

PERCEPÇÕES DE DISTÚRBIOS SOCIOAMBIENTAIS RELACIONADAS ÀS MUDANÇAS CLIMÁTICAS AO LONGO DE UM ESTUÁRIO TROPICAL NO BRASIL 7° SUL

PERCEPTIONS OF SOCIAL-ENVIRONMENTAL DISTURBANCE RELATE TO CLIMATE CHANGE ALONG A TROPICAL ESTUARY IN BRAZIL 7° SOUTH

PERCEPCIONES DE ALTERACIONES SOCIOAMBIENTALES RELACIONADAS CON EL CAMBIO CLIMÁTICO A LO LARGO DE UN ESTUARIO TROPICAL EN BRASIL 7° SUR

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RESUMO: A crise climática é o principal problema ambiental contemporâneo, especialmente, nas regiões pobres dos países mais pobres, submetendo o ser humano a múltiplos e complexos desafios relacionados aos meios de subsistência, à ocupação dos territórios costeiros, expondo comunidades carentes a condições de extrema vulnerabilidade. O objetivo deste trabalho é avaliar a percepção de pescadores, gestores, especialistas e leigos sobre as vulnerabilidades sociais impostas pelas mudanças climáticas e elevação do nível do mar no ambiente costeiro e estuarino paraibano em 2017 e até 2050. A pesquisa utilizou uma abordagem quali-quantitativa para descrever e analisar a percepção de diferentes atores, relacionando problemas sociais influenciados pelos impactos das mudanças climáticas: no custo habitacional, na migração das comunidades costeiras e estuarinas, na saúde e índices de violência, se algo está sendo feito para aumentar a capacidade de adaptação. 73% dos que têm poder institucional acham que em 2050 as casas de praia terão maior valor. Porém, 75% deles prevêem que até 2050 as comunidades costeiras próximas à água serão removidas, gerando diversos tipos de conflitos, além de perdas financeiras. Enquanto as percepções das comunidades de pescadores são muito mais preocupantes. Todos os entrevistados esperam taxas crescentes de violência devido a um ambiente hostil.

Palavras-chave: Mudanças climáticas. Percepção de risco. Vulnerabilidade socioambiental.

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ABSTRACT: Climate crisis is the main contemporary environmental problem haunting everyone, especially the poor regions in the poorest countries. It subjects the human being to multiple and complex challenges, mainly related to means of subsistence in occupation of coastal territories, exposing poor communities to conditions of extreme vulnerability. The objective of this work is to evaluate the perception of fishermen, managers, specialists and lay people about social vulnerabilities imposed by climate change and sea level rise in the Paraíba-Brazil coastal and estuarine environment in 2017 and up to 2050. The research used a qualitative-quantitative approach to describe and analyse different actors, relating social problems influenced by climate change impacts: on housing prices, coastal and estuarine communities' migration, health and wellbeing, violence and if something is being done to enhance the adaptive capacity. 73% of those who have institutional power think that in 2050 beach houses will have greater value. However, 75% of them expect that by 2050 coastal communities close to water will be removed, causing and stirring up various types of conflicts, as well as financial losses. The fishermen communities, however, are far more concerned. Every single respondent expects rising rates of violence due to a hostile environment.

Keywords: Climate change. Risk perception. Social-environmental vulnerability.

