



RESEARCH ARTICLE

PERCEPTION AND ENVIRONMENTAL KNOWLEDGE OF ANTHROPOGENIC ACTIVITIES IN A COASTAL COMMUNITY

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ABSTRACT

The ecosystem services provided by coastal zones have been severely affected by anthropogenic activities. The purpose of this study was to determine both the perception of residents of a coastal town on their environmental issues; as well as the empirical knowledge that they have developed over the years, with which environmental education strategies can be established for the sustainable use of their natural resources. The study was carried out in three localities settled around the Nuxco lagoon, Guerrero, Mexico, applying surveys to settlers and interviews with key informants. The results show that the inhabitants perceive strong anthropogenic pressures both in their locality and in the water body, which is an essential part of their economic activities and sustenance for their families. The perception and the environmental knowledge manifested must be considered in environmental education programs and in the design of strategies for the mitigation and prevention of anthropogenic impacts in the community.

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INTRODUCTION

Coastal areas provide important ecosystem services necessary for the development of various species including humans. However, diverse anthropogenic activities exacerbate the loss of goods and services that support the communities settled along the coastline, impacting these areas and contributing to climate change (Poudel *et al.*, 2017; Sánchez-Arcilla *et al.*, 2016; Sun *et al.*, 2015). Several problems are perceived, especially rapid urbanization and the expansion of economic, social and cultural activities resulting in diverse changes in the dynamics of these ecosystems (Cai *et al.*, 2016; Mateus *et al.*, 2016; Wang *et al.*, 2016; Xu *et al.*, 2016).

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In Latin America, coastal lagoons are among the most threatened ecosystems on earth due to multiple factors, including high consumption and overexploitation of natural resources (Castro-Tavares *et al.*, 2015; Palazón *et al.*, 2016). The lack of an environmental culture in local people and the lack of government initiatives towards a sustainable management of these ecosystems, evidence a complex system that difficult their prevention and adaptation to anthropogenic changes (Chatton *et al.*, 2016; Pascual-Aguilar *et al.*, 2014; Milanés and Pacheco 2011). This situation cause inadequate management of natural resources and a deterioration of the environment (Rojas-Maturana and Peña-Cortés 2015). In addition, the lack of the transfer of environmental knowledge among generations, results in a progressive loss of a culture associated with good practices and awareness towards the environment (Borroto-Pérez *et al.*, 2011). The perception of local population on the environment and on anthropogenic

changes is fundamental to design mitigation strategies for a sustainable use at the local, as well as at the national level (Aswani *et al.*, 2015). It is also important to consider the traditional knowledge of the inhabitants that can set the guidelines to favor the management and sustainable use of natural resources, although unfortunately, this type of knowledge is not usually taken into account for the design of management plans and do not take into account the real social and economic needs (Báez-Ponce and Estrada-Lugo, 2014). The relationship between human beings and their environment is largely a reflection of the environmental perceptions that each individual appreciates and how much value their environment, and their knowledge provides elements that can contribute to its conservation (Olmos-Martínez, 2016; Moyano, 2009). Therefore, public participation should be focus the environmental policy (Fernández-Moreno, 2008). Nevertheless, Mexican environmental policy reflects more the perceptions, visions and interests of decision makers rather than those of the local population Subirats (1995), which may compromise the success of management plans or public programs (Olmos-Martínez, 2016; Fernández-Moreno, 2008). Given the above, there is a need to carry out research that provides information on the environmental perception of local populations, in order to make more effective the implementation of both public policies on environmental issues, as well as environmental education programs for the conservation and sustainable use of these ecosystems (Olmos-Martínez, *et al.*, 2013; Fernández-Moreno, 2008; Subirats, 1995). The objective of this study is to know the perception and environmental knowledge of the inhabitants of the localities settled around the coastal lagoon of Nuxco, Guerrero, Mexico to identify the main anthropogenic disturbances in the locality to, what in the future will allow establish environmental education strategies for prevention and reduction of negative impacts on the environment, as well as a sustainable use of their natural resources.

