in the adjacent fishing grounds. In 2005, 27% of the total catch of Abalone was illegal and worth approximately US$5 million (Cunningham, 2013).

Generally speaking, FEDECOOP is an excellent example of small-scale fisheries management through TURFs. It maintains a flexible co-management structure used to resolve current and future challenges.

5. CONCLUSION

Despite all the efforts put into fisheries management globally, marine fishery resources are increasingly being overexploited (FAO, 2018). Even though some management regimes have demonstrated success, conventional top-down management schemes have proven ineffective in small-scale fisheries given their heterogeneity in targeted species, gears and fleet as well as a large number of participants, seasonality and spatial distribution (Auriemma et al., 2014). Yet, the importance of small-scale fisheries cannot be overstated, as they account for almost half of worldwide catches and provide livelihoods for millions of people globally (FAO, 2018).

New management models in which users participate in governance have been adopted in different parts of the world, as the implementation of traditional management schemes has not shown great success in recent decades (Romero & Melo, 2021). In recent years, Right Based Fisheries Management (RBFM) has gained substantial popularity due to its strength in bringing incentives to protect the resources and maximize the benefits for future gains by giving exclusive rights of exploitation to fishers while excluding unauthorized users (Wilen et al., 2012). As discussed earlier, there are three main schemes in RBFM:

ITQs (Individual Transferable Quotas): Individuals are given the right to harvest a share of a biologically determined annual catch (species-specific), and it is known for economic efficiency (Yagi et al., 2012). However, their application in multi-gear, multi-species fisheries is not easy (Cancino et al., 2017).

COOPs (Cooperatives): Rights are given to a specific group of actors allowing them to participate in certain aspects of fishery management (Ovando et al., 2013).

TURFs (Territorial Use Right Fisheries): In TURFs, exclusive rights are assigned for the resources of a clearly defined spatial area.

Despite varying levels of government engagement, TURFs are frequently regulated in line with local demands, allowing managers and community members to design site-specific laws based on local knowledge and practices. TURFs have grown in popularity as a management technique, and fisheries management benefits from TURFs because they prevent overexploitation by eliminating the "race to fish" and its effects, such as economic losses and dissipation of income. In other words, TURFs inspire fishers to manage their fisheries more sustainably than conventional tools. When fishers have access to a physical resource without competition, their incentives change immediately because they are no longer competing with each other to catch it. In contrast, they focus on getting the most value for their catch. It is based on the premise that people who feel safe are likely to save and spend more than when they feel less safe. Safer and less vulnerable fishers are more likely to contribute to the sustainability of fish stocks, thus resulting in a more effective and motivated fisheries management process under participatory or rights-based circumstances (Bromley, 2016).

Therefore TURF-based management is becoming an essential institutional option, as it is successful in conserving a variety of marine resources, such as fish stocks in Vietnam (Armitage et al., 2011), shrimp stocks in Japan (E. Uchida et al., 2012), and benthic fisheries in (Chile Villela, 2013). Evidence suggests that allocating TURFs benefits fishermen economically by reducing the "race-to-fish" crisis, restoring biological productivity of stocks, increasing yields, lowering resource extraction costs, and increasing bargaining power (Villela, 2013). As a result, fishers have an opportunity to stop overfishing because they can now reap the benefits of sustainable management. However, theoretical assumptions regarding economic, social, and biological impacts do not always match empirical findings (Nguyen Thi Quynh et al., 2017).

TURFs occasionally fail to meet fisheries management goals, casting doubt on the regime's efficacy (Armitage et al., 2011).

It is reasonable to assume that the effectiveness of TURFs as a governance mechanism depends on the historical, institutional, and social context of a given location. The institutional dimension of TURFs is also contingent on the ingenuity of those involved in designing and implementing this governance structure and everyone's willingness to share power and expertise. Fishers should be motivated as proud members of their societies and profession to participate fully in the process. In particular, where conventional and customary use rights are already in place, TURF systems may be more likely to succeed in managing small-scale fisheries (Wandira et al., 2017). Chile and Mexico can also be considered efficient in TURF systems however, there are still controversies when fishers bear the brunt of management costs or when fisher-scientist mistrust flares up. In Chile, for example, the most common traditional area of use is the one established by long-standing local harvester cooperatives that are considered the most successful (Anderson et al., 2011).

