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SOCIAL PERCEPTION ABOUT CLIMATE CHANGE IN THE PANTANAL BIOME: A SURVEY IN THE SUB-REGIONS OF AQUIDUANA AND NHECOLANDIA, IN MATO GROSSO DO SUL STATE (BRAZIL)

PERCEPÇÃO SOCIAL SOBRE ALTERAÇÕES CLIMÁTICAS NO PANTANAL: UM LEVANTAMENTO NAS SUB-REGIÕES DE AQUIDAUANA E DA NHECOLÂNDIA, EM MATO GROSSO DO SUL

PERCEPCIÓN SOCIAL DEL CAMBIO CLIMÁTICO EN EL BIOMA PANTANAL: UN ESTUDIO EN LAS SUBREGIONES DE AQUIDAUANA Y NHECOLÂNDIA, EN MATO GROSSO DO SUL

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ABSTRACT
What is the social perception about residents of the Pantanal sub-regions of Aquidauana and Nhecolândia regarding climate change in the Pantanal biome? This was the research question we sought to answer at the end of this text. To do so, we seek to understand your environmental perceptions about the climate; the territory and on the rivers. This time, through participant observation, in a theoretical sample, we critically analyzed the findings, establishing new evidence on the topic.

Keywords: Climate. Biome. Lifestyle. Brazil. Mato Grosso do Sul State.

RESUMO
Qual é a percepção social dos moradores das sub-regiões do Pantanal de Aquidauana e da Nhecolândia, acerca das alterações climáticas no bioma Pantanal? Esta foi a pergunta de pesquisa que buscamos responder ao final deste texto. Para tanto, buscamos compreender quais são suas percepções ambientais sobre o clima; o território e sobre os rios. Desta feita, por meio da observação participante, em uma amostra teórica, analisamos criticamente os achados, estabelecendo uma nova evidencia sobre o tema.

Palavras-chave: Clima. Bioma. Modos de Vida. Brasil. Mato Grosso do Sul.

REUMEN
¿Cuál es la percepción social de los habitantes de las subregiones pantanales de Aquidauana y Nhecolândia sobre el cambio climático en el bioma del Pantanal? Esta fue la pregunta de investigación que buscamos responder al final de este texto. Para ello, buscamos comprender sus percepciones ambientales sobre el clima; el territorio y en los ríos. Esta vez, a través de la observación participante, en una muestra teórica, analizamos críticamente los hallazgos, estableciendo nuevas evidencias sobre el tema.

Palabras clave: Clima. Bioma. Modos de Vida. Brasil. Mato Grosso do Sul.

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1 INTRODUCTION

The development of a scientific research in which the object of study is a phenomenon of nature, perceived by groups of human beings, with its anthropological peculiarities is a complex task. Even more so when we are gathering information about issues related to climate over chronological time.

There are all sorts of situations that can impact the conduct of the investigation, and this is part of the processes and risks that involve scientific research. But, in this specific case, we can be proud of having been in the right place, at the right time, with the right people/institutions and with resources available to carry out this work.

Therefore, we seek to converge actions and act in synergy, aggregating initiatives, adjusting methods and techniques, in order to obtain subsidies that support our arguments and interpretations, achieving the objective proposed in this study.

In this sense, it is pertinent to mention that our field observation took place in parallel with the "Pantanal Expedition 2024", promoted by the State Secretariat for the Environment, Development, Science, Technology and Innovation, of the state of Mato Grosso do Sul (SEMADESC) and carried out by the Pantanal Association of Organic and Sustainable Livestock (ABPO).

In this event, which took place between May 22 and 26, 2024, at least 650 (six hundred and fifty) kilometers were traveled on side roads and rural properties installed in the Pantanal biome. Leaving Campo Grande, capital of the state of Mato Grosso do Sul (MS), entering the municipalities of Aquidauana and Corumbá, reaching, respectively, the sub-regions of the Pantanal of Aquidauana and Nhecolândia.