RESUMEN: La crisis climática es el principal problema ambiental contemporáneo que afecta a todos, especialmente a las regiones pobres de los países más desfavorecidos. Esta somete al ser humano a desafíos múltiples y complejos, principalmente relacionados con los medios de subsistencia en zonas costeras, exponiendo a las comunidades pobres a condiciones de extrema vulnerabilidad. El objetivo de este trabajo es evaluar la percepción de pescadores, gestores, especialistas y personas ajenas al sector sobre las vulnerabilidades sociales derivadas del cambio climático y el aumento del nivel del mar en el entorno costero y estuarino de Paraíba (Brasil), abarcando el periodo de 2017 a 2050. La investigación empleó un enfoque cualitativo-cuantitativo para describir y analizar a los distintos actores, relacionando problemas sociales influidos por los impactos del cambio climático: precios de la vivienda, migración de comunidades costeras y estuarinas, salud y bienestar, violencia y las medidas adoptadas para mejorar la capacidad de adaptación. El 73 % de quienes ostentan poder institucional considera que, en 2050, las casas de playa tendrán un mayor valor. No obstante, el 75 % prevé que para entonces las comunidades costeras situadas cerca del agua serán reubicadas, lo que provocará diversos tipos de conflictos y pérdidas económicas. Por el contrario, las comunidades de pescadores muestran una preocupación mucho mayor; la totalidad de los encuestados prevé un aumento de la violencia derivado de un entorno hostil.

Palabras clave: Cambio climático. Percepción del riesgo. Vulnerabilidad socioambiental.

INTRODUCTION

Climate change exists and it is a consensus among scientists Bayes, *et al.* (2023), it is exacerbated by human interventions of different forms and intensities at different scales of time and space Lorenzoni e Whitmarsh (2014). Climate disturbances interfere directly and indirectly in several international strategic interests, such as geopolitical arrangements, national sovereignty, energy matrices, economic competitiveness and political and scientific representation Parry *et al.* (2007).

The changes in the environment represent a threat to the current way of life, contemporary world is subordinated to two major global synergistic processes: climate change and economic globalization; sectors, ecosystems and social groups are subject to a double exposure Leichenko e O'Brien (2002). The susceptibility to impacts by the association of economic and climatic crises is already experienced and perceived in different ways depending on the age, gender, social class and level of social organization of the individuals and groups Chidakwa *et al.* (2020). Poverty, social exclusion, the occupation of potential risk areas, rapid urbanization and deep social inequalities are determinant for the worst direct or indirect climate consequences on human health and quality of life.

Data from global atmospheric reanalysis point out that the world's lowest income countries have experienced more intense climate changes. In Northeast Brazil projections suggest rising temperatures and decreasing rainfall may reduce productivity in a short time, threatening food security for the poorest populations Nobre *et al.* (2019). Precipitation decline also tends to affect the flow of rivers in Northeast basins, which are fundamental for energy generation, its costs, and irrigation.

Regarding fishing activities, the predicted effects of climate change can be divided between those that will harm fishing infrastructure and safety on leaving for fishing, and those that will affect the biological and ecological dynamics of resources catching. The increase in sea level and the increase in the frequency and intensity of storms will mainly affect fishing communities, since they live in the lower areas and near the sea, where climatic conditions are a fundamental factor in the daily fishing Faraco (2013).

Despite these stresses, social factors have not been adequately considered in climate change scenarios, reducing the ability to adapt to new disturbances, which delayed the exchange

of information between biophysical scientists, social scientists, and affected communities Moss *et al.* (2010). Besides physical impacts, a number of coastal communities face additional socioeconomic challenges such as geographic isolation, poor housing, transient populations, population aging, youth emigration, high proportions of retirees, over-reliance on tourism, seasonal employment, low income and pressure on services during high seasons, low political representation and exclusion from the public policies of assistance Atterton (2006).

Climate change has increasingly been recognized as a security problem because it expresses the risk of multiplying violent conflicts for a variety of reasons in some of the most volatile regions of the world, including disputes over water, energy, natural resources, food security and climate refugees, among others Barnett e Adger (2007).

The effectiveness with which society responds to risk depends on how that risk is understood by the citizens. Risk perception studies examine the judgments people make when asked to identify and evaluate activities, phenomena and technologies that pose threats to life Slovic (1987). The role of this research is to contribute to the accumulation of knowledge and collective strategies and techniques understanding regarding environmental change, that are recognized and accepted by the population. Such knowledge provides an important basis for informed and well-founded actions, which can avoid wasting human and financial resources Stern (2008).

