

# Community perspective of the fishing activity in El Arenal, Acapulco, Mexico

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## ABSTRACT

For many communities settled on the coastline of coastal lagoons, fishing is an important activity because of the income it generates.

**Objective:** To analyze the community perspective of the fishing activity in the community of El Arenal, in Guerrero, Mexico.

**Methodology:** The research is a mixed case study and its development consisted in seven stages, which were: description of the area where field immersion was carried out and identification of socioenvironmental problems, dialogues with the fishermen, information processing, data analysis through descriptive statistics, and deductive analysis of the discourse.

**Results:** Overfishing is evident, and the breach of closed season and high levels of capture in live weight which was 1275 t in 2022. The 37 cooperatives do not have trade channels and brokers are in charge of trading the product. At the socioenvironmental level, the community of El Arenal does not have residue collection programs or for lagoon or mangrove care.

**Conclusions:** The production model based on overfishing exhausts the natural resource because there is no planning for the fishing resource and it does not respect the closed season law, resulting in socioenvironmental problems for the community, overfishing, contamination of the lagoon, and social marginalization.

**Keywords:** fishing activity; rural community; socioeconomic structure; Laguna de Tres Palos; socioenvironmental problems.

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## INTRODUCTION

The fishing activity is an important economic sector because it is part of food security at the global level and in 2021 there was a production of 188 million tons (FAO, 2022). When it comes to the Mexican context, it occupied the 13<sup>th</sup> position of countries with most fishing activity and contributed 2% of the world production, which makes it a country with strong economic development in this economic environment (FAO, 2020). The fishing activity in Guerrero, Mexico, is in the third branch of highest development and economic growth; during 2021 there was capture in live weight of 1.8 t, where Acapulco contributed 49.83% (CONAPESCA, 2020). However, this economic activity faced intense difficulties when the

fishing activity decreased considerably, which resulted in economic impacts in the rural sector in national, state and local contexts (Sandoval *et al.*, 2020; Secretaría de Agricultura y Desarrollo Rural, 2021). Fishing is an important source of income for 280 households and 385 fishermen in El Arenal, although the social marginalization rate continues to be high because there are no social programs to help fishermen. The fishing activity has decreased due to overfishing, the breach of closed season laws, the contamination of the ecosystem and deforestation of the mangrove. In addition, there is low economic diversification and null financial strengthening.

The cooperatives do not have trade channels and the appearance of intermediaries (“brokers”) has caused inequality in commercialization of the product, which prevents the community from having a sustainable fishing production system. Therefore, government strategies are necessary for the welfare of the community and the fishermen. The government must develop social programs that contribute to the wellbeing of fishermen, and which strengthen and diversify local economy to minimize the inequalities in commercialization of the product and to ensure a sustainable fishing productive system. In addition, it is necessary to control and plan the fishing activity better to avoid the breach of the closed season law and the appropriation of the Laguna de Tres Palos. At the same time, it is important to take steps to reduce overfishing and deforestation of mangroves. These actions are fundamental for the sustainable development of the fishing community of El Arenal.

The perspective of the community of El Arenal through this study prevails because it makes a significant contribution about the fishing activity and shows the socioenvironmental state of an activity of the primary sector, which provides sustenance to rural households far from tourism as a dominant economic matrix in the city of Acapulco. In addition, it documents a community socioenvironmental reality and questions the lack of community and government connections within rural and territorial development of the fishing activity.

## **Theoretical discussion**

### **Economic structure**

The economic structure is the dynamic set of the relationship of productive forces that are empowered to promote development at the social level (Tamames and Rueda, 2014; Ceballos and De anda, 2021). This interaction between society and economy forms new market niches that lead to overconsumption, exhaustion of natural goods, and cause a decline in rural development because production is low scale and originates a deep scarcity of natural resources in rural communities (Gutiérrez and Glückler, 2022; Richmond and Casali, 2022; Zhang *et al.*, 2022). Therefore, in the case of fishing communities, scarcity is an economic problem generated by the production model, the socioenvironmental or extraction problems, and the susceptibility of market dynamics (Debaere & Kapral, 2021; Kuhl, 2021).

### **Fishing activity**

The fishing activity is important because it offered 174 thousand direct jobs in 2021 in the rural population in Mexico and contributed to the decrease in unemployment by 2.7%

(SADER, 2021 A; SADER, 2021 B). It also contributed to the nation's food security and sovereignty and is part of the basic economy of the coastal states in Mexico (CONAPESCA, 2020). According to SADER (2019), in Mexico the total capture of the fishing sector is approximately 2 million tons (T), where a large amount is extracted from lagoons, which have a fundamental role within production and capture since they are strategic and economically productive ecosystems. However, fishing production in Mexico presents overfishing and generates strong socioenvironmental pressures on the coastal lagoons that end up affecting local and rural communities (Cruz *et al.*, 2021; SADER, 2022). In this context, paradoxically, the fishing resource allows the growth of local economies; rural communities have taken advantage of the economic niche to obtain monetary income, recognizing that in some zones next to lagoons, lakes and the sea there is overfishing which reduces the abundance of the resource (García *et al.*, 2021).

During recent years, Mexico has shown a sustained growth in the fishing activity (capture and production); however, during 2017 and 2018 there was a decrease, and even so, fishing contributed 35 billion pesos MX, a historical value (SEDER, 2017). All in all, the fishing sector has experienced a favorable significant growth (Table 1) and it has been consolidated as an important economic branch for rural and economic sustainability of the country, despite the socioenvironmental problems that underlie this economic activity (SEGOB, 2020; Cortés, 2021; SADER, 2022).