A TURF's effective implementation requires a robust governance strategy that encourages and empowers various stakeholders, such as individual fishers and fisheries associations. One might argue that consolidating existing fisheries organizations is more likely to be beneficial than establishing new ones. Another essential element is collecting fisher`s knowledge and involving them in the data collection, design, and implementation processes. The evidence has pointed out that the efficacy of co-management regimes associated with TURFs appears to be influenced by the number of stakeholders involved, the size of co-management, the spatial scale of TURFs, the productivity of resources, the openness of decision-making processes, compliance, and leadership (Jentoft & McCay, 1995). TURFs can facilitate cooperation by leveraging stakeholders' mutual engagement and decision-making processes, as Ostrom`s (1990) paper mentions. He claimed the effectiveness of collective governance structures, which is analogous to well-functioning TURF systems. But then, assigning rights to a group incurs internal coordination costs that result in collective-good externalities. Sufficient internal governance is necessary to address these externalities. Internal governance can come from either top-down or bottom-up methods, although bottom-up management is seen to be more effective in establishing self-governance standards that match local requirements and promote local buy-in. As a result, emerging countries with weak top-down governance may be more inclined to accept TURF development (Wilen et al., 2012). There are also a variety of traditional biological and economic criteria used to characterize successful fisheries, in addition to the social metrics connected with cooperative management. For example, fisheries are frequently regarded to be biologically or ecologically successful if management can prevent overfishing, prevent or limit bycatch, allow stock recovery, or maintain key habitats (Poon et al., 2013).

TURFs are generally acknowledged as powerful methods for managing immobile species (Auriemma et al., 2014; Christy, T Francis, n.d.). For immobile species, restricting the movement of adult fish outside the designated fishing areas can be part of a fisheries management strategy within the framework of territorial use rights for fisheries (TURFs), allowing fishermen to internalize the long-term benefits associated with sustainable fishing. TURF is particularly well suited for stocks containing "small micro stocks" that allow fishermen to accurately track the impact of fishing on the stocks within the TURF and internalize most of the long-term benefits of conservation (Poon & Bonzon, 2013). Despite some evidence to the contrary (J. A. Aburto et al., 2014), some think that TURFs can also be successful for migratory species (Poon & Bonzon, 2013). However, there is a lack of evidence on the conditions under which TURFs can perform optimally for mobile species. Sufficient and adequate knowledge is essential for establishing a functional framework such as TURFs involving ecological and social systems.

This paper argues that collective space-based access rights, TURFs, seem to be feasible alternatives or even supplements to species-based ITQs because TURFs provide opportunities for addressing interspecies conflicts (prey/predator), as well as profits from spatial and temporal uses of resources. The success is primarily based on the TURF`s governance system that reasonably, cost-efficiently, and effectively coordinates fishing activities. However, TURFs alone may not achieve better fishery management. Considering all constraints and comparing TURFs to other current fisheries management systems (e.g., ITQs, ecosystem-based approach, group quotas, co-management), it would not be a mistake to assume that TURFs, as a management mechanism and an institution of fisheries governance, can contribute to the sustainably of certain fisheries. TURFs provide spatial allocation of fishing efforts, self-monitoring, enforcement, multispecies management, habitat enhancement, marketing coordination, and developing other ecosystem services such as tourism. It is important to note that while TURFs offer several potential advantages, no single management system is universally superior. The success of TURFs, as with any fisheries management approach, depends on various factors such as effective governance, scientific understanding, and community involvement. The specific characteristics of the fishery, including the target species, ecosystem dynamics, and socioeconomic factors, should be carefully considered when determining the most suitable management approach.

While increased economic rent, job growth and cost reductions are all common economic objectives, the intricacy of elements impacting TURF management may lead to contradictory definitions of success. A TURF, for example, may result in significant increases in fish populations and environmental health, but communities may suffer from inequitable rights distribution, resulting in harmful social disputes (Poon & Bonzon, 2013). The success of a TURF, or any fishery for that matter, is inextricably linked to the objectives connected with that specific fishery. TURFs are commonly thought to be intended to achieve fishery objectives; however, this is not always the case. Users may seek to maximize net economic revenue in some circumstances, while others may seek to achieve social goals such as increasing job possibilities (Christy, 1982). The objectives of TURF management are diverse and include fisheries, environmental, economic, and social.

Overall, TURFs alone may not improve fisheries management as fishers could continue to race-to-fish and compete within the TURF. Some Japanese coastal catch fisheries, primarily governed by TURFs, continue to struggle to maintain viable fish stocks and profit margins (H. Uchida, 2017). White and Costello (2011) demonstrated that without a TURF that is large enough to cover the entire larval, dispersal, and migration area or cooperation or strategic behaviors among TURFs (and within them, fishery cooperatives), overharvesting and reduced stock size would result (White & Costello, 2011). If the TURF system is used in conjunction with collective action, the effectiveness of this collective action determines the success of TURFs. The ultimate aim is financial gain and the ecological recovery of fish populations and the surrounding environment. The problem is that these changes and benefits can take a long time to manifest and are inherently unpredictable. First, the idea is to concentrate on the financial return of new fisheries management through TURFs and fishery cooperatives to persuade the most cynical and unwilling fishermen and stimulate them to continue to respect the new system. With its own TURF, multiple-fishery cooperatives will work together to produce enough benefits from the alliance. When fishers start to realize financial gains, it will become apparent that improved fish stock and ecosystem health will also support them financially. They will then be motivated to adopt environmentally sustainable fishing practices.

One must concede that world fisheries are ecologically, economically, and socially varied, and there are no globally approved management practices or one-size-fits-all use rights arrangements. As a result, the effects of various management styles and their benefits and drawbacks differ from one site to the next. Understanding how the conditions of a specific fishery impact the acceptability of certain management alternatives over others is more essential than determining which set of use rights is the best. Fisheries are socio-ecological systems (Ostrom, 2009) which are immersed in socio-ecological-economic realities with significant institutional components (Rahimi et al., 2016). Attempting to mend the fishery when the socio-economic- ecological framework and institutions are collapsing will inhibit solutions to fisheries management problems. The fisheries, on the other hand, must be managed. This is where policy and regulation play an important role.

This major project reviewed key themes in sophisticated and constantly changing fisheries governance systems worldwide, including the history and evolution of various aspects of use rights, traditional and customary use rights, and reinvention of modern territorial use rights under rights-based fisheries management systems.

TURFs have shown promise as a fisheries management approach, but there is still much to learn and understand about their possibilities and limitations. The effectiveness of TURFs can vary depending on the specific context and fishery, and more research is needed to enhance our understanding of their role in comprehensive fisheries management programs. Here are a few reasons why further study is essential:

- Context-Specific Considerations: TURFs operate within diverse social, economic, and ecological contexts. Studying the interactions between these factors and TURFs is crucial to determine the most appropriate design and implementation strategies. Factors such as cultural norms, local governance structures, economic conditions, and ecological characteristics can significantly influence the outcomes of TURFs, and more research can help identify best practices and optimize their effectiveness.
- Ecological Impacts: Understanding the ecological consequences of TURFs is vital. While TURFs can promote sustainable fishing practices, their impacts on broader ecosystem dynamics, species interactions, and biodiversity must be thoroughly examined. Research can help identify potential unintended consequences and develop mitigation strategies to ensure the long-term health of the ecosystem.
- Socioeconomic Implications: TURFs can have social and economic implications for fishing communities. Studying the socioeconomic impacts of TURFs, including their effects on livelihoods, income distribution, social equity, and community well-being, is essential to ensure that these management approaches are socially and economically sustainable.
- Adaptive Management: Fisheries management is an evolving field, and adaptive management strategies are crucial for effective decision-making. Conducting research on TURFs can contribute to the development of adaptive management frameworks that incorporate feedback loops, monitoring systems, and iterative learning processes. This can enable managers to continually improve and refine TURFs based on scientific evidence and practical experience.

- Comparative Analysis: Comparative studies that examine different types of TURFs and their outcomes can provide valuable insights into their relative effectiveness. Research can explore variations in TURF designs, governance structures, and management approaches to determine which factors contribute to success or challenges in different contexts.

By conducting further studies on TURFs, policymakers, researchers, and stakeholders can better understand their potential benefits, limitations, and appropriate applications. This knowledge can help refine and optimize TURFs as a fisheries management tool and contribute to the development of comprehensive and sustainable management programs.

TABLE OF FIGURES

Bibliography and References

Aburto, J. A., Stotz, W. B., & Cundill, G (2014). Social-ecological collapse: TURF governance in the context of highly variable resources in Chile. *Ecology and Society*, *19*(1). https://doi.org/10.5751/ES-06145-190102

Aburto, J., Gallardo, G., Stotz, W., Cerda, C., Mondaca-Schachermayer, C., & Vera, K (2013). Territorial user rights for artisanal fisheries in Chile - intended and unintended outcomes. *Ocean and Coastal Management*, *71*, 284–295. https://doi.org/10.1016/j.ocecoaman.2012.09.015

Aceves-Bueno, E., Cornejo-Donoso, J., Miller, S. J., & Gaines, S. D (2017). Are Territorial Use Rights in Fisheries (TURFs) sufficiently large? *Marine Policy*, *78*(November 2016), 189–195. https://doi.org/10.1016/j.marpol.2017.01.024

Afflerbach, J. C., Lester, S. E., Dougherty, D. T., & Poon, S. E (2014). A global survey of "TURF-reserves," Territorial Use Rights for Fisheries coupled with marine reserves. *Global Ecology and Conservation*, pp. *2*, 97–106. https://doi.org/10.1016/j.gecco.2014.08.001

Agrawal, A., & Goyal, S (2001). Group size and collective action: Third-party monitoring in common-pool resources. *Comparative Political Studies*, *34*(1), 63–93. https://doi.org/10.1177/0010414001034001003

Allison, E. H., Ratner, B. D., Åsgård, B., Willmann, R., Pomeroy, R., & Kurien, J (2012). Rights-based fisheries governance: From fishing rights to human rights. *Fish and Fisheries*, *13*(1), 14–29. https://doi.org/10.1111/j.1467-2979.2011.00405.x

Anderson, T., Arnason, R., & Libecap, G. D (2011). Efficiency advantages of grandfathering in rights-based fisheries management. *Annual Review of Resource Economics*, *3*, 159–179. https://doi.org/10.1146/annurev-resource-083110-120056

Armitage, D., Marschke, M., & van Tuyen, T (2011). Early-stage transformation of coastal marine governance in Vietnam? *Marine Policy*, *35*(5), 703–711. https://doi.org/10.1016/j.marpol.2011.02.011

Arnason, R (2005). Property rights in fisheries: Iceland's experience with ITQs. *Reviews in Fish Biology and Fisheries*, *15*(3), 243–264. https://doi.org/10.1007/s11160-005-5139-6

Arnason, R (2012). Property rights in fisheries: How much can individual transferable quotas accomplish? *Review of Environmental Economics and Policy*, *6*(2), 217–236. https://doi.org/10.1093/reep/res011

Auriemma, G., Byler, K., Peterson, K., Yurkanin, A., Byler, K., & Peterson, K (2014). A global assessment of Territorial Use Rights in Fisheries to determine variability in success and design. *Bren School*, 45.

Berkes, F (1986). Local-level management and the commons problem. A comparative study of Turkish coastal fisheries. *Marine Policy*, *10*(3), 215–229. https://doi.org/10.1016/0308-597X(86)90054-0

Bonzon, B. K., Mcilwain, K., Strauss, C. K., & Leuvan, T. Van (2010). Catch Share Design Manual. *Environmental Defense Fund*, *1*, 195. http://hdl.handle.net/10535/7071

Branch, T. A (2009). How do individual transferable quotas affect marine ecosystems? *Fish and Fisheries*, *10*(1), 39–57. https://doi.org/10.1111/j.1467-2979.2008.00294.x

Bromley, D. W (2016). Rights-based fisheries and contested claims of ownership: Some necessary clarifications. *Marine Policy*, *72*, 231–236. https://doi.org/10.1016/j.marpol.2016.07.002

Campbell, D., Brown, D., & Battaglene, T (2000). Individual transferable catch quotas: Australian experience in the southern bluefin tuna fishery. *Marine Policy*, *24*(2), 109–117. https://doi.org/10.1016/S0308-597X(99)00017-2

Cancino, Jose, Hirotsugu Uchida, J. E. W (2017). TURFs and ITQs: Collective vs. Individual Decision Making. *Journal of Chemical Information and Modeling*, *8*(9), 1–58. https://doi.org/10.1017/CBO9781107415324.004

Cancino, Jose p., (Pontificia Universidad Católica de Chile), Uchida, H (University of R. I., & Wilen, James E (University of California, D (2007). TURFs and ITQs: Collective vs. Individual Decision Making. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Charles, A. T (2001). Use Rights in Fishery Systems. *IIFET Proceedings*.

Chen, C. L (2012). Unfinished business: Taiwan's experience with rights-based coastal fisheries management. *Marine Policy*, *36*(5), 955–962. https://doi.org/10.1016/j.marpol.2012.02.009

Christopher, C., & Deacon, R (2007). The Efficiency Gains from Fully Delineating Rights in an ITQ Fishery. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Christy, T Francis, F (n.d.). *Territorial use rights in marine fisheries: definitions and conditions*.

Cinner, J (2005). Socioeconomic factors influencing customary marine tenure in the Indo-Pacific. *Ecology and Society*, *10*(1). https://doi.org/10.5751/ES-01364-100136

Cochrane, L. K., & Garcia, M. S (n.d.). *A fishery manager`s guidebook*.

Coglan, L., & Pascoe, S (2015). Corporate-cooperative management of fisheries: A potential alternative governance structure for low value small fisheries? *Marine Policy*, *57*, 27–35. https://doi.org/10.1016/j.marpol.2015.03.023

Consortium, M (2007). *An analysis of existing Rights-Based Management (RBM)-PART 1*.

February, 3–5.

Copes, P (1986). A Critical Review of the Individual Quota as a Device in Fisheries Management. In *Land Economics* (Vol. 62, Issue 3, pp. 278–291). https://doi.org/10.2307/3146392

Costanza, R., Andrade, F., Antunes, P., Van Den Belt, M., Boersma, D., Boesch, D. F., Catarino, F., Hanna, S., Limburg, K., Low, B., Molitor, M., Pereira, J. G., Rayner, S., Santos, R., Wilson, J., & Young, M (1998). Principles for sustainable governance of the oceans. *Science*, *281*(5374), 198–199. https://doi.org/10.1126/science.281.5374.198

Costello, C (2012). Introduction to the symposium on rights-based fisheries management. *Review of Environmental Economics and Policy*, *6*(2), 212–216. https://doi.org/10.1093/reep/res007

Costello, C., Gaines, S. D., & Lynham, J (2008). Can Catch Shares Prevent Fisheries Collapse? *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Costello, C., & Kaffine, D. T (2010). Marine protected areas in spatial property-rights fisheries. *Australian Journal of Agricultural and Resource Economics*, *54*(3), 321–341. https://doi.org/10.1111/j.1467-8489.2010.00495.x

Cunningham, E (2013). *Catch shares in action: Mexican Baja California FEDECOOP benthic species Territorial Use Rights for Fishing System.* 11.

De Alessi, M., Sullivan, J. M., & Hilborn, R (2014). The legal, regulatory, and institutional evolution of fishing cooperatives in Alaska and the West Coast of the United States. *Marine Policy*, *43*, 217–225. https://doi.org/10.1016/j.marpol.2013.06.006

Deacon, R. T., & Ovando, D. A (2013). Fishery Cooperatives as a Management Institution. *Encyclopedia of Energy, Natural Resource, and Environmental Economics*, *2–3*, 169–175. https://doi.org/10.1016/B978-0-12-375067-9.00048-6

Deacon, Robert T (2012). Managing Fisheries by Assigning Rights to Harvester Cooperatives. *Review of Environmental Economics and Policy*, *6*, 258–277.

Doremus, H (2013). Why International Catch Shares Won't Save Ocean Biodiversity. *Michigan Journal of Environmental & Administrative Law*, *2*(2), 385.

Essington, T. E., Melnychuk, M. C., Branch, T. A., Heppell, S. S., Jensen, O. P., Link, J. S., Martell, S. J. D., Parma, A. M., Pope, J. G., & Smith, A. D. M (2012). Catch shares, fisheries, and ecological stewardship: A comparative analysis of resource responses to a rights-based policy instrument. *Conservation Letters*, *5*(3), 186–195. https://doi.org/10.1111/j.1755-263X.2012.00226.x

Fao (2018). The state of world fisheries aquaculture and marine fisheries 2018. In *Aquaculture* (Vol. 35). https://doi.org/issn 10

Fernandez, G. L. G (2017). From Seascapes of Extinction to Seascapes of Confidence. In *From Seascapes of Extinction to Seascapes of Confidence*. https://doi.org/10.4324/9781315159829

Foley, P., Mather, C., & Neis, B (2015). Governing enclosure for coastal communities: Social embeddedness in a Canadian shrimp fishery. *Marine Policy*, *61*, 390–400. https://doi.org/10.1016/j.marpol.2014.11.009

Food and Agriculture Organisation (2014). World review of fisheries and aquaculture. *The State of World Fisheries and Aquaculture*, 3–89. https://doi.org/E-ISBN 978-92-5-108276-8

. Christy, F.T. (1982). *Territorial use rights in marine fisheries*. FAO. http://www.fao.org/3/T0507E/T0507E01.htm

Gallardo Fernández, G. L., & Friman, E (2011). New marine commons along the Chilean coast-the management areas (MAs) of Peñuelas and Chigualoco. *International Journal of the*

Commons, *5*(2), 433–458. https://doi.org/10.18352/ijc.284

Gelcich, S., & Donlan, C. J (2015). Incentivizing biodiversity conservation in artisanal fishing communities through territorial user rights and business model innovation. *Conservation Biology*, *29*(4), 1076–1085. https://doi.org/10.1111/cobi.12477

Gelcich, S., Edwards-Jones, G., & Kaiser, M. J (2005). Importance of attitudinal differences among artisanal fishers toward co-management and conservation of marine resources. *Conservation Biology*, *19*(3), 865–875. https://doi.org/10.1111/j.1523-1739.2005.00534.x

Gelcich, S., Edwards-Jones, G., & Kaiser, M. J (2007). Heterogeneity in fishers' harvesting decisions under a marine territorial user rights policy. *Ecological Economics*, *61*(2–3), 246–254. https://doi.org/10.1016/j.ecolecon.2006.02.017

Gelcich, S., Kaiser, M. J., Castilla, J. C., & Edwards-Jones, G (2008). Engagement in co-management of marine benthic resources influences environmental perceptions of artisanal fishers. *Environmental Conservation*, *35*(1), 36–45. https://doi.org/10.1017/S0376892908004475

González, J., Stotz, W., Garrido, J., Orensanz, J. M., Parma, A. M., Tapia, C., & Zuleta, A (2006). The Chilean turf system: How is it performing in the case of the loco fishery? *Bulletin of Marine Science*, *78*(3), 499–527.

Grafton, R. Q (1996). Individual transferable quotas: Theory and practice. *Reviews in Fish Biology and Fisheries*, *6*(1), 5–20. https://doi.org/10.1007/BF00058517

Grafton, R. Q (2005). Social capital and fisheries governance. *Ocean and Coastal Management*, *48*(9–10), 753–766. https://doi.org/10.1016/j.ocecoaman.2005.08.003

Grafton, R. Q., Squires, D., Fox, K. J., Journal, S., & October, N (2011). Private Property and Economic Efficiency: A Study of a Common-Pool Resource. *Fisheries (Bethesda),* *XLIII*(October).

Gutiérrez, N. L., Hilborn, R., & Defeo, O (2011). Leadership, social capital, and incentives promote successful fisheries. *Nature*, *470*(7334), 386–389. https://doi.org/10.1038/nature09689

Halpern, B. S (2003). *The Impact of Marine Reserves : Do Reserves Work and Does Reserve Size Matter ? Author (s): Benjamin S. Halpern Source : Ecological Applications, Feb ., 2003, Vol . 13, No. 1, Supplement : The Science of Marine Reserves (Feb ., 2003), pp. S117-. 13*(1).

Halpern, B. S., Lester, S. E., & Kellner, J. B (2009). Spillover from marine reserves and the replenishment of fished stocks. *Environmental Conservation*, *36*(4), 268–276. https://doi.org/10.1017/S0376892910000032

Hannesson, R., & Herrick, S. F (2010). The value of Pacific sardine as forage fish. *Marine Policy*, *34*(5), 935–942. https://doi.org/10.1016/j.marpol.2010.01.024

Hart, P. J. B (2004). The Fisheries Co-management Experience: Accomplishments, Challenges, and Prospects. In *Fish and Fisheries* (Vol. 5, Issue 1). https://doi.org/10.1111/j.1467-2979.2004.00145_4.x

Hilborn, R (2007). Defining success in fisheries and conflicts in objectives. *Marine Policy*, *31*(2), 153–158. https://doi.org/10.1016/j.marpol.2006.05.014

Hoggarth, D., Abeyasekera, S., Arthur, R., Beddington, J. R., Burn, R. W., Halls, A. S., Kirkwood, G. P., McAllister, M., Medley, P., Mees, C. C., Parkes, G. B., Pilling, G. M., Wakeford, R. C., & Welcomme, R. L (2006). Stock assessment for fishery management: a framework guide to the stock assessment tools of the Fisheries Management and Science Programme. In *FAO Fisheries Tecnical Paper* (Vol. 487).

http://books.google.com/books?hl=en&lr=&id=Rt7L8RgC6f8C&oi=fnd&pg=PP16&dq=Stock+assessment+for+fishery+management.+A+framework+guide+to+the+stock+assessment+tools+at+the+Fisheries+Management+Science+Programme&ots=rNZ7CAFt6O&sig=2el2NayPF2-kUAPMYzymG9gyoFQ

Holland, D. S (2004). Spatial Fishery Rights and Marine Zoning: A discussion with Reference to Management of Marine Resources in New England. *Marine Resource Economics*, *19*(9), 21–40.