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The objective of this work is to evaluate the perception of fishermen, environmental managers, professors and lay people about socio-environmental issues (housing and relocation, health and well-being and violence) exacerbated by climate change and sea level rise on the coast of Paraíba, Brazil today and in 2050. Subjectively, aiming to reduce information asymmetry among the stakeholders in an interdisciplinary approach, crossing knowledge, wisdom and perspectives from different actors, sectors and their expertise on current and future risks.

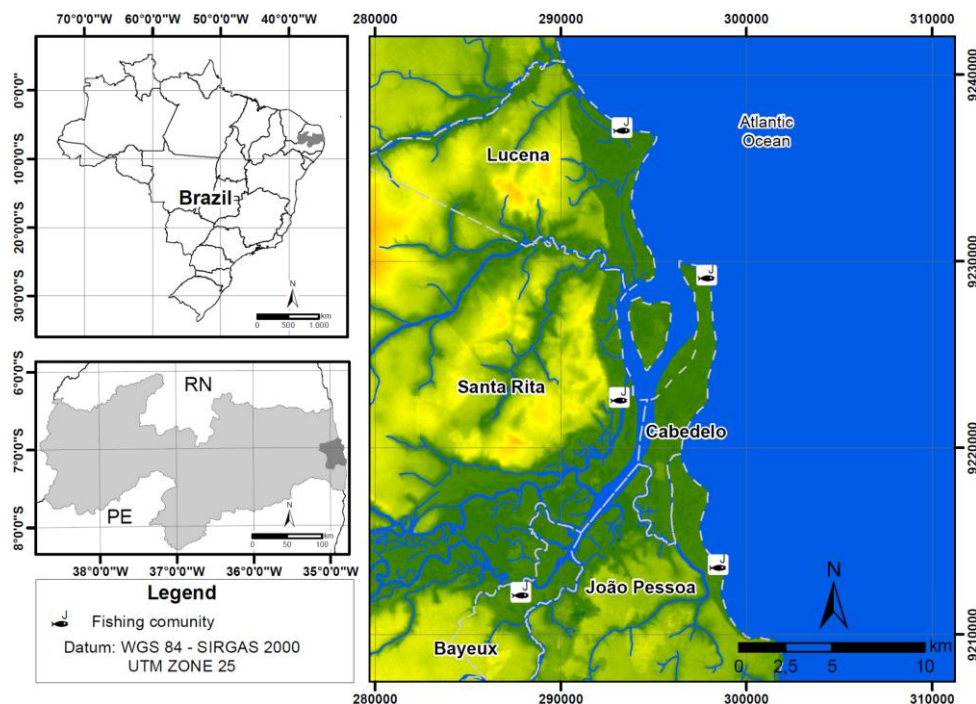
The lack of continuous primary data on the coast of Paraíba, particularly in tropical northeast Brazil, bathymetric charts and tide data with good resolution and the strong presence of traditional populations - artisanal fishermen, quilombolas and indigenous groups make this perception research more relevant. Another factor to be taken into account is the high illiteracy rate in the Northeast region of Brazil. This traditional knowledge has been handed down from generation to generation orally. This adaptive memory is valid and valuable knowledge that

must be considered in any search for impact reduction. Thus, Traditional Ecological Knowledge plays a key role in fisheries management, community-based resource management, and conservation efforts in the Global South Awazi, N. P. (2025).

METHODOLOGICAL PROCESS

The Paraíba River estuary (Figure 1) is an excellent place to study perceptions about the complex consequences of climate change and sea level rise, since it receives waters from the largest drainage in Paraíba and is being threatened and impacted by a range of interests in the region Marcelino *et al.* (2005). On the right bank there is a Port, activities such as tourism, sport fishing, subsistence fishing and leisure, contrasting with the left bank, where the area is mostly used for shrimp farming, navigation, storage, waste disposal and domestic sewage disposal.

