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Abstract

Chira Island is a complex system that is currently facing an issue with managing common pool resources, specifically fish. Fish populations are being overexploited and as a result the people of the island, and specifically the Palito community, are feeling the effects. In Palito, fishing is not only culturally important, but it provides its people with food and an economic resource. The depletion of fish around Palito is due to poor common pool resource management. Common Pool resources are described as natural or human made resources where one person's use subtracts from another's use and where it is often necessary, but difficult and costly to exclude other users outside the group from the resource (Neiland, 2005). Poaching and advanced fishing technology have accelerated the exploitation of Palitos fish. Chira and specifically Palito are trying to adapt to the changes in their systems by being conservative with fishing practices, while still having their common pool resource to maintain their economy and livelihoods. Therefore this policy brief is aimed at making changes for the Palito community to efficiently manage fish as a common pool resource. I recommend that Palito adopt fish farming, monitoring of fish in the AMPRs, develop rule enforcement with the aid of co-management, and finally delegate two representatives of the Island to advocate for the management of common pool resources on a governmental level.

Introduction

Chira Island is located in the Gulf of Nicoya in the Puntarenas province. It is home to about 1,750 people who rely on its natural resources like fish, clams, and oysters (Morales & Chaves, 2012). The

island is considered a tropical dry forest with a wet and dry season. Approximately a quarter of the island is covered in mangrove trees providing ecosystem services to Chira (Paez, 2016). The mangrove ecosystem is an essential part of the island in providing ecosystem services like sediment catchment, fish nurseries, etc. Chira is in a unique position because it is at the mouth of the Tempisque river. This is important to note because river plantations of crops upstream release sediment and nutrients into the river bringing it into the Nicoya Gulf. This impacts Chira because the sediment buildup can affect the delicate balance of the ecosystems in terms of the species population of common pool resources. The reason why this can be an issue is that these are all common pool resources that need to be managed or remediated. Historically, fishers would come into the Nicoya gulf and overharvest resources or degrade the environment. A big reason this occurred was due to the technological advancements in fishing technology, as well as sediment build-up due to upstream agricultural plantations. The result of this was a decrease in fish and shellfish populations, as well as a degradation in the environment.

The human-environmental intersection in Chira lies in a delicate system. Its components are fishing, mangrove services, and harvesting of shellfish. The people of Chira rely heavily on common pool resources for their livelihoods. For example, fishing is important to the island's culture as a resource for its economy and as a food source. The small island is enveloped as a delicate system so that if fishing or other systems falter the whole system feels the effects. This is what happened when commercial fishing failed in the Nicoya Gulf due to high sediment loads and overexploitation.

Historically the Island fostered a strong "Machismo" attitude and was dominated by individualistic men whose identities were predominantly as fishermen. Now dynamics are changing to adapt to the pressing threat of common pool resources. Women on the island created a chain reaction of diversifying activities on the island. Due to stresses on common pool resources and the environment, Chira created responsible fishing areas, harvested oysters in farms, encouraged the younger generation to pursue an education, as well as women empowerment Marine Areas for Responsible Fishing (Áreas Marinas para la Pesca Responsable, AMPR), became a big driver in how Chira, and Costa Rica, moved to its current regime (Lozano & Heinen, 2016). The AMPRs in Palito were the first of their kind in Costa

Rica and more have come to fruition around the country since then. The AMPRs in Chira was developed in association with Instituto Costarricense de Pesca y Acuicultura (INCOPESCA), La Asociación de Cuerderos (ASOPECUPACHI), and MarViva (Babeu et al., 2012). The purpose of these areas is to conserve fish populations that have been threatened due to overfishing and pollution from upstream agricultural activities. In an interview with previous presidents of the fishing association in Chira said they all felt AMPRs are necessary for the community because it allows them to conserve fish populations for future generations (Babeu et al., 2012). In addition, these areas have a three-month moratorium to allow for fish populations to regenerate without the threat of fishing (Paez, 2016). Oyster farming is another adaptation of how humans have adapted to the changing environment to fit a new regime. This was necessary due to the depletion of fish around the gulf of Nicoya. The residents needed alternate food resources as well as a new economic incentive. Education in the younger generations has also been another driving factor in the new regime of Chira Island. The youth are being encouraged to seek higher education on the island leading them to become more specialized. In turn, they return to the island bringing new development. Though this is a social change that is occurring now and hasn't come to full effect yet. Finally, women's empowerment has been the pinnacle reason for the change on the island in the early 2000s. The formation of a women's group centered around La Amistad, a women's lodge in Palito. This created a plasticity in the attitudes and ideas of the inhabitants of Chira. Without them, Chira might have run the fish to extinction around the island. Without any other knowledge or motivation of other resources and options, who knows what might have happened to the island's people if not for the women of Chira?