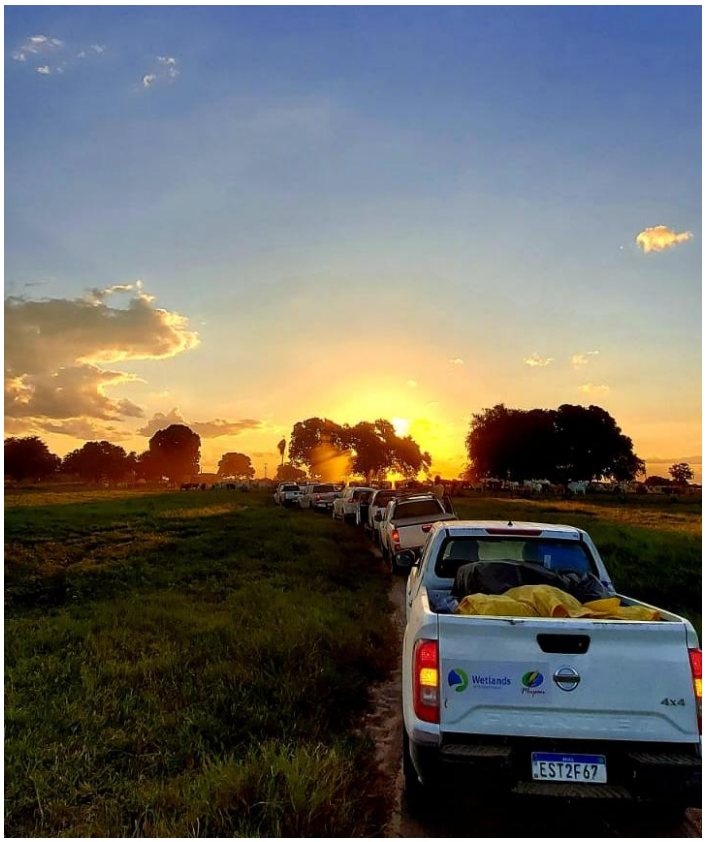
This expedition closed in its ranks, subjects and organizations with different profiles of action and approach, but which have in common: the focus of action for the conservation and sustainable use of the Pantanal biome. The journey had 25 4x4 diesel vehicles and 55 (fifty-five) people, in addition to those found on the long paths and on the properties where the troop landed, such as: Taboco Farm, Santa Isabel Farm, Barranco Alto Farm, Baía das Pedras Farm and Santa Fé do Corixinho Farm. The first two properties were fixed in the sub-region of Aquidauana and the others in the sub-region of Nhecolândia (Figures 01 and 02).

Along the stretches traveled, along the stops and overnight stays, several agendas ran in parallel. Scientific, technical, political-institutional teams, class association and third-sector, exchanged knowledge and good practices related to the Pantanal.

The convoy was interconnected via radio, in which the most evident information about the geography, hydrography, fauna, flora and the historical processes of occupation of the paths and properties that were being traveled were passed on. There were numerous pauses, along the entire stretch, so that the teams could carry out their sample collections, make records in photos and videos and, above all, confer about the phenomena expressed in the landscape.

Figure 1

Sunset in the Pantanal of Aquidauana



Source: The author, (2024).

Also, technology was present and the campaign continued inside Pantanal with the support of very high speed Internet antennas. But, it is worth noting that, in this event, the highlight - in addition to being immersed in the biome, enjoying its landscape, culture and gastronomy - were the dialogue circles. Especially when the announcers were the "*pantaneiros*", incredible men and women who, with more or less resources, chose to be and live in/from the Pantanal.

Throughout the lectures, discussions and pleasant prose, technical-scientific reports intersected "*stories*" and these were combined. Everyone was surprised to receive information that traditional and empirical knowledge had a scientific foundation and that ordinary and traditional practices of use, occupation and management of local resources were being presented as being "*great* technical-scientific novelties" of today.

In each farm a story of struggles, resistance, victories, defeats and, especially, declarations of affection and pride for the place. In different places, arguments uttered resoundingly: "*(...) the Pantanal is our place, our life, our love!*" or, even: *"(...) the Pantanal is, at the same time: Paradise and Hell. With its beauties and charms and, extremely hostile weather!*".

Specifically, it is worth noting that this authentic connection with the environment - of generations - makes these brave "*pantaneiros*", subjects especially capable of observing and perceiving changes in the climate and landscape over chronological time. This time, environmental issues, their changes and implications in everyday life were recurring themes in this event. Of course, production, economy, development and politics were also expressed and debated, but "*so much in a while*" the argument about contemporary climate change was resumed and, as it weakens, it weakens the place as a whole, its production and its people.

Figure 2

Native grasslands in the Pantanal of Nhecolândia

Source: The author, (2024).

Even welcoming so many actors with dissimilar attributes and, in addition, different interests, it was sought to present to all, a common reality, in order to mobilize knowledge and capacities in favor of the Pantanal. But this was the objective of the event. Specifically, this research and this *paper* is the following: "what is the social perception of the residents of the Pantanal de Aquidauana and Nhecolândia sub-regions about climate change in the Pantanal biome?".

This time, in order to methodologically adapt to the situation, we collect the data in a conscious and adequate way, so that they can support our considerations with the necessary accuracy. We focused on observing, listening attentively and recording the speeches and dialogues focused on the following topics: 1) general perception of the climate; 2) general perception of the territory; 3) general perception of rivers.

Therefore, to support this conception, we must indicate that environmental perception unifies psychological, geographical, biological and anthropological understandings of certain groