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Climatic Dynamics and Vulnerabilities: The Social Cartography of Baixo Tocantins in the Amazonian Estuary

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Abstract

In the Lower Tocantins, Amazonian estuary, there are dozens of islands separated by rivers, streams, water holes, bays, beaches and coasts. It is also in this region that large multinational projects, involved in mining and logistics, have been setup and thus affecting the delicate environmental balance of the ecosystems of the Tocantins delta, which receives the vast amounts of water from the Amazon river, Tocantins river and its tributaries, contributing to the formation of the great diversity of natural resources in their different ecosystems. Faced with this situation, the human groups that live their face constraints to maintain their ways of life. These constraints are found both in the biophysical and socio-political fields, making it impossible for them to exercise other methods in the management of resources; the manifestation of natural inclemencies, including climatic incidents, has been causing negative impacts on crops, fisheries, aquaculture and the livelihoods of these people. Greed around these resources has provoked socio-political and environmental pressures, giving rise to vulnerabilities that manifest themselves in these situations. This study aims to contextualize these dynamics, based on socio-environmental cartography, and thus, identify and analyze the adaptations of local groups in the midst of changes, in view of these assumptions.

Keywords: Vulnerabilities, Way of Life, Climate Change.

Introduction

The wealth of natural resources found in Brazil provides ecosystem services that are extremely important to human communities, including food, leisure, nutrient cycling, housing, clothing, and contribute to climate maintenance. The so-called traditional societies that inhabit the ecosystem of the Brazilian Amazon, in order to obtain a large part of these services, generally need to collect directly from nature the resources for their survival. These social agents, called rubber tappers, artisanal fishermen, quilombolas, caiçaras, riverine people, traditional farmers, etc. (Diegues & Arruda 2001) over time have built up a broad knowledge of the environment in which they live, thus establishing a relationship of resilience.

This knowledge is embodied in the way they conceive, collect, and utilize the resources available in the environments, and becomes essential for survival, being passed on, reorganized, and experienced over the generations. It is in this sense that Diegues & Arruda (2001) speak of an ethnobiodiversity, which corresponds to the wealth of the nature from which man participates by naming, classifying and domesticating.

Specifically, at the mouth of the Tocantins River, known as the Baixo Tocantins region (Lower Tocantins) on the coast of Pará, in the north of Brazil, the traditional peoples who live there created strategies and ways of using resources, taking into account the dynamics and techniques of socialization of resource found there. This region receives the massive amount of water from the Amazon and Tocantins rivers and their tributaries, forming the great diversity of natural resources derived from the different ecosystems.

However, much of this biological and sociocultural diversity in recent years has been negatively impacted by various types of pressure from the disorderly exploitation of natural resources – especially deforestation and mining, the economic pressures of powerful social groups, the substitution of forest diversity for monoculture of açaí palm (Euterpe oleracea Mart.) and dendê palm (Elaeis guineensis) – which have been causing local anomalies that might have effects on global changes. Greed around the

region's resources has provoked social and environmental pressures, giving rise to vulnerabilities[1] manifested by environmental and political changes that directly impact human groups and other living beings in this environment, in one way or the other.

The paper aims to reflect on the processes of environmental change for human groups living in the Amazon estuary, from the observation of their strategies in adapting to local environmental changes, having as reference their processes of territoriality construction and the expansion and enrichment of biodiversity. Nevertheless, in the study site, the impacts of the changes are marked by both natural inclemencies effects and those from large metallurgical-mining and logistic projects meant for the unloading of grains for export. In order to identify the dynamics of the effects of socio-environmental impacts, in the context of climate change, and the adaptive capacities of the subjects and their ecosystems in the face of environmental changes, two communities were studied: Ilha do Capim (Capim Island) and Vila de Beja (Beja Village) in the Arienga river. The first one is located in a floodplain area, while the second one is on solid ground.

Materials and Methods

The research was carried out with the fishermen and extractivists of Capim Island and with the farmers and fishermen of the Arienga river, Vila de Beja (Beja Village). Both are located in the municipality of Abaetetuba, next to the municipality of Barcarena, where the metallurgical-mining and port complex of Vila de Conde (Village of Conde) at the confluence of the mouth of the Tocantins river and the Pará river, in the region called Low Tocantins, in northeast Pará. The study involved twenty-six fishermen/farmers, of whom eighteen were from the Capim Island and eight from the Arienga river who were selected at random, to obtain better investigative understanding of their relationship with the environment.