Methods

To understand some of the complexities that Chira has, Melvin González of Chira's fishing association, ASOPECUPACHI, was interviewed. González oversees this association that is dedicated to sustainable fishing, an extremely important feat in a small island system that relies on fishing as a

common pool resource. González explains the changing dynamics on the island in response to the decrease in common pool resources like fish.

In terms of Ostrom's principles for adaptive management González talks about the struggle to monitor the amount of fish that are in Nicoya bay. Additionally, he described how coast guards don't provide proper rules following conditions so that poachers won't overharvest fish in the protected AMPRs around the Island. In terms of conflict management, ASOPECUPACHI does a fairly good job of aligning itself as an organization by voting and communicating with one another. The association also elects a president to streamline its operations. Moving on, González notes that infrastructure is a possible challenge for the adaptive management of fish in the Nicoya Gulf. He says the association lacks the funds to have an adaptive system. The infrastructure that Chira needs is a functioning fish processing plant, monitoring devices, GPS traceability, and abundant gasoline. Finally, adaptive management for managing common pool resources is something that Chira and specifically Palito have grown into doing very well. Thanks to the plasticity in attitudes toward change and resilience, managing common pool resources has become a more achievable goal. For example, Palito has opted for adaptive systems like oyster farming as an alternative to other common pool resources being depleted.

To understand how Palito manages common pool resources, this paper also analyzes different readings to get a wide understanding of sustainable fishing, adaptive management, common pool resources, Chira, and the human ecosystem interactions on the island. Ostrom's "Challenge of the Common- Pool" is used to understand how common pool resources like fish need to be managed by using several principles as measured for maintaining an adaptive system (Ostrom, 2008). Babeu et al. reading helps us understand using a socioeconomic baseline for sustainable fishing communities can help in creating resilient systems specific to Palito and Montero (Babeu et al., 2012). Next Polo's writing "A Situational Analysis of Community-based oyster farming in Palito, Isla Chira, Costa Rica" helps us to understand the geographic, socioeconomic, and institutional context that oyster farming in Palito is taking place (Polo, 2016). Additionally, this paper takes into account Lozano & Heinen's paper on "Property Relations and the Co-management of Small-scale Fisheries in Costa Rica: Lessons from Marine Areas for

Responsible Fishing in the Gulf of Nicoya". This helps us to understand models for co-management of small-scale fisheries in Costa Rica, where the natural resources have traditionally been governed as state property through centralized regulation and the creation of protected areas (Lozano & Heinens, 2016). Nieland's paper "Common Pool Resources and Fisheries Management", helps readers to understand how fisheries are important to societies and need to be managed to not overexploit populations (Neiland, 2005). Supplemental reading helped have a complete understanding to aid in formulating policy recommendations

Conclusion

It's clear that the management of fish as a common pool resource is a complex adaptive system, yet not to the fullest extent that it could be. Stakeholders, such as villagers, fishers, co-management actors, and poachers are all a part of this system (Babeu et al., 2012). Fishing has been a historical and cultural practice in Palito, which brings economic and natural resources to the people of the island. Fishing is a common pool resource that has been subtracted due to fishing technology advancements and worsening water quality in Nicoya Gulf from upstream plantation sediment loads. Different adaptive management strategies have been put into place, but still, some principles of management are lacking and affect the common pool resources. Lots of common pool resource management development has occurred in Palito and the rest of Chira due to the creation of the ASOPECUPACHI, increasing education in younger generations, and women's empowerment. These have and still are creating ripple effects that will shape the growth of Palito and the rest of Chira as an adaptive system. Co-management has been used to help manage fish as a common pool resource. The bottom-up approach in association with universities and NGOs has been instrumental in the development of managing common pool resources in Palito. There is an issue of the lack of rule enforcement that could be aided by the contributions from governmental institutional organizations like a reliable coast guard that protects AMRPs from poachers. The fishers are still lacking the infrastructure to properly protect AMPRs, though investment or scaling up

Palito's economy could help the community to effectively manage them. This goes hand in hand with rule enforcement, without proper infrastructure it is difficult to enforce rules in managing a common pool resource. The ASOPECUPACHI has come a long way and has developed conflict resolution within its organization. Palito has developed into an adaptive system in that it can face its problems and adapt to them.