MATERIALS AND METHODS

The study area include the towns of Colonia Veinte de Noviembre (705 inhabitants), Los Tarros (110 inhabitants) and Costa del Sol (8 inhabitants), which are settled around the lagoon of Nuxco, located in Tecpan de Galeana, Guerrero (17 ° 12' 15.29" N; 100 ° 47' 52.45" W; Fig. 1) (INEGI, 2010). These places have a high degree of marginalization and social backwardness; being the main economic activities the fishing, agriculture and livestock (SEDESOL, 2010). The lagoon of Nuxco is characterized by a marine estuarine environment, with a variable salinity throughout the year with a mean annual temperature of 32 degrees Celsius, a mean annual precipitation of 900 millimeters, an altitude of 20 meters above sea level, lower dissolved oxygen and high diversity of species (Mañón, 1985). Several plant species were found in the lagoon, including the four mangrove species: buttonwood (*Conocarpus erectus*), red mangrove (*Rhizophora mangle*), blackmangrove (*Avicennia germinans*) and white mangrove (*Laguncularia racemosa*). Among the commercial aquatic species, stand out the snapper (*Lutjanus novemfasciatus*), the snook (*Centropomus undecimalis*), the crab (*Callinectes sapidus*), the white mojarra (*Gerres cinereus*), the shrimp (*Farfantepenaeus paulensis*) and the mussel (*Mytella strigata*). The study area has a total population of 823 inhabitants, in the three localities, within the area of influence. To determine the environmental perception of the inhabitants, a sample was determined with a confidence index of 90%, following Lohr and Velasco (2000).

A pilot test was applied to a group of villagers to formulate the final questionnaire, which was applied to 128 inhabitants. The surveys consist of a series of 47 items, organized into several sections: socioeconomic data, basic sanitation, occupation and environmental perception. Once knowing the occupation of the respondent, another survey of 15 questions related to the ways in which develops its economic activity was applied. Key informants were identified and interviewed, using as a reference the residence time in the town, its economic activity, experience and perception that they had concerning problems affecting the water body (Silva-Lira, 2003). Data from questionnaires were analyzed with the statistical package SPSS version 20.

RESULTS

The surveyed population was comprised of 62.5% men and 37.5% women. Around 62 % were 45 years old or older and with more than 20 years living in the locality. Most people live without potable water, sewage services, health and garbage collection. Regarding to the occupation of the people, 36% is devoted to fishing, 23% to housekeeping, 13% to agriculture and 9% to commerce.

Environmental perception

Since there is a lack of waste collection, sewage water and garbage usually ends inside the lagoon. According to the survey, 52% of the population recognized that threw their garbage anywhere. The inhabitants perceived a series of environmental problems that needed to be addressed urgently; including discharge of wastewater and solid waste, dumping of agrochemicals, and deforestation of the mangrove (Figure 2). As proposals to resolve these environmental problems, most people (61%) considered the need to implement environmental education workshops, whereas other considered that conservation actions (14%) or rehabilitation activities (9%) should be taken. Most villagers considered the mangrove as a very important resource, and exploited mainly for firewood (64%), for construction of cabins (18%), and for fencing (14%). Since most of the land around the lagoon is destined to agricultural activities, many farmers (82%) applied chemical fertilizers without a technical advisor or specialist in agricultural products. They stated that a large part of these agrochemicals ends up into the lagoon, contaminating it. The 77% of farmers reported that they did not perform crop rotation and 48% practiced slash and burn before planting, 36% used tractor machinery and 16% applied chemical herbicides. Most of the farmers (36%) sold their products in the municipal market, while others went from house to house or used them for their own consumption (24%), delivered to the marketer or hoarder (20%) or sold to the local market (20%). Finally, all the farmers mentioned that they do not have any contact with any educational institution or with any institution of the government. In relation to fishing, all fishermen said that they extracted all kinds of species ranging from those with little commercial value to those of high value by using any implement that they have, including garnets, nets, ropes, some of them prohibited by national official standards (i.e., NOM-064-SAG/PESC/SEMARNAT-2013). For instance, the trammel nets, which capture large quantities of juvenile fish that have not reached their reproductive stage. The most common mesh size they used is of 2.5 inches (63%), followed by 3 inches (25%), and greater than 4 inches (7%). Moreover, most of the fishermen (69%) say that they caught 4–8 kg per day, almost all days of the week.