For this research of basic nature, the "life history" method was used to understand the process of change in the way of life of the analyzed groups. The principle of analogy was also used to establish similarities and differences in the study of the geographic fact (Gomes, 1996, p. 212) and, therefore, the establishment of common points to ascend to the explanation of the observations in the floodplain area and solid ground.

For each locality, four visits were made, two in the winter and two in the summer, between September 2016 and April 2017. The following procedures were performed as means of data collection: a workshop of social mapping of the traditional peoples was held on the Capim Island. The objective of the workshop was to enable the participants to carry out their own cartography, to demarcate and characterize disputed territories to socio-environmental interests. Their sketches represent the vision they have of their living space and the socio-environmental transformations that occur there, through the specific conventions to explain economic and cultural aspects, the ancestral and symbolic ties of their territory. At the end there was the socialization of the sketches, in which the residents reported the socio-environmental impacts that they have experienced.

In order to locate the fishing territories drawn in the sketches, the fishermen were trained to handle the GPS (Global Positioning System) device and to proceed with them, the points taken to locate the fishing grounds. Semi-structured interviews, questionnaires and informal conversations were also carried out, which provided a better understanding of the practices and strategies of the subjects involved in the research. Based on this information and techniques the map was produced (illus. 1).

[1]The term "vulnerability" has been used initially in geography and in research on natural hazards and threats, however, the term currently stands out in other research contexts, and each domain of knowledge that uses the concept has its own way to define it, which depends on the context and purpose of its application (Füssel, 2007). Nevertheless, it is a central concept for research on climate change and global environmental change, so it encompasses science for purposes that deal with issues such as ecology, public health, poverty and development, livelihoods and hunger, sustainability impacts and adaptation (Füssel, 2007:165). It is also noteworthy investigations based on the analysis of social-ecological systems, i.e., the interactions between human conditions and biophysical conditions, and its multiple factors and processes (Turner II et al., 2003) and others that evaluate the possible impacts that climate change can have on people, places and systems (Acosta-Michlik et al., 2008).

Results and Discussions

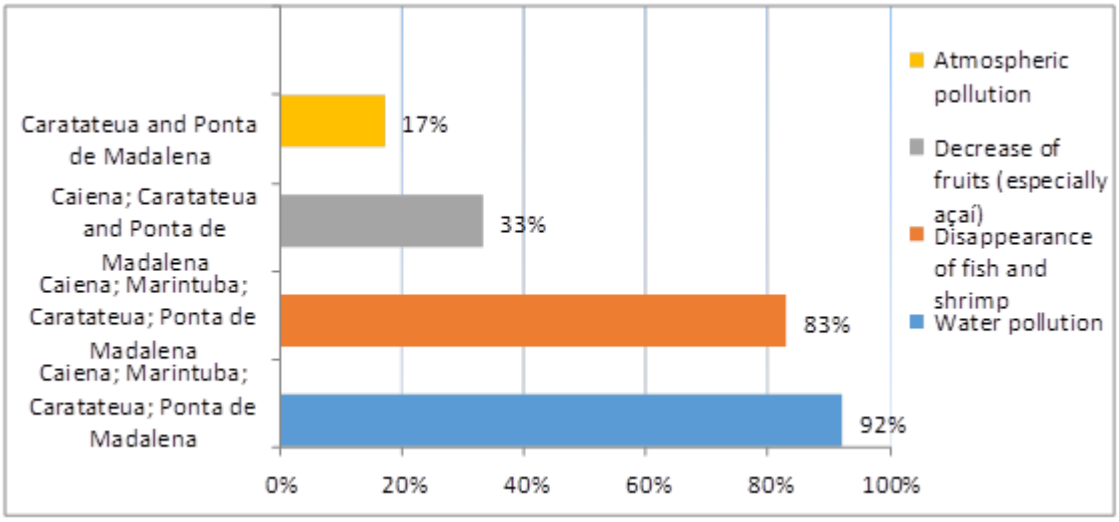
The interviews and narratives indicate that the change throughout time is tied to environmental problems from companies and governmental projects initiated on the site.