Figure 1: location of the fishing colonies heard i this research



Source: Figure elaborated by the authors

The estuary of the Paraíba River bathes the capital of the state of Paraíba, João Pessoa, the municipalities of Santa Rita, Lucena, Bayeux, Cabedelo, with an estimated population of 1,170,915 inhabitants. The State of Paraíba presents a Human Development Index (HDI) of 0.658 in 2010, the 23rd in the 26 states and the Federal District Atlas (2014).

COLLECTION AND DATA PROCESSING

The mental models methodology developed by Morgan *et al.* (2002) and oriented to coastal zone by Thomas *et al.* (2015) employed instruments in order to produce and analyse the results. The technique consists in comparing perceptions (mental models) that specialists and residents of areas vulnerable to disasters have about the studied problem. Through semi-structured interviews, individuals respond to any aspect that they feel is more important, in a way that has meaning to them. This research also used a quantitative approach, exploring the perception of lay people randomly selected from the area studied.

In order to obtain the perception of the local population, five focus groups were conducted with artisanal fishermen colonies with an average of five fishermen per group. The communities selected as the target of the research were Costinha, in Lucena; Forte Velho, in Santa Rita; Porto Moinho, in Bayeux; Porto do Capim in João Pessoa and Cabedelo fishermen colony.

The experts/managers interviewed were selected based on their professional experience, the representativeness and responsibility of the positions held regarding impacts and emerging socio-environmental within the estuary, make up the same category. Eighteen interviews were conducted, of which thirteen were addressed to university professors and managers in the research, treated as specialists, who in some way interact with the problems of the climate crisis. Teachers heard are from public universities near the estuary, such as the Federal University of Paraíba - UFPB, the State University of Paraíba - UEPB, the Federal Institute of Paraíba - IFPB, Federal University of Campina Grande - UFCG. Managers' perception was addressed to representatives of the public administration involved with the research problem among which were representatives of the State Civil Defense, the Secretariat of Patrimony of the Union (SPU), the Superintendency of Environmental Administration (SUDEMA) the Executive Agency for Water Management (AESAs), the Municipal Secretariats of the Environment and the Chico Mendes Institute for Biodiversity Conservation (ICMBio). On behalf of the ethics committee, the names of the interviewees and the focus groups are not disclosed to keep them confidential at the end of the researcher's commitment to the interviewees as well as at the end of the agencies' agreement.

Only at the time of the interview, the participants were informed that the study was about the perception and knowledge about the consequences of climate change and sea level rise. This approach excludes the possibility of alteration of previous knowledge and reformulation of the mental model. It makes it possible to compare current scenarios and information asymmetry that helps to comprehend the understanding of the perceived and expected consequences of climate change and sea level rise Morgan *et al.* (2002).

RESULTS AND DISCUSSION

The perceptions, knowledge and wisdom translated here reflect what stakeholders expect about the consequences of climate and sea-level changes in the estuary of the Paraíba river. Regarding the educational level, of 47 fishermen were consulted, 80% declared they had schooling until primary school, while among experts 73% were postgraduates and 27% had bachelor's degrees. The vast majority of the lay public questioned also finished the college course.

One hundred questionnaires were applied, 80% answered by men and 20% by women. This gender discrepancy can be considered a fragility of this study, since literature shows that the perception of risk and the response to it are expressed differently between men and women. In a report, Chidakwa *et al.* (2020) state that women and men experience climate change differently, and that the impacts and climate change policies are not gender neutral because of different levels of vulnerability and capacity for mitigation and adaptation. Nevertheless, the results bring up to discussion changes in environmental aspects that impose challenges to individuals and social groups in coastal and estuarine areas on housing, health and violence.