Holland, D., & Schnier, K. E (2006). Individual habitat quotas for fisheries. *Journal of Environmental Economics and Management*, *51*(1), 72–92. https://doi.org/10.1016/j.jeem.2005.04.005

Jentoft, S., & McCay, B (1995). User participation in fisheries management: lessons drawn from international experiences. *Marine Policy*, *19*(3), 227–246. https://doi.org/10.1016/0308-597X(94)00010-P

Jentoft, S., McCay, B. J., & Wilson, D. C (1998). Social theory and fisheries co-management. *Marine Policy*, *22*(4–5), 423–436. https://doi.org/10.1016/S0308-597X(97)00040-7

Lai, T. P (2008). Fisheries co-management in Vietnam: issues and approach. *IIFET 2008 Vietnam Proceedings*.

Matsuda, H., Makino, M., Tomiyama, M., Gelcich, S., & Castilla, J. C (2010). Fishery management in Japan. *Ecological Research*, *25*(5), 899–907. https://doi.org/10.1007/s11284-010-0748-5

McCay, B. J., Micheli, F., Ponce-Díaz, G., Murray, G., Shester, G., Ramirez-Sanchez, S., & Weisman, W (2014). Cooperatives, concessions, and co-management on the Pacific coast of Mexico. *Marine Policy*, *44*, 49–59. https://doi.org/10.1016/j.marpol.2013.08.001

Melnychuk, M. C., Essington, T. E., Branch, T. A., Heppell, S. S., Jensen, O. P., Link, J. S., Martell, S. J. D., Parma, A. M., Pope, J. G., & Smith, A. D. M (2012). Can catch share fisheries better track management targets? *Fish and Fisheries*, *13*(3), 267–290. https://doi.org/10.1111/j.1467-2979.2011.00429.x

Nguyen Thi Quynh, C (2019). Territorial Use Rights for Fisheries : How can they provide adequate institutional incentives against capital stuffing and illegal fishing ?

Nguyen Thi Quynh, C., Schilizzi, S., Hailu, A., & Iftekhar, S (2017). Territorial Use Rights for Fisheries (TURFs): State of the art and the road ahead. *Marine Policy*, *75*(May 2016), 41–52. https://doi.org/10.1016/j.marpol.2016.10.004

Orensanz, J. M., Seijo, J. C., Orensanz, J. M., & Seijo, J. C (2013). Rights-based management in Latin American fisheries. In *FAO Fisheries and Aquaculture Technical Paper*.

Ostrom, E (2009). *A general framework for analyzing sustainability of social-ecological systems*. *325*(5939), 419–422.

Ovando, D. A., Deacon, R. T., Lester, S. E., Costello, C., Van Leuvan, T., McIlwain, K., Kent Strauss, C., Arbuckle, M., Fujita, R., Gelcich, S., & Uchida, H (2013). Conservation incentives and collective choices in cooperative fisheries. *Marine Policy*, *37*(1), 132–140. https://doi.org/10.1016/j.marpol.2012.03.012

Ovando, D., Poon, S., & Costello, C (2017). Opportunities and precautions for integrating cooperation and individual transferable quotas with territorial use rights in fisheries. *Bulletin of Marine Science*, *93*(1), 101–115. https://doi.org/10.5343/bms.2016.1081

Palumbi, S. R (2004). Why mothers matter? *Fisheries Science*, 621–622.

Pinkerton, E (2013). Alternatives to ITQs in equity-efficiency-effectiveness trade-offs: How the lay-up system spread effort in the BC halibut fishery. *Marine Policy*, *42*, 5–13.

https://doi.org/10.1016/j.marpol.2013.01.010

Poon, S. E., & Bonzon, K (2013). *Territorial Use Rights for Fishing-Catch share manual*. *3*, 161.

Poon, S. E., Bonzon, K., & Leuvan, T. Van (2013). *Catch Share Design Manual, Volume 2: Cooperative Catch Shares*. *2*, 141. http://fisherysolutionscenter.edf.org/sites/catchshares.edf.org/files/CSDM_Vol2_Cooperative_Catch_Shares.pdf?_ga=2.78146260.1947155182.1524580837-444719867.1523876102

Romero, P., & Melo, O (2021). Can a Territorial Use Right for Fisheries management make a difference for fishing communities? *Marine Policy*, *124*(December 2020), 104359. https://doi.org/10.1016/j.marpol.2020.104359

Ruddle, K (2017). *Introduction to the collected works of R.E. Johannes, publications on marine traditional knowledge and management 1*. *March*.