Respondents relate climate change to pollution. On the other hand, they mention “change of weather” to refer to the increase in temperature, which has been changing their dynamics in fishing, because they feel vulnerable to excessive exposure to the sun's rays, feeling limited in their activities. Likewise, for those who work in the field, in the Arienga river, Beja Village, the increase in temperature and changes in the precipitation regime, altered the agroecological calendar. The planting previously performed between October and December, is now performed between January and February, which has an impact on the harvest. With the adaptation process under way, the farmers have experienced other variations in cassava and maize species. As for cassava, the most productive species that have been able to withstand the rise in temperature are those that in the emic category are called “leather hat” and “miriti”, both of a yellow color.

They delimit as a temporal marker for the increase in temperature the period of ten years, the same applies to the period of observation in the oscillations of precipitations. The level of water in the flood is mentioned in the interviews, as an indicator of variation, as well as the month of occurrence, which was previously in March and today, in April.

In the Capim Island, planting, especially of açaí, present a drop and dryness of the fruits before maturing, this anomaly was verified *in loco* during the research.

The chart below highlights a summary of the changes perceived by the fishermen and farmers mentioned in the interviews:



Graphic 01: Percentage of respondents from each sector of the floodplain, who report on environmental issues.

Among the interviewed in Arienga, 80% attributed the disappearance of fish species to mining companies in Barcarena and the Tucurui hydroelectric plant on the Tocantins River. The table below indicates species of fish that have disappeared from the fishing grounds in the vicinity of Capim Island:

Table 01: List of species of fish no longer found in the investigated localities.

Popular name	Scientific name
Pescada	*Cynoscion sp.*
Capitarí	*Brachyplathystoma, sp.*
Tucunaré	*Cichla sp.*
Branquinha	*Yahuarach, sp.*
Sarda	*Sarda sarda*
Dourada	*Sparus aurata*
Barba chata	*Pinirampus pirinampu*
Bacú	*Platydoras costatus*
Tainha	*Mugilidae*
Piaba	*Leporinus obtusidens*
Mandubé	*Ageneiosus brevifilis*
Mapará	*Hypophthalmus sp.*
Acarí Cachimbo	*Hemiodontichthys sp.*
Pratiqueira	*Mugilidae*

The adaptation strategies in fishing can be seen in the equipment used to capture fish in the Capim Island and Arienga river, as shown below:

Table 02: Adaptation strategy made by fishermen to catch fish

Fishery (Before)	Fishery (After)
Distance between fish hooks: 3 fathoms*	**Distance between fish hooks:** 1, 5 fathoms
Waiting time: 30 minutes	**Waiting time:** 1 hour

* Corresponds about 5 meters.

In the Capim Island, the loss of fruit in the sites located in the direction of Village of Conde is added to the disappearance of fish species in the 32 fishing grounds identified in the map below.