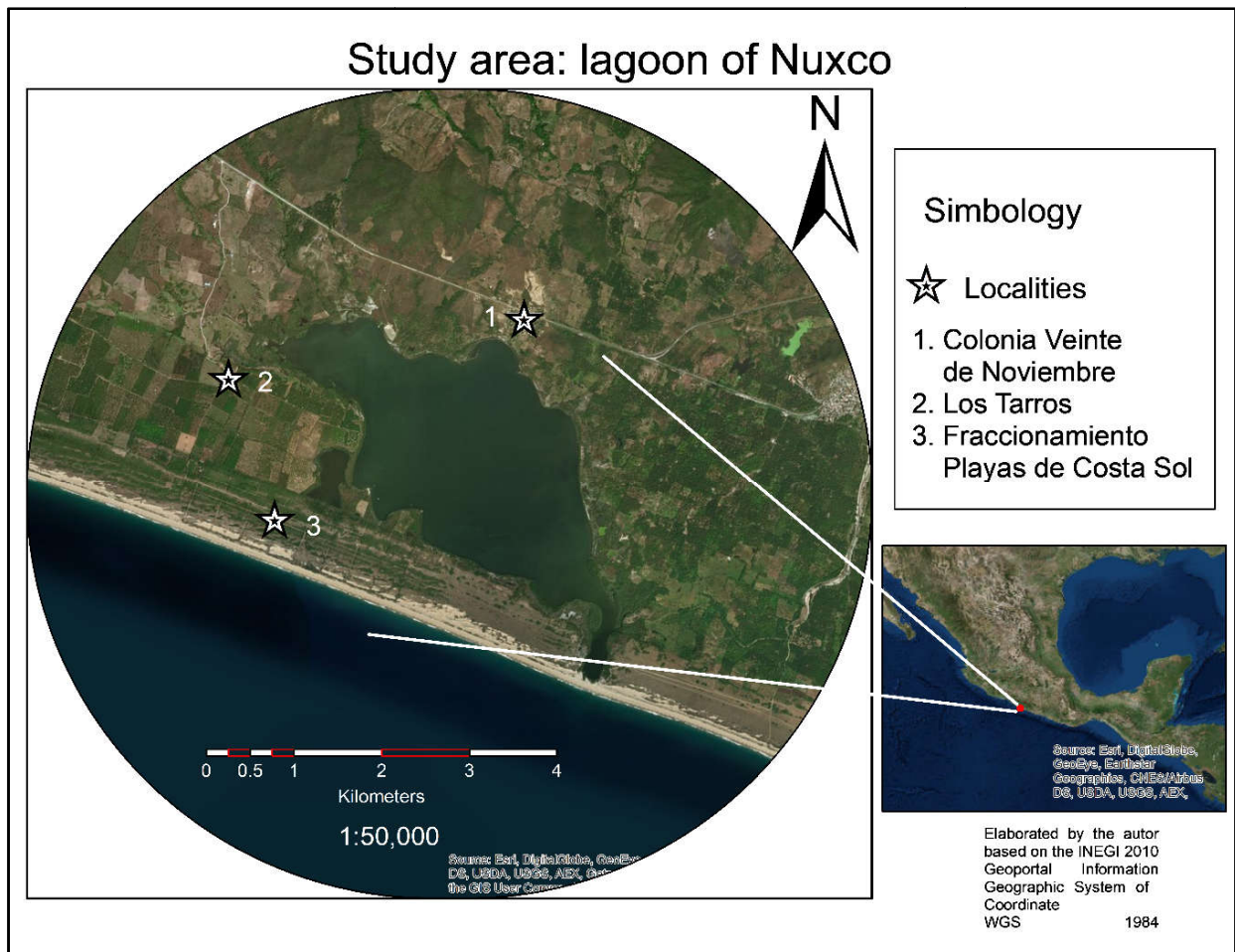


Figure 1. Location of the study area

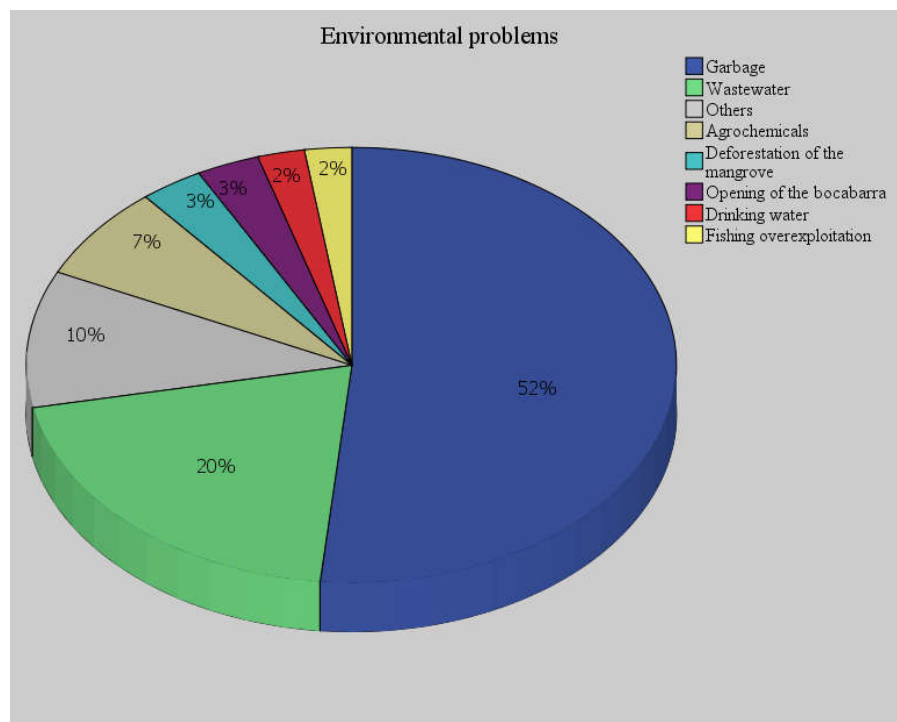


Figure 2. Principal environmental problems as perceived by villagers

The residents referred not to have a rapprochement with any educational institution nor with any institution of the government.

Regarding to the opinion of the amount of the fishing in the lagoon, 77% said it is fair, 10% said it is excellent, 10% said it was good, and 3% said it was bad.

The 68% of fishermen sold their product to a marketer or a hoarder, 15% to the municipal market and 17% elsewhere.

Environmental knowledge

The key informants focus their concern on the lagoon since it is the habitat on which the economic activity of the majority of the population depends. They pointed out that twenty years ago this body of water was an important area for the extraction of salt and that the fishing resource was abundant. However, they perceive changes in the abundance of aquatic species, as well as disturbances in the mangrove and in the landscape. They also perceived that the lagoon was impacted mainly by the dump of solid wastes, agrochemicals and wastewater in the body of water, as well as the use of devastating fishing techniques that capture juvenile species. The interviewers believe that the lagoon is an ecosystem of great relevance due to the diversity of flora and fauna, highlighting the importance of the aquatic species, mainly the fishes due to their commercial value and as sustenance for the fishermen. They also consider valuable a species of mussel *Mytella strigata* as it serves as a biofilter having an essential role in the balance of the water body.