According to SEGOB (2022), the state of Guerrero had a fishing capture of 1.7 million tons in 2021. This figure marked the trend of a rising primary sector, which drives the local development of the communities that have fishing as the basis of their economy. Based on this, the authors Villerías *et al.* (2016), Herrera *et al.* (2016), and Villerías (2021) explain that fishing is an economic sector driven by tourism, which guarantees rural development. However, the touristic economic spill has led to socioeconomic vulnerability due to inequality in commercialization of the product and, consequently, low income. Therefore, the activity does not ensure the social wellbeing of the fishermen in addition to the socioenvironmental damage to fishing ecosystems with economic value (Uc, 2018; Villería *et al.*, 2017).

In accordance with this, the study analyzes the community perspective of the fishing activity in the community of El Arenal.

## MATERIALS AND METHODS

### The case study

This research is framed by a mixed approach, which allows an integral analysis of qualitative and quantitative data and approaching the phenomenon's complexity. The decision was made for a case study design that leads to an in-depth understanding of a

**Table 1.** Growth of the fishing activity (2013-2022).

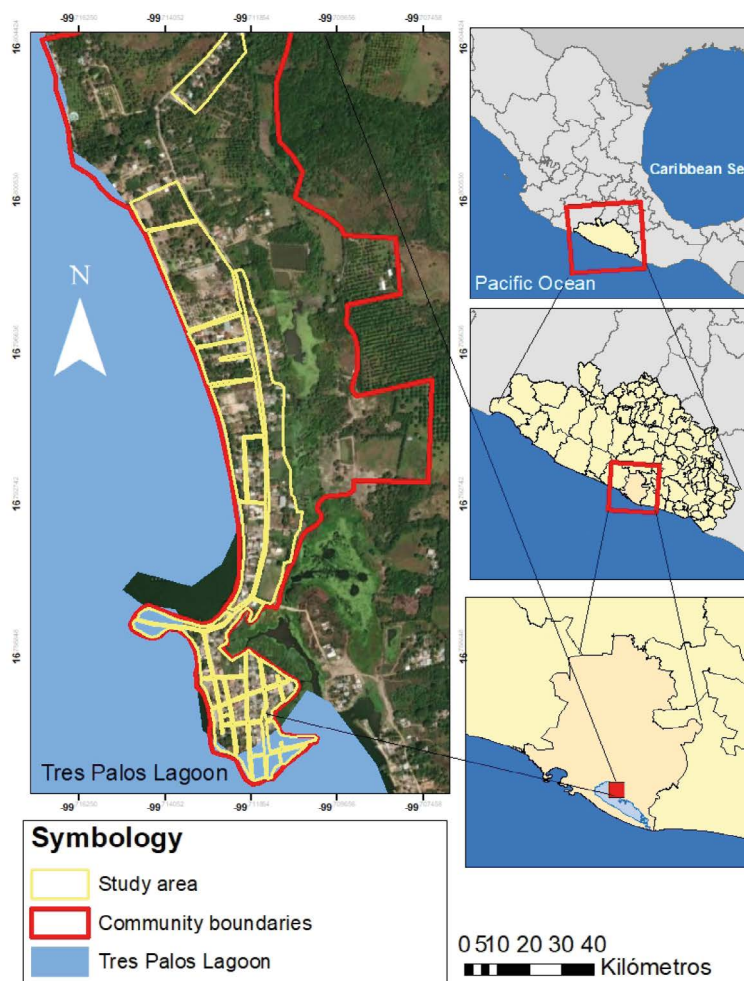
Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Growth (%)	4.50%	21.40%	17.90%	1.90%	-4.90%	-5.00%	5.40%	1.60%	7.50%	15%

Source: Prepared by the authors with data from SEGOB (2020), Cortés (2021), and SADER (2022).

problem or phenomenon and involves epistemological amplification (Buttazzoni, 2022). The research had seven phases: a) description of the study area; b) field immersion; c) review of institutional databases and geo-portals; d) visits and visual inspection; e) informal dialogue; f) information processing; and g) information analysis; and it is a case study located in the rural sector of the city of Acapulco. The community of El Arenal was selected because of the research precedents achieved by Juárez *et al.* (2019), which make a prevailing recommendation to research socioenvironmental problems within the fishing activity as an economic axis of the communities adjacent to Laguna de Tres Palos.

### Description of the study area

El Arenal is part of the rural zone of the city of Acapulco ( $16^{\circ} 48' 43.85''$  N and  $99^{\circ} 41' 47.50''$  W) and it is an annex of the community of Cacahuatpec (Figure 1). At the population level, the community of El Arenal (Acapulco, Guerrero) appears for the first time in the census of 1960 performed by the National Statistics Direction with 76 inhabitants (INEGI, 2020), recorded as a *ranchería*; the growth of the community has



**Figure 1.** Study area, community of El Arenal, Guerrero, Mexico.  
Source: Prepared by the authors with data from INEGI and Google Earth.

been exponential and currently there are 1037 inhabitants with a population growth rate of 92% and a base of young population between 10 and 40 years old, which indicates a significant productive strength (INEGI, 2020).

Regarding the biophysical system, the study area is found in the sub-basin of the La Sabana River and Laguna de Tres Palos; it has an average temperature of 27.4 °C (Celsius) and an average annual rainfall of 107.4 millimeters (mm) with a rainfall system divided into two seasons (Google Earth, 2022), which is important for the reproductive cycles of fish and the tasks for fishermen; it is an important ecosystem for territorial development because of the offer of ecosystem services and its key use, exploitation and conservation for the economic and territorial development of the communities that are part of the sub-basin. Indirectly, El Arenal is in continuous relationship with the La Sabana River and directly with Laguna de Tres Palos, and the latter ecosystem provides the raw material (fish) that is the economic basis of the place.