When asked, during the interview, about assertive policies to increase the social resilience of residents of the coast of Paraíba, 86% of interviewees report that nothing has been done to prepare, to enhance the adaptive capacity of the residents and the estuary for new disruptions in the biophysical and social environment.

In Bygdaby, Norway, the possibility of global warming, just as in Paraíba, is perceived as deeply disturbing and almost completely invisible, and simultaneously unimaginable to common knowledge. Addressing the invisibility of climate change and the inertia of the population (Norgaard, 2006) states that "the people I talked to believe that global warming was happening, expressed concern about it, but live their lives as if they did not know about any of

that". The notion of climate change denial demonstrates that ignoring is a response to social circumstances constructed through the daily basis of a social interaction process (Norgaard, 2006).

Denial in Bygdaby as in the State of Paraíba, despite the huge environmental and socioeconomic differences, is not a negation of information about the consequences of changes in climate, it represents an escape mechanism, a failure to incorporate this knowledge to transform it into social action. The public tend to show little concern about the consequences of climate change when compared to daily basis problems Harvatt *et al.* (2011). In one of the poorest States in Brazil this is more evident when the struggles for basic needs today overwhelm the time and energy demanded for thinking tomorrow's survival conditions.

Many specialists and managers talk about the responsibility for causing the climate alteration, that each country has different responsibilities in helping others to mitigate and adapting to impacts. But the same specialists and managers do not use the same logic regionally. They do not acknowledge the local riches as more morally responsible to help the ones in risk areas. In this context, environmental and climatic justice denotes that different social groups have different responsibilities on the exploitation of natural resources, and that social inequality determines the degree of exposure of social groups to environmental risks. Environmental justice also opposes the policy of exporting risk and pollution to poorer communities or countries, which reduces the efforts of those who degrade the environment to mitigate the consumption and use of natural resources. Environmental justice helps to articulate social, territorial, environmental and civil rights struggles focused on the right to a safe and healthy environment for all, as well as access to natural resources and the distribution of environmental risks arising from degradation produced by public or private agents Acsehrad *et al.* (2009).

HOUSING AND RELOCATION

Participants were questioned about the possibility of rising sea levels to raise house prices. Approximately 73% of experts consider the question to be right. 20% did not know how to respond and 7% believe that the relative price of homes will decrease. Among fishermen, 50% consider this a false assumption and 37% consider it a true possibility. Among the lay

people 50% also consider it a false possibility, while 17% consider it to be true and 33% did not know the answer.

When asked whether by 2050 people will have to leave the coastal region due to the sea's advance, the laity were the most skeptical, with 37% believing that there will be climate refugees, 37% could not answer, and a little more than 25%, think that there will be no need to remove people. For fishermen this statement is true for almost 50%, 30% did not respond and 20% think they will not need to leave their region. Experts seem to be more concerned: 75% believe it will be necessary to relocate communities; 20% did not know how to respond and 6% of them responded it will not be necessary to remove anyone.

Yes because areas of occupation are being reduced. There are already environmental refugees from areas that have been suppressed. Not only the low-income population, but also the smart ones who are appropriating common areas (interviewee 12/manager).

The disordered occupation and the development model adopted is predatory. Occupying undue spaces or doing improper works along the coast, causing changes in the currents causing erosive processes (Interviewee 15/Specialist).

In a 2050 scenario, approximately 75% of decision makers think that house prices will keep rising. However, Zsomboky *et al.* (2011) argue that areas affected by climate change are considered to be high risk and may suffer a reduction in housing, development and investment values, as well as increasingly expensive insurance for owners.

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This is a call to managers and experts to review science and experiences around the world in order to help propose an effective alternative to manage the cost-effective realignment of the coastline. Managed realignment, for example, is seen as a sustainable defence strategy against flooding as it provides environmental and economic benefits. However, the public perception and attitudes towards this approach are negative because there is always resistance in the delivery of land to the sea Myatt *et al.* (2003).