In relation to fishing activity, they do not have a management plan aimed to a sustainable fishing, there are no local agreements and they are not very organized. The words of a fisherman were "depending on the time and what may abound is what we fishing, the aim is to bring sustenance to the house, because we have to eat something", even if they need to use a fishing gear that impacts severely the fish population. At present, some agreements among the fishermen like eradicating some fishing gear that impact the ecosystem have been established and many fishermen are working in raising awareness in their peers to regulate the fishing. However, there is a lack of support and vigilance by the government and some were not willing to modify their current fishing activities. During the wet season there is a large volume of fluvial discharge and the level of the lagoon increases to such an extent that floods some wells which are salinized, as well as some paddocks and agricultural fields. Those wells are used for agricultural irrigation and for livestock consumption; which creates a nuisance dedicated to these agricultural activities. In addition, the increase of the level of the lagoon obstructed the main path to reach it. Therefore, a conflict among the fishermen, the farmers and the ranchers occur when the sandspit, that isolates the lagoon from the sea, is opened. Given all the aforementioned environmental problems, the key informants revealed that is necessary the intervention and monitoring of government agencies to guide towards the implementation of laws and regulations for the conservation and sustainable use of the resources. They also mentioned that the implementation of workshops for environmental awareness, as well as constant clean-up programs and efficient management of solid waste are needed.