### Stages in the research

The research was divided into seven stages that range from the compilation of information to obtaining and analyzing empirical data, which allowed responding to the objective of the study and satisfying the thematic interest about the socioenvironmental state of the fishing activity in the community of El Arenal.

- A) Description of the study area: it consisted in the review of authors (Juárez *et al.*, 2019; Galán *et al.*, 2020; Casarrubias, 2021) who have studied the subsequent zones to Laguna de Tres Palos or the communities adjacent to the Laguna de Tres Palos, including El Arenal. The review managed to evidence the need to research the community of El Arenal.
- B) The field immersion consisted in four visits to the study area to carry out the prior recognition to build a communication bridge between the local stakeholders (fishermen) and the researchers. This resulted in five visits to the study area to begin the dialogue with these local stakeholders with the aim of obtaining permission to work with the community.
- C) The review of institutional databases and geo-portals, was important because some socioenvironmental and economic problems were detected that currently persist in the community and which affect the territory and the Laguna de Tres Palos. Information about the fishing production, felling of the mangrove and economic problems of the community were obtained within the analysis of geo-portals; this information was contrasted with the field immersion. However, four in-person visits to government institutions were necessary to request information, which were to the following: National Statistics and Geography Institute (*Instituto Nacional de Estadística y Geografía*, INEGI); National Commission for Aquaculture and Fishing (*Comisión Nacional de Acuicultura y Pesca*, CONAPESCA), and National Council for Evaluation of the Social Development Policy (*Consejo Nacional de Evaluación de la Política de Desarrollo Social*, CONEVAL).

- D) The visits and visual inspection of the places where socioenvironmental problems are manifested were the fourth step of this research. This consisted in various field visits with the fishermen of the community, as well as a guided visit to the Laguna de Tres Palos with a local stakeholder. The visual inspection was key in the detection of socioenvironmental problems and the knowledge of species with economic value, the fishing techniques and arts, as well as the commercialization of the product inside and outside the community.
- E) Dialogues with the fishermen in the community: the amplification and the knowledge of the fishing economic dynamics were clarified through the knowledge from local stakeholders. At this time of the study, the institutional information was contrasted.
- F) Information processing: the quantitative information was analyzed through the Excel software of the Microsoft Office package with descriptive statistics, and the qualitative data with deductive categories.
- G) Information analysis: the information was analyzed through Excel and Atlas-Ti of the socioenvironmental and economic aspects of the fishing activity: the quantitative analysis was done with independent variables and the qualitative data through discourse analysis.

## RESULTS AND DISCUSSION

### Approaching the local stakeholders

Once the study area was described, approaching the fishermen began in order to understand the socioeconomic dynamics through a structured interview, although it was not enough for the quandary, the commercialization of the production, and the analysis of economic units in the community of study (cooperatives). The local stakeholders considered the following about the fishing economy:

#### Local stakeholder 1:

*“The economy of the community of El Arenal is dependent on fishing and the environmental problems have made us vulnerable because of this, since there is almost no more fish, and when we fish, we cannot eat and there is no income to sustain the households; it is very complicated to have a job without guarantees and the backing programs do not reach this community to face the scarcity”.*

One of the worries that emerged from the dialogues with the stakeholders is the dependency on fishing and the socioenvironmental inequality as basic resource of the local economy and the economic dependency on a natural resource. This economic circumstance is the result of rural productive systems with low diversification and little attention from the institutions; the participants of this research feel economic vulnerability at the local level because the environmental factors of the lagoon sometimes decrease the production of fish and this affects the monetary resource of the fishermen.

On the other hand, the stakeholder describes recognition of the vulnerability that emerges from the absence of the productive model which sustains the community, leading to suggest the following: socioenvironmental inequalities due to the shortage and lack

of recognition of the role of “Fisherman”, lack of strength of fishing cooperatives, and little institutional help which creates deep inequalities in the community with the city of Acapulco (center).

**Local stakeholder 2:**

*“The fishing production decreases when the bar between the lagoon and the sea is closed, since water from the sea that could contribute nutrients to the lagoon does not enter; the drought makes the body of water decrease and young fish are lost because oxygen in the water drops, and in sum, we are left without products to sell and eat”.*

Therefore, a mono-productive economy through fishing dominates in the community, which represents a monetary value and is not only a natural resource that also has an ecological value, but rather a relational value (fisherman-lagoon) that transcends a meaning of welfare and the possibility of satisfaction and sustenance. The community has moved away from other modes of production, they have forged a productive system and human capital for fishing, and thus the loss of the tasks means moving away from welfare.