Recommendations

The management of fish in Palito has changed a lot in recent years, yet I recommend some policies that would further enhance the management of common pool resources. Firstly, the people of Palito should look to aquaculture to enhance sustainable yield. Secondly, a system for monitoring the amount of fish surrounding the island would aid in understanding the common pool resource. Thirdly, Palito should develop rule enforcement co-management with INCOPESCA, universities, and or NGOs so the common pool resource isn't exploited. Finally, Chira should delegate two individuals to advocate for them in provincial governmental affairs.

Fish farming and aquaculture are beneficial for small islands that are facing the struggles of common pool resource management. Palito would benefit from fish farming because it would decrease the stress of overexploitation. The people of Chira rely on their fish populations, yet they are decreasing due to overfishing and chemicals in the ocean. Creating fish farms in the AMPRs around Palito is a sustainable way for its people to harvest the sustainable yield of fish as well as replenish them. Ostrom explains how poachers decimate populations of common pool resources (Ostrom, 2008). In fish farms, managers can more efficiently manage their resources and protect them from poachers. With the demographic growth of the island, food, and economic security will continue to become a pressing issue and fish farming represents a solution for a renewable common pool resource (UN, 2022). Fish farms and other aquaculture farms can be set up in a relatively small area while producing a high yield of resources (Polo, 2016). Previous models of fishing that involve hook-in lines scarcely provide fishers with a livable

income (Polo, 2016). With the implementation of fish farms in the AMPR areas fishermen can expect a new way of harvesting fish that will take less effort, will conserve their resources, and will protect common pool resource management.

In addition, Palito should implement monitoring techniques to measure the amount of fish that are in their AMPRs. They can do this by either training locals in the community or bringing in biologists and other officials from institutions like INCOPESCA, universities, or NGOs. Monitoring might be enhanced by using co-management from other institutions. However, in the long run, it would be beneficial if locals knew how to monitor the amount of fish in their waters. Different methodologies are used to measure the amount of fish in an area, the most common being mark and recapture. Ostrom notes monitoring as one of the principal measurements of complex adaptive systems (Ostrom, 2008). Therefore management of fish as a common pool resource would be beneficial by monitoring the population. The response to an accurate account of fish populations will aid the people of Palito in knowing when they might need to encourage or impede fishing.

Palito can improve the management of common pool resources by improving rule implementation with the assistance of a co-management system. INCOPESCA, the coast guard, universities, and NGOs have commonly helped to protect AMPRs near the Palito community from poachers. Gonzalez notes how INCOPESCA helped to keep poachers out of Chira's waters. Now lacking these institutional resources, Palito is having a difficult time keeping poachers out. This is where policy can come in. I recommend that INCOPESCA agrees with the locals of Chira to always have one person, either funded by INCOPESCA or brought from INCOPESCA, to patrol AMPRs and prevent poachers from coming and depleting important common pool resources. Ostrom explains, to have a complex adaptive system rule enforcement is key (Ostrom, 2008). If rule enforcement fails and poachers come into the protected fishing areas they might exploit fish into temporary extinction from their habitats.

Stemming from rule enforcement, Palito should also have a stake in governmental decisions. Therefore I propose that two elected representatives from the Palito and further Chira community get to have a seat in local government. This would likely be on a provincial level, so they would participate in

government affairs in Puntarenas. This would allow for the community needs to be heard, as well as get ideas and assistance from others. When disconnected from the rest of the bureaucratic body Chira is subject to following rules based on the province. Essentially, they have no stake in the affairs of that body. Therefore it would be beneficial for Chira to delegate representatives to join the bureaucratic discourse in Puntarenas to get their needs heard to better manage common pool resources like fish.

All in all, Chira is a delicate adaptive system that is going through massive amounts of change. The fishing industry is especially fragile due to overexploitation and high amounts of sediment from plantations upstream. As a common pool resource, fish need to be managed more efficiently to benefit the inhabitants of Chira's economic and natural resources. Management of common pool resources looks like implementing fish farms, monitoring populations of fish, bolstering rule enhancement, and delegating representatives for Chira to be a part of bureaucratic discussions.

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