Only a few hundred kilometres from the studied area there is the Brazilian semi-arid region, one of the most impacted places on Earth by changes in climate (Field *et al.*, 2014). There is a historical process of mass population movement escaping from desertification and large droughts from this region to the periphery of the capital João Pessoa and other Brazilian larger cities, mainly in coastal and estuarine environments exposed to threats of the consequence of hydrometeorological hazard risks. The population living in high-risk occupation needs the

implementation of adequate public policies of social assistance in order to limit its vulnerability.

The manager 12 reminds us that we already have refugees and that not only those who are considered the most vulnerable, but also the "smart ones", those who take advantage of the institutional fragility to build in protected and risk areas. Expert 15 points out the problem of disordered occupation is not only in the sub-yards in areas of risk of climate impacts. It resides mainly in interventions and constructions that destabilize hydrodynamics and the deposition of sediments, causing erosive processes. These results show the importance and urgency in the context of the climate crisis refugees. Margulis *et al.* (2010) suggest that in one or two decades migration of populations affected by droughts may occur, causing an increase in the demand for services, mainly in urban areas and aggravating the socioeconomic conditions that are already among the most unfavourable in the country. Migration leading to greater competition for resources, it may result in more violent conflicts and wars, within and between states.

HEALTH AND WELL-BEING

Asked about future population's health and well-being prospects, 73% of fishermen believe that these conditions tend to worsen, 12% believe that the consequences of climate change and rising sea level will not harm the health and well-being of the people living around the estuary and 15% of them did not know how to respond. Among managers/professors only 46% understand that these conditions tend to worsen; 27% did not realize this tendency and 27% could not respond. Regarding the lay public, 42% believe that by 2050 quality of health and well-being will be reduced, 42% have not been able to respond and 16% have the perception that these conditions will not be affected.

Today's health is already totally affected by the absence of this sanitary sewage, the issue of the allocation of solid waste improperly that today is already chaotic. So from a 2050 perspective, even if we were able to solve this problem with great effort and investment, with this seaward advance, it would indeed be a huge loss (interviewee 10/manager).

I am very worried, persisting the nowadays problems without any solution to mitigate these effects the river is heading to mainly drastic reduction of species, health problems of the population itself. The future prospects remaining this picture that has today is not good (interviewee 0/manager).

The results show that only less than half of managers and lay public believe that the increased frequency and intensification of extreme events, loss of land and properties, loss of

ecosystem services and salinization of groundwater reserves will undermine the health and well-being of the coastal population, which means the consequences are underestimated by managers.

While the most vulnerable, the fishermen communities, are far more concerned, because they already live under the impacts and need for public health services today, as well as the historical socioeconomic disparity that separates both groups.

Health impacts will be among the greatest dangers of climate change for human societies Raihan (2023), especially for the poor and children in developing countries Lorenzoni *et al.* (2006). Regarding this topic Confalonieri e Marinho (2007) consider as probable consequences of climate change on health malnutrition, respiratory problems, cholera and other endemic infectious diseases and accidents due to extreme events and highlight the greater demand on health services, problems of water supply and possible increase of respiratory disorders, besides the global spread of vector-borne diseases as one of the main causes of these deaths.

The respondents “io” and “o” were the only ones who promptly related the consequences of climate change to health problems due to lack of adequate sanitary sewage and waste collection. Interviewee “io” emphasized that planning of improvements in the sewage system should consider a detailed study of the consequences of raising the water table because failing to do so would risk wasting effort and investment. Manager o highlights damages to biodiversity due to the increase in water temperature associated with eutrophication of rivers caused by domestic and industrial sewage discharges. Sugar cane monoculture and shrimp farms will challenge the public well-being.