Salas, S., Chuenpagdee, R., Seijo, J. C., & Charles, A (2007). Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. *Fisheries Research*, *87*(1), 5–16. https://doi.org/10.1016/j.fishres.2007.06.015

Schumann, S (2007). Co-management and “consciousness”: Fishers’ assimilation of management principles in Chile. In *Marine Policy* (Vol. 31, Issue 2, pp. 101–111). https://doi.org/10.1016/j.marpol.2006.05.008

Scott, A (2008). *The evaluation of resource property rights*. 226–228.

Staples, D., & Funge-Smith, S (2009). Putting into practice the ecosystem approach to fisheries. In *Rap Publication 2009/11*. http://www.fao.org/docrep/field/003/ab825f/AB825F00.htm#TOC

St. Martin, K (2003). Making space for community-based sea tenure: Considering the structure of tenure regimes in the common property literature. *World Development, 31(6), 977-996.*

The Drama of the Commons (2002). In *The Drama of the Commons*. https://doi.org/10.17226/10287

Type, C., & Materials, S (2021). *CONTENT : SYMPOSIUM : SYMPOSIUM PROPERTY RIGHTS IN ENVIRONMENTAL ASSETS : ECONOMIC AND LEGAL PERSPECTIVES : Improving Efficiency by Assigning Harvest Rights to Fishery Cooperatives : Evidence From the Chignik Salmon Co-op*. *1*, 0–21.

Uchida, E., Uchida, H., Lee, J. S., Ryu, J. G., & Kim, D. Y (2012). TURFs and clubs: Empirical evidence of the effect of self-governance on profitability in South Korea's inshore (maul) fisheries. *Environment and Development Economics*, *17*(1), 41–65. https://doi.org/10.1017/S1355770X11000246

Uchida, H (2003). Collective Fishery Management in TURFs: The Role of Effort Coordination and Pooling Arrangement.

Uchida, H (2017). TURFs, collective fishery management, and fishery cooperatives. *Bulletin of Marine Science*, *93*(1), 83–99. https://doi.org/10.5343/bms.2015-1102

Uchida, H., & Baba, O (2008). Fishery management and the pooling arrangement in the Sakuraebi Fishery in Japan. *Case Studies on Fisheries Self-Governance*, 175–189.

Ueyonahara, J (2012). Fishing the future A snapshot of the Chilean TURFs through the lens of fishers and key stakeholders' perceptions. *Department of Earth Sciences*, *Master the*.

Viana, D. F., Gelcich, S., Aceves-Bueno, E., Twohey, B., & Gaines, S. D (2019). Design trade-offs in rights-based management of small-scale fisheries. *Conservation Biology*, *33*(2), 361–368. https://doi.org/10.1111/cobi.13208

Villaseñor-Derbez, J. C., Aceves-Bueno, E., Fulton, S., Suarez, A., Hernández-Velasco, A., Torre, J., & Micheli, F (2019). An interdisciplinary evaluation of community-based TURF-reserves. *PLoS ONE*, *14*(8), 1–17. https://doi.org/10.1371/journal.pone.0221660

Villela, lucia maria aversa (2013). TURFs and ITQs: vs. Individual Decision Making. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Villena, M. G., & Chavez, C (2005). On the Enforcement of Territorial Use Rights Regulations: A Game Theoretic Approach. *Economia*, *6*(1), 1–44.

Wandira Ayu Bertin, D. S. H (2017). Territorial Use Rights in Fishing (TURFs): An Analytical View towards Wider Changes in Global Fisheries Governance. *Journal of Chemical Information and Modeling*, *8*(9), 1–58. https://doi.org/10.1017/CBO9781107415324.004

White, C., & Costello, H (2011). Matching spatial property rights fisheries with scales of fish dispersal. *Ecological Applications*, *21*(2), 350–362. https://doi.org/10.1890/09-1188.1

Wilen, J. E (2006). Why fisheries management fails: Treating symptoms rather than the cause. *Bulletin of Marine Science*, *78*(3), 529–546.

Wilen, J. E., Cancino, J., & Uchida, H (2012). The economics of territorial use rights fisheries, or turfs. *Review of Environmental Economics and Policy*, *6*(2), 237–257. https://doi.org/10.1093/reep/res012

Yandle, T (2003). The challenge of building successful stakeholder organizations: New Zealand's experience in developing a fisheries co-management regime. *Marine Policy*, *27*(2), 179–192. https://doi.org/10.1016/S0308-597X(02)00071-4