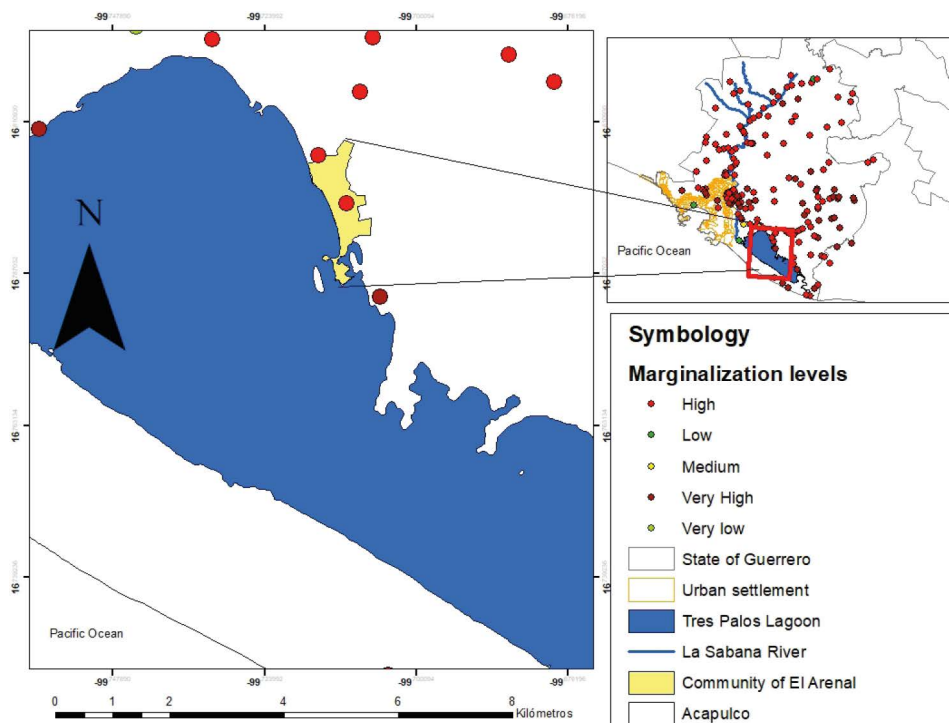
**Socioenvironmental situation**

Regarding the social situation of the community, local stakeholder 3 suggested the following:

*“We feel that Acapulco has forgotten us, the social problems of the city’s growth reach us daily in the form of trash. The social problem lies in that we feel excluded from the opportunities of Acapulco’s tourism model, there is a lot of poverty in the community and a lack of opportunities; when we don’t fish, we don’t have anything to take home and the local government does not support us. On the other hand, there is the garbage issue, because socially Acapulco does not have much environmental awareness, and this is reflected every day in the residues that reach the beaches on the lagoon and inside the mangrove forest. The mangrove is vital because that is where important species that we fish have a hiding place when we don’t fish them; for example, with popoyote we have less income and this makes the problem of residues not only an environmental issue but also a social one because the community does not have residue collection by the local government; the river brings the trash from the high part and the government does not clean it”.*

Likewise, the social situation together with the institutional neglect has derived into a community with a high degree of marginalization (High DM) (Figure 2), and this leads to the assertion that the “institutional neglect”, the scarce management of the municipal, state and federal governments, and the low social cohesion of fishermen are part of the socioenvironmental quandary that still has not been solved. This is how the fishermen explain it:

*“Institutional neglect, Acapulco hoards the public services and does not answer for the welfare of rural communities that are part of a productive system not included in the city’s development”.*



**Figure 2.** Marginalization Index.

Source: Prepared by the authors based on data from the National Council of Social Development Policy Evaluation (*Consejo Nacional de Evaluación de la Política de Desarrollo Social, CONEVAL*).

Therefore, there is evidence of a structural social problem in the DM of the municipality of Acapulco de Juárez; the analysis centers its attention in the communities adjacent to the Laguna de Tres Palos, and it detects that all the communities settled in that area have high marginalization indices. Broadening the spectrum of marginalization, the rural zone of the municipality presents the same characteristic, and it also explains how the economic structure of the communities that depend on the lagoon, even El Arenal, are far from the economic motor of tourism in the city; therefore, they have wagered on fishing and extraction activities for sustenance.

### **Socioeconomic problems of the community of El Arenal**

The abundance of the fishing resource is associated to two factors, mainly the rainy season and the opening of the bar that separates the lagoon from the Pacific Ocean. The first causes an exchange of nutrients with the ocean that stabilizes the salinity of the lagoon and the second removes the nutrients from the bottom and scarcity of oxygen. If these main factors do not happen, they cause an economic problem induced by environmental causes of which there is no control. However, there are variables that constitute an economic problem from fishing and are manageable: contamination of the lagoon by the La Sabana River and overexploitation of the fishing resource.

The problem of fishing in the community of El Arenal lies in overexploitation, breach of closed season, and a rural economy of low development and diversification, as well as



prioritization of the exploitation of an unrenovable resource, exhausting it and leading to a local economic crisis, which explains why the community of El Arenal has deep socioenvironmental problems that are evidenced by inequality and marginalization with a young workforce.

### **Economic activity**

The primary sector is the main sustenance of the community of El Arenal, with a productive system of the fishing exploitation of Laguna de Tres Palos. According to one of the founders of the community, fishing has been the daily productive activity of communities adjacent to the lagoon and it has developed since the decade of the 1960s, when there was a significant economic potential, and the state of Guerrero was supplied from there. However, the appearance of exogenous factors influenced the exploitation of fishing and defined the productive system of artisanal type due to the following causes: the price determined by the market and the contamination of the lagoon. Also, although this phenomenon would not be spoken about until years later, the real estate growth of the city of Acapulco between the 1980s and the 2000s, the tourism economy, the opening of the bar that separates the lagoon from the sea, and the insecurity for fishermen.

This mix of socioenvironmental problems detonated a strong crisis at the economic level in the community from the 2000s until today; the price of production was regulated by the market of offer and demand of the fishing resource and by the high levels of competition; in some moments it made the price of the fish decrease and profits were not generated. On the other hand, it should be clear that the contamination of the Laguna de Tres Palos is consequence of the real estate development of Acapulco, from the La Sabana River, which discharges domestic and industrial residual waters and causes the loss of species with economic importance for the fishermen (Melgar *et al.*, 2021).

The urban growth of the city of Acapulco is a factor that aggravated the stability of many ecosystems like the lagoon systems, the pelagic and inter-oceanic zones and even the Laguna de Tres Palos, and it is well-known that the La Sabana River nourishes the lagoon; it also discharges contaminated water and solid residues that affect the ecosystem, all product of the urbanization that developed in the high zone of the sub-basin and the growth of irregular settlements, which do not have drinking water and a drainage system, whose option is the direct discharge into the river.