The poor correlation between climate change and health problems from the respondents is not local. Lorenzoni *et al.* (2006) points out that none of the survey respondents in the United States associated global warming with impacts on human health in their first responses. It is not perceptible in the speeches the interaction between its synergistic long-term impacts. The

VIOLENCE

When asked about the relation between the consequences of climate change and a possible increase in violence rates, 100% of respondents stated that social problems exacerbated by the climate crisis will be felt by all in their various forms of physical violence; institutional

violence, violence motivated by economic, gender, and ethnic-racial inequalities and violence against property and values.

Yes, right! I think everything is very interconnected, unemployment generates violence, risk situation generates violence. If you are in a situation of great vulnerability your social limit also decreases. It's no good for you to come and tell me that better days will come, "my day is today". People who live in vulnerability have no future (interviewee 1/manager).

Yes, because as it becomes more difficult the production of food, then it will affect considerably the rates of violence (interviewee 13/manager).

One of the consequences is health, another is lack of education. The very high rate of violence is very influential, which creates insecurity. If we can improve education, the trend is to improve, not to get worse. It only depends on education, basic sanitation and security. By 2050 the situation may improve but it depends on political will (interviewee 16/specialist).

Today we realize that fishing is increasingly difficult. The fisherman has to go further, spend more time, spend more to bring something. The children of the fishermen no longer want to be fishermen. A drastic problem in this environment are the drugs. The drug has entered very violently (interviewee 2/focus group).

Especially among the small, traditional communities and great entrepreneurs, as the issue of recourse is very different, access to the resource, access to information and the way it can be prevented or even improved in a possible impact will always interfere (interviewee 9/manager).

The interviewees 01 and 13 point out that the greater the vulnerability, the smaller the "social boundaries" leading to more violent acts. Respondent 01 argues that those who are in a situation of extreme vulnerability have no future, nor the possibility of planning their lives. Expert 16, on the other hand, ponders that if education improves in the coming years, the rates of health and violence tend to improve and not to worsen.

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Despite the exposure to a certain threat, what can be managed more efficiently is the social system, the lack of this exchange and permutation competence is recognized as the main factor raising the vulnerability of human societies (Lorenzoni; Whitmarsh, 2014). Manager 9 states that one of the most evident forms of violence is between the different social groups, because one side has access to information, political and financial resources and on the other side are the traditional communities of fishermen, quilombolas and native Indians living on the coast of Paraíba, without the same access.

The perception of a group of fishermen emphasizes that the difficulties imposed by the other human activities in the estuary have systematically hampered the artisanal fishing production. The increase in the difficulty to maintain the quality of life discourages children of fishermen from following the same profession. Without perspectives, fishermen interviewed are concerned about drug dissemination in the fishermen communities.

The better the resolutions of these scenarios of impacts, the better will be the readjustment of the law in order to reduce misery and violence in all its states. The university researchers in water related studies are focusing on the impacts of climate change on ecosystems, whereas government agencies focus on day-to-day management of water permits (Kharel *et al.* 2018; Souza, 2024). The expectation of the social consequence of climate impacts connotes a moral imperative to act collectively and preventively.

FINAL CONSIDERATIONS

Unaware 73% of those who have institutional decision-making power find that the price of houses near the beach will have greater value in 2050. Paradoxically, 75% of them are sure that by 2050 coastal communities close to water will be removed, causing and stirring up various types of conflicts, as well as financial losses. Most respondents also do not make a clear relationship between adaptive capacity and improvements in social systems, rare exceptions have highlighted social policies as ways of adapting to the climate. The term adapting is still only related to coastal defence construction, which in general tend to prevail fragmented, immediate and rather concentrated interests.

While fishermen communities are far more concerned, because they already live under the current impacts, which already have caused community migration. Though 73% of fishermen are aware that environmental conditions tend to harm their well being and health, that percentage drops to 46% and 42% among decision makers and lay people, respectively. Rising rates of violence are expected by all respondents. Despite the causes of already property losses in the speeches of specialists/managers and fishermen's focuses groups, no one recognizes the losses of fishermen as victims of slow violence, which occurs gradually dispersed over time and space.

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