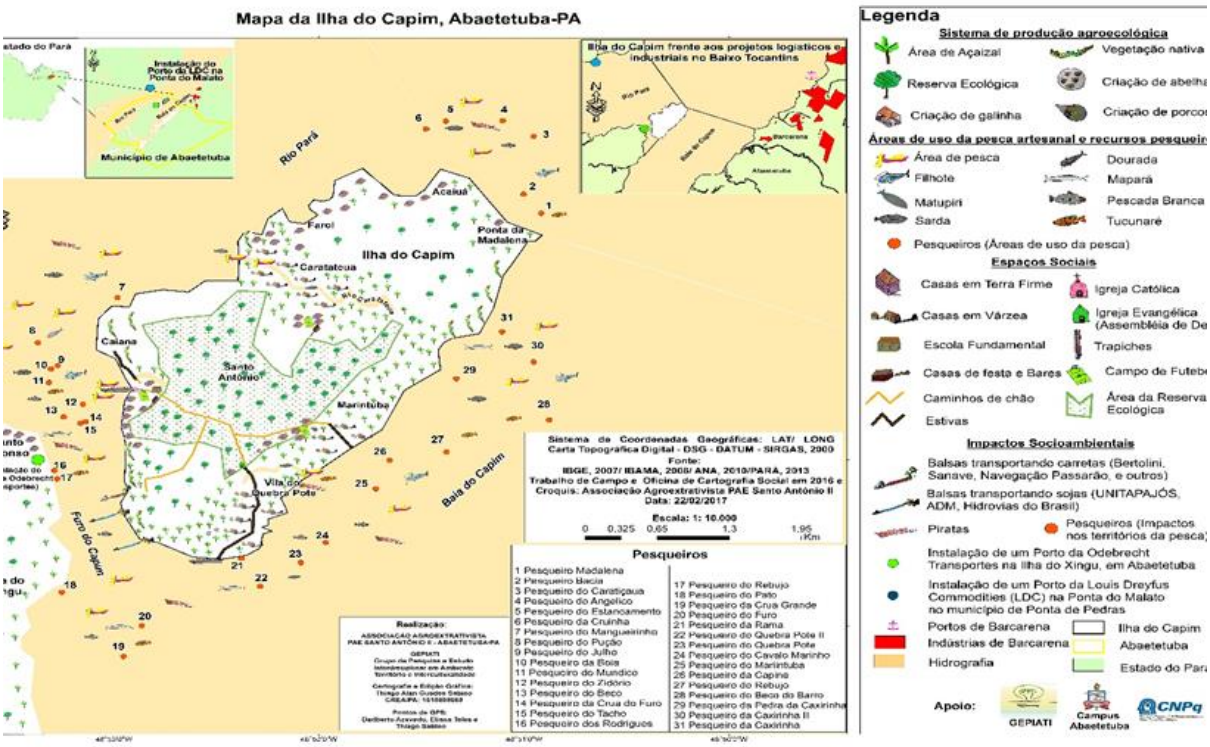


Illustration 01: Location map of Capim Island produced by the New Social Cartography project, according to the representation of the island's residents. In it is seen the 31 fishing grounds and other natural resources identified according to the emic categories, as well as the mining-metallurgical and port complex of Conde Village in its vicinity. Field research, 2017.

The decrease of the fish in the investigated localities, forces the fishermen to move for longer distances, extending to the bay. Because of that there is an increase of fuel expenses and increase in the waiting time for the catch of the fish.

Discussion

The social mapping, based on the local knowledge of each interviewee, demonstrates how resources are appropriated and modified by external agents and point to a socioenvironmental vulnerability situation in the two ecosystems: floodplain and solid ground. In general, the changes observed in this stretch of the Amazonian coast points to environmental impacts[2] and conflicts.

Indicative of negative externalities, the installation of large industrial and port complexes in the vicinity of the communities investigated, tend to intensify more and aggravate the problems found there, such as skin and stomach diseases. In this case, a cumulative vulnerability[3] has been occurring, which is gradually established as these external agents enter their territories. This situation adds up to changes in climate change and compromises working conditions. In this way, even their conditions of survival are jeopardized, because the maintenance of life is tied to access to local natural resources.

There is also plans to establish metallurgical-mining and logistics companies, as well as waterway and rail terminals in the region. However, it is notorious that the expansion of this model of intensive riverbank use will further increase the environmental effects and imbalances in the Low Tocantins region, because as they become territorial, they cause damage to fauna and flora. Given the evidence of the disappearance of the fish in the locality, the business policies propose the construction of tanks of pisciculture in the Arienga river, but this strategy points to a dependence on the external market, not being characterized, therefore, as a sustainable alternative to the traditional population.

[2]According to Sánches (2008), the environmental impacts correspond to an "[...] alteration of the environmental quality that results from the modification of natural or social processes caused by human action" (2008, p. 32).
[3]According to Alcântara et al (2013), "vulnerability is cumulative, since disasters can add other types of vulnerabilities through other risk conditions." (2013, p. 558).

Conclusion

The social mapping in the studied area consists of a basic research contribution to comprehend the effects of climatic dynamics and socioenvironmental impacts in the Low Tocantins. The strategies of the local knowledge, however important, on their own are not enough to deal with local and global inclemencies and dynamics, and thus present risks to socio-biodiversity in both research sites. With regard to the loss of natural resources such as shrimp and fish species, it has affected one of the main means of subsistence that is fishing, and thus the very survival of these human groups.

The effects of these actions directly impact the lives of artisanal fishermen, as members of the Fishermen's Colony, which for this reason, depend on government policies such as "secured insurance". However, they take the risk of losing this benefit, because once the local fishery resources end, its function will no longer make sense. So, this is a risk that they are subjected to and that worries the fishermen, farmers and the entire traditional population of the Amazon coast.

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