The economic tourism model of the city of Acapulco did not integrate the rural zones; instead, it generated an imbalance in the socioeconomic matrix that made a “center” (city) and a “periphery” (rural) emerge. The first responds to a capitalist model and the second to a primary model where fishing and agriculture are part of the livelihood system. On the other hand, the opening of the bar is important because it favors the entry of fish and crustacean species, and the input of marine species that are exploited by the fishermen; however, the bar that separates the ecosystem from the sea many times does not open naturally and there are also political and economic interests, since opening it would imply a mobilization of the municipality’s financial and technological resources and many times the local government is not willing to commit to expenses. Lastly, insecurity started in 2010, power groups stirred the territory and

the community of El Arenal was affected, since it had a local economy that was based on the service sector, fishing and agriculture before, which was reduced and created dependence exclusively on the fishing sector.

### **Commercialization of fish**

Fishing production is distributed through dealers called “brokers” which are people who have monetary, logistic and commercial resources to purchase and resell the raw material in the local, state and even national markets. They act independently as a bridge between the fisherman and the market system, substituting the function of fishing cooperatives which, in theory, should buy the production from the fishermen. The brokers become important figures within the fishing activity because they guarantee commercial dynamism at the local level, and they are included in the productive chain. The fishermen have a good opinion of intermediaries, as explained by the Key Stakeholder 5:

*“The brokers are important because the cooperatives do not buy the raw material; here in the community we do not have income to trade fish with our own means at the state level or throughout Mexico, so we need them, since they guarantee the exit of the fish”.*

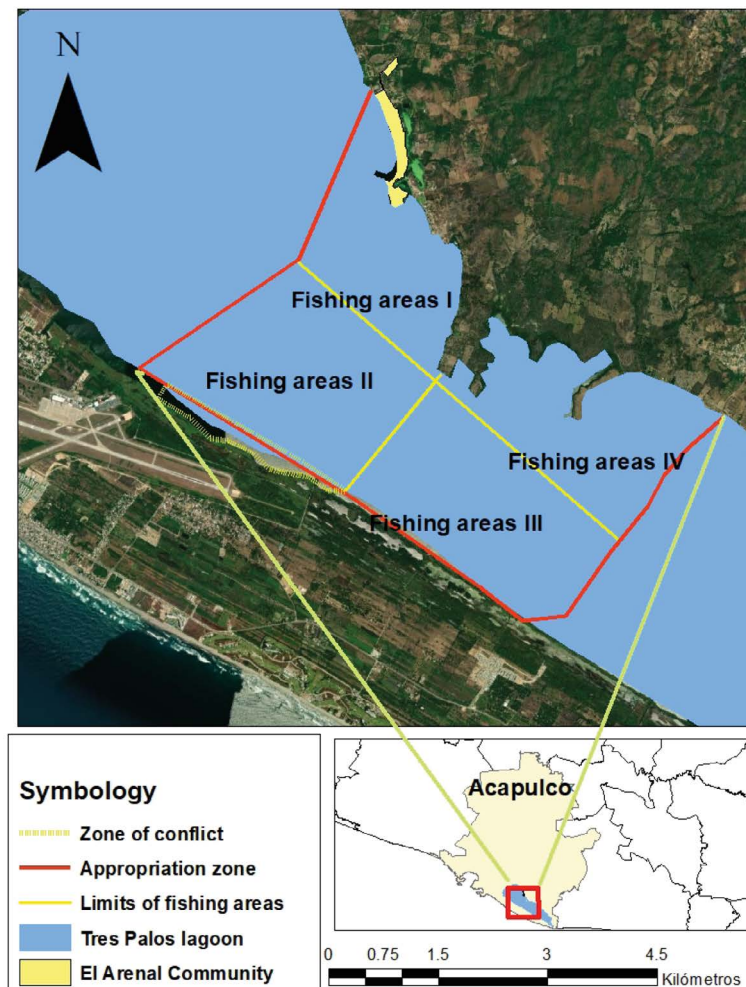
Regarding the sale price of the fish, the free market determines the price; however, the “brokers” have the power to impose quite reduced prices, placing the fishermen at a disadvantage, since they obtain low profits from their work. On the other hand, the broker resells the raw material in the local and national markets at a much higher price than they acquired.

### **Factors of production (lagoon territory)**

Laguna de Tres Palos is a means of production for the community of El Arenal, where the fish is extracted for commercial profit. This common economic zone of approximately 57 square kilometers has led to territorialization of the lagoon, with communities that establish social, political and productive links with the consumption and exploitation of the fishing resource. It has generated a social value of the ecosystem. These fishing areas are identified by knowledge of the fishermen, although other communities can also extract the fish. This equality and mobility make the lagoon a common good for everyone, despite the fixed zones where the communities acquire the resource. The link between these communities is manifested through economic and cultural means. The Laguna de Tres Palos is an economic zone of great importance for the community of El Arenal, since it provides resources such as fish for consumption and commercialization. The various communities have established economic, social and cultural relationships based on the use and exploitation of these resources. This has generated a social value of the ecosystem, in addition to ensuring that all the members of the community have equality or access to the resource. Although there are fixed zones for fishing where members of the community extract the fish, the lagoon is a common good for everyone. These relationships between the communities have been established based on the mobility of the resources, ensuring for all to have equal access.

Based on this, the territorialization and the appropriation by communities adjacent to the Laguna de Tres Palos became a central axis of the local economy. In this sense, a means of production was developed and specialized human capital (fishermen) emerged for the exploitation and extraction of fish offered by the ecosystem. This relationship between human capital and fish extraction resulted in a subsistence model at the community level. The fish has become the main input and the motor of the economy because it materialized in monetary income for the households that live at the expense of the lagoon.