DISCUSSION

The environmental perception serves as a tool to know the main problems that the population perceives in their community, the strategies that inhabitants have implemented to solve them, the willing to train and change the way they manage their resources and if they are interested in being part of the decisions of public policy and governance of their locality, as well all orienting towards what is convenient or what is more suitable (Calixto and Herrera, 2010).

It is important to note that social participation is a key factor to identify the main environmental problems that can impact the natural resources, specially for the high degree of marginalization of the locality (SEDESOL, 2010). The lack of organization and environmental education are some of the main reasons why the inhabitants carry out an exploitation of their natural resources without an awareness nor environmental commitment about the damage to the ecosystem putting at risk the future existence of these resources to future generations. Many respondents have more than 20 years living in the localities which allow us to investigate how natural resources have been changing across the years in the lagoon, how is the dynamic of the ecosystem, and how is the adaptation and resilience of this ecosystem towards human impacts (Kiley *et al.*, 2017). The main problems perceived by these people were the presence of solid wastes and wastewater in the lagoon. They believe that these environmental problems were not solved because of the lack of public policies by the municipal government, the lack of strategies with low environmental impact, and the lack of management plans (Barboza-Guzman, 2013; Fernández-Tarrio, 2009). However, given that these problems were caused mainly by their key economic activities (agriculture, livestock, and fishing); it is difficult that the government or educational institutions could be involved in the solution (Rochette, 2009).

For many years, the main economic activity of the inhabitants is fishing, which has been impacted considerably. If this trend follows, it may occur a similar scenario as that observed in the bay of Aracá, Brazil with Mani-Peres *et al* (2016), where both biotic and abiotic changes results in pollution, reduction of marine fauna, decrease in mangrove coverage and changes in the sediments and hydrodynamics. Therefore, Choudri (2016), mentioned that is necessary to alert villagers about the possible consequences of a unsustainable use of this resource through programs of environmental education to the community and being aware of the impacts and adopt environmental mitigation measures. In addition to fishing, another main economic activity is agriculture, so most people refer the huge use of chemicals on crops as another important environmental problem. Thus, a strategic plan focused on fishermen and farmers is necessary (Gier, 2017).

To create the necessary strategies to stop the negative impacts caused in the environment, it is also important to point out the knowledge the inhabitants have developed over time. So, these perceptions and attitudes could be integrated as part of the solutions to the local problems mentioned previously (Elrick-Barr *et al.*, 2017; Romagosa and Pons, 2017; Roca *et al.*, 2015). Currently, coastal communities are among the world's most threatened biomes due to climate change and creates economic uncertainty developed throughout the coastline Bunce *et al* (2010), so that coastal communities need to understand the importance of these ecosystems and its function in relation to climate change (Munji *et al.*, 2014; Mycoo and Gobin, 2013; Glavovic, 2013). Therefore, it is important to establish links with the inhabitants, which known in a certain way the dynamics of these ecosystems, as well as the changes that they have suffered through time, the impacts and the causes that could originate them. For a decision making from the local and the implementation of strategies that lead to the sustainable use of this natural resources, the experience of these people should became a binomial with the knowledge of the investigator.

Conclusion

The inhabitants of the locality of Nuxco are able to perceive different environmental problems in their ecosystem and understand that part of the impact caused to the environment is associated with the various activities they performed daily but that they need to do for their own sustenance. They perceived several environmental problems, including the excessive use of chemicals that end up in the lagoon, mangrove deforestation, overfishing, capture of juveniles species and the lack of a treatment for wastewater to decrease pollutant concentrations ending in the body of water. However, they considered the garbage as the main environmental problem, mainly due to the lack of environmental culture and the lack of both local and governmental strategies. In addition, they realize the importance of the establishment of programs and strategies related to the care and sustainable use of their natural resources. The environmental perception of the population joined with the knowledge acquired through several years by the settlers are key factors to the implementation of these strategies, since they conceive the effects of inadequate practices that could deplete their natural resources that supports themselves and their families and to implement actions to adapt to climate change.

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