The visits to the study area allowed the identification of a considerable productive force; the fishermen practiced their trade and took advantage of the fishing resource from the lagoon with its fishing arts (*atarraya*, *trasmayo* and string), and the points for fishing appropriation where the fish is extracted were revealed (Figure 3). In dialogue with the Local Stakeholder 1, he described that: “*We know that the lagoon belongs to everyone, but each community has its fishing points; I have been making this journey since I was a child, and we find a lot of fish in these points*”.

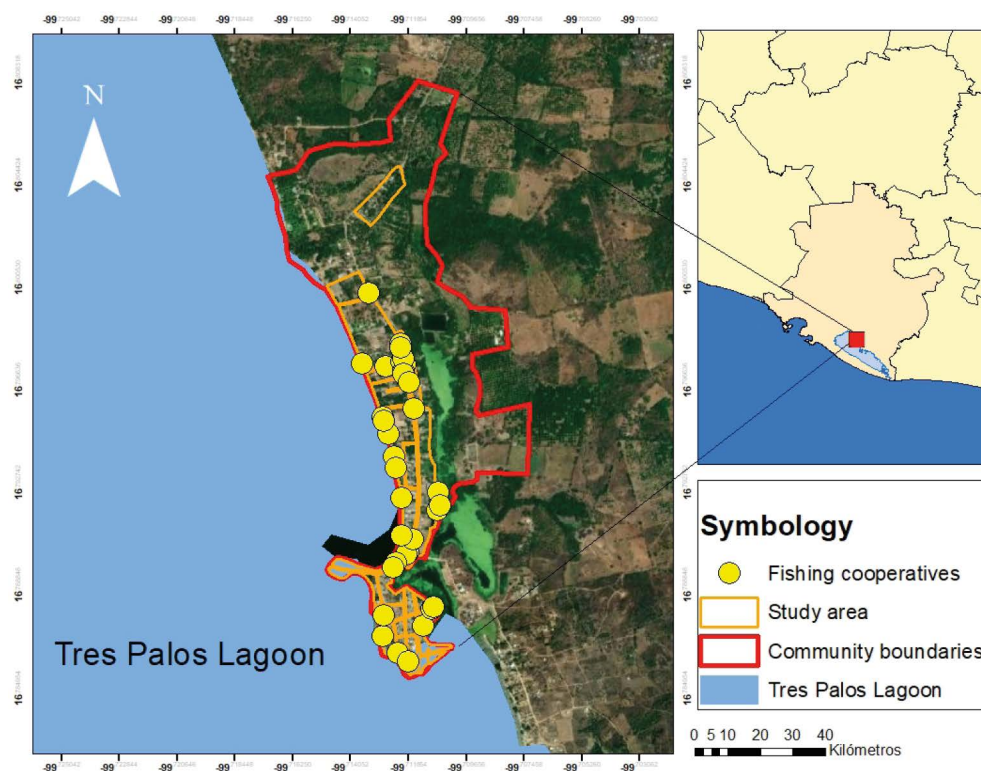


**Figure 3.** Appropriation of the Laguna de Tres Palos and strategic zones for fishing.  
Source: Prepared by the authors with data obtained from the visit by boat at Laguna de Tres Palos with the fishermen.

### Fishing cooperatives

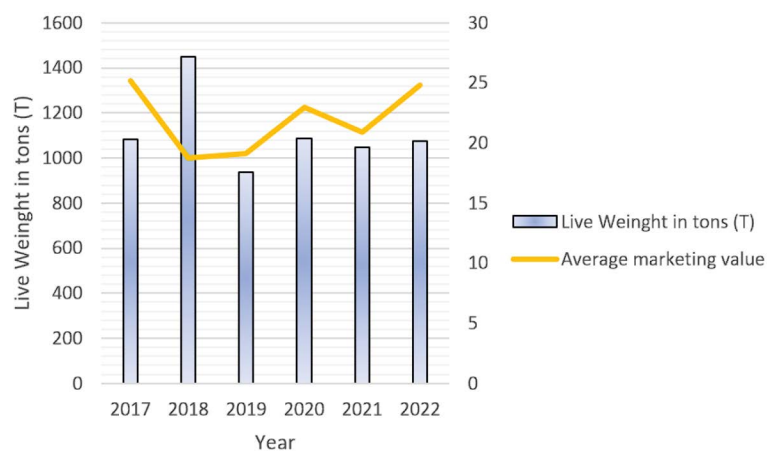
In the community of El Arenal there are 37 fishing cooperatives and they group 385 fishermen, which in theory were created to purchase the production from fishermen and to carry out the productive process within the market for consumption (Figure 4). On the other hand, the function of the cooperatives changed, and now they are devoted to managing monetary resources from the state to strengthen and support fishermen. According to Hernández *et al.* (2021), the cooperatives have a social and organizational function: the dynamization of local productive processes. However, in the community of El Arenal there was a change in the social function of the cooperatives, which did not solve the socioeconomic needs and the socioenvironmental problems —such as those from the community—, and in fact there was no evidence of consolidated community cooperative movement in matters of decision making and management of fishing problems, which resulted in a disorganization of the productive model that would solve many of the problems already described, which are disadvantages in face of other communities that have secured the cooperative movement as a mechanism for organization and strengthening.

Regarding the capture in live weight and the commercialization value, it was analyzed during the period of 2017-2022; there was a growth rate of capture of 13.4% and a variation of average price of 21.2% (Tables 2, 3 and Figure 5). The production has been limited and has been impacted for some years by socioenvironmental problems, for example:



**Figure 4.** Fishing cooperatives of the community of El Arenal.

Source: Prepared by the authors with data from the Statistical Directory of Economic Units (*Directorio Estadístico de Unidades Económicas, DENUE*).



**Figure 5.** Live weight capture and commercialization price (2017-2022).

Source: Prepared by the authors with data from CONAPESCA.

opening of the bar that separates the lagoon from the sea, contamination of residual waters of domestic and industrial origin that are dragged by the La Sabana River, cutting the mangrove, and intensive fishing.

The fishing resource is pressured because of overfishing by all the communities adjacent to the Laguna de Tres Palos; if this rhythm continues, a future exhaustion of the resource is possible, and approximately 10 rural communities live from the fishing activity offered by the Laguna de Tres Palos. This entails an impact on the environmental capital and the ecosystem services, the lack of regulation and control of overfishing would lead to profound changes in the ecosystem and by default in the human settlements that have fishing as a basis of economy.

**Table 2.** Species with economic value for fishing.

Common name	Scientific name
Bagre	<i>Ictalurus punctatus</i>
Camarón blanco	<i>Litopenaeus vannamei</i>
Chacal	<i>Macrobrachium tenellum</i>
Charal	<i>Lile stolidifera</i>
Cuatete	<i>Ariopsis guatemalensis</i>
Huarache	<i>Paralichthys woolmani</i>
Langosta verde	<i>Panulirus gracilis</i>
Langostino de agua dulce	<i>Macrobrachium rosenbergii</i>
Lisa	<i>Mugil curema</i>
Pargo	<i>Lutjanus guttatus</i>
Popoyote	<i>Dormitator latifrons</i>
Robalo	<i>Centropomus nigrescens</i>
Tilapia	<i>Oreochromis niloticus</i>

Source: Prepared by the authors with data from CONAPESCA.

**Table 3.** Capture of species of economic importance in live weight and commercialization value (2017-2022).

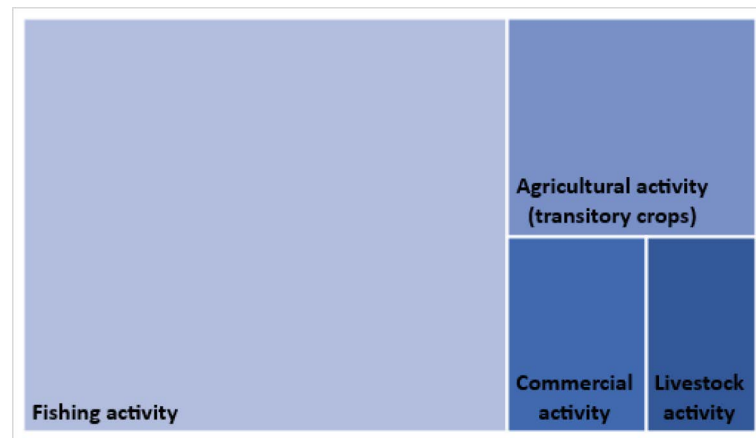
Year	2017		2018		2019		2020		2021		2022	
	LW (T)	ASP *Kg	LW	ASP *Kg	LW	ASP *Kg	LW	ASP *Kg	LW	ASP *Kg	LW	ASP *Kg
Bagre	0	0	0	0	12.7	19.8	3.3	20.4	0	0	9.9	20
Bandera	0	0	306.3	16	277.1	16.7	102	18.6	96.8	20.2	89.2	20.4
Carpa	3.8	40	0.63	14	1.7	12	0	0	3.3	25	3	25
Chacal	12.5	43.5	0	0	0	0	0	0	0	0	0	0
Charal	2.5	37	19.9	12	26.3	10.5	278.5	14.2	675.4	15	696.7	13.4
Charra	5.9	15	8.1	13	0	0	400	15	0	0	0	0
Cuatete	276.4	15	0	0	0	0	0	0	0	0	0	0
Huarache	0	0	0	0	0.85	15	0	0	0	0	0	0
Langosta	0	0	0	0	0	0	0.08	36	0	0	0	0
Langostino	2.3	47.2	22.1	45	73.1	42.5	38.5	40	56.4	33.7	56.9	32.4
Lisa	325.7	14	477.8	14	233.7	16.4	118.7	15.5	93.7	17	93.9	17.3
Mojarra	0	0	311.3	21	309.4	24.3	116.7	25.5	99.1	24.2	106.1	24.5
Pargo	0	0	0	0	0	0	0	0	0	0	1.1	20
Pijolin	0.155	15	0	0	0	0	0	0	0	0	0	0
Popoyote	197	14	304.4	15	0	0	28.5	12	23.3	12.1	17.9	12.4
Tijereta	0	0	0	0	0	0	0.215	25.3	0	0	0.36	27.5
Tilapia	255.8	17	0	0	0	0	0	0	0	0	0	0
Robalo	0.068	19	0	0	1.7	15	0	0	1	20	0.44	60

Source: Prepared with data from CONAPESCA. (LW = Live Weight; ASP = Average Sale Price; kg (kilograms) and t (tons)).

### Economic matrix

The economic matrix was validated with field visits and informal dialogue with the tenants; the fishing activity has a representation of 66% and it is the predominant sector; 17.8% corresponds to agricultural activities. It is important to emphasize that productive systems of backyard agriculture are small-scale, which function as alternative model when there is scarcity of fishing; for example, there are watermelon, legumes and transitory crops that serve as sustenance for the households. The commercial activity has a representation of 8.9% and this sector is not as developed; they are shops and tortilla selling; and lastly, the livestock production sector which has a representation of 7.1% and is not a very developed sector at the local level. These activities have a strong impact on the rural sector and the human needs of the study area. The community of El Arenal has several problems at the economic level: the low diversification of the primary sector and a mono-productive matrix (Figure 6). The development of new forms of social organization is proposed as strategy to protect and conserve the fishing resource, the increase in backyard agriculture, and the strengthening of community links with institutions of power for an optimal consolidation of fishing cooperatives and the minimization of the exhaustion of natural resources.

According to Josephraj *et al.* (2022), in fishing zones of Colombia there was evidence of a strong marginalization, the rural communities have few access paths, and this made the fishermen sell the fishing product to intermediaries at a low cost. This reality is not far from



**Figure 6.** Economic matrix. Source: Prepared by the authors with data from the Statistical Directory of Economic Units (*Directorio Estadístico de Unidades Económicas* (DENUE)), field observation of economic units, and informal dialogue with key stakeholders.

this study, where a strong marginalization has been detected due to the lack of integration of the community of El Arenal with the city of Acapulco, which has eased the emergence of intermediaries or the so-called “brokers” that purchase the fishing product at a low cost and sell it to the local markets. According to Kimani *et al.* (2020), this problem of brokers is a consequence resulting from the lack of guarantees from local governments. However, the commercialization of fishing and the sustainability of households from the communities is achieved, even with low income for the fishermen.

This is related with the function of fishing cooperatives in the community of El Arenal. In theory, these associations have to guarantee the purchase and the commercialization of the fishing product and the search for market niches that ensure the exits of the stock of the fishing product. Likewise, in the study area the fishing activity does not have a positive impact at the local and regional level because communities lack monetary resources, inter-institutional management, and organization between cooperatives. However, in the studies by Samian *et al.* (2022) and Salomón (2023), they found that fishing cooperatives have a great socioeconomic impact and guarantee the purchase and sale of the fishing product to fishermen. The fishing cooperatives contribute to the regulation of prices and manage support programs to reduce the vulnerability of the social capital; the cooperative movement has been important to stop the appearance of monopolies and to avoid overfishing and the intermediaries that place fishermen at an economic disadvantage.

On the other hand, the socioeconomic problem of coastal fishing in El Arenal is the lack of management and planning of the fishing resource and the lack of programs for the mitigation of overfishing, in addition to the breach of the closed season that generates a strong pressure on important species for the social, economic and ecological scope (Juárez *et al.*, 2019; Sandoval *et al.*, 2020). The socioeconomic problem of the fishing activity is similar and has been detected by Makwinja *et al.* (2021), where the Molombe Lake (Malawi) was affected from overfishing, the lack of imposition of closed seasons and of community leadership to stop overfishing and the recovery of lagoon resources also,

causing a loss of social capital and a deceleration in the regional and local development of communities.

Fishing is linked to a territorial conception that allows fishermen from the community of El Arenal the legitimate right to take advantage of the resources from the Laguna de Tres Palos. With time, this lagoon has been territorialized and has become a common economic zone for the subsistence of the community. This appropriation of the lagoon has also generated social, political, and productive links related to the consumption and use of the fishing resource. This has also created a social value of the ecosystem thanks to the knowledge of fishermen about the fishing areas, ensuring that they all have equal access to it. However, for Song and Soliman (2019) and Lechuga *et al.* (2021), the right to fishing territory leads to a process of governance and conceptualizing the relationship of the individual with the productive territory is a challenge in terms of the fishing exploitation and the recognition of rights of fishermen on the use of the space. The productive territories for the use and exploitation of fishing still have problems in terms of the recognition, the legitimation of the fishing task, and the role that fishermen play within the local economies. Likewise, it opens the window to few socioeconomic guarantees on those territories that became productive for fishing and the sustainability of the communities.

On the other hand, Raycraft (2019) and Castillo and Mariano (2020) found similarities. The fishing activity led to processes of governance at the community level because the participation of fishermen, the management and the knowledge about the ecosystem for exploitation have contributed to a territorial configuration of the link and the social recognition of an ecosystem that provides welfare. However, this study has not reached an analysis of the presence of governance of fishing in the communities adjacent to the Laguna de Tres Palos; if the socioeconomic development is linked to territorialization of that lagoon and perhaps there are possible leaderships that serve or act as an instrument for scenarios of fishing governance, and which allow greater guarantees within the economic process and the institutional stakeholders involved in local economies.

## CONCLUSIONS

The production model based on fishing generated overfishing at the Laguna de Tres Palos. The communities adjacent to the lagoon would be the ones most affected, even El Arenal, given that the primary economy has low diversification. On the other hand, fish production is in an economic scheme where “brokers” play an important role in the commercial dynamics. The low function of the cooperatives to fulfill the role of facilitators between the commercial relation of the fisherman and the local market has been minimal. All in all, one of the socioeconomic problems is the few guarantees that the community has in times of scarcity. On the other hand, institutional neglect is an element that contributes to the problem due to the lack of support programs, as well as “temporary employment”. In addition to this situation, there is centralism of Acapulco and scarce attention to the rural communities that was evidenced in the high marginalization that displaces the possibility of accessing basic services and overcoming human needs (education, employment, health, and water).



On the other hand, within the production factors, something that stands out is the knowledge of locals about the loss of biodiversity from overfishing at the Laguna de Tres Palos; the local stakeholders who participated in this research considered that the excessive exploitation without respecting closed seasons ultimately determines the interaction with the ecosystem and the attainment of a future for the product; this is explained by the relationship of economic dependency on a resource and a local economy that has low diversification, sustained by fishing cooperatives.

Fish reproduction and fishing is mediated by the opening of the bar which favors the exchange of sediments and salinity, and the influx of marine fish with economic value, as well as climatic factors and rainfall that increase the abundance of species. Community participants express a social and cultural rootedness with the lagoon, which is perceived as a common economic zone that favors the sustainability of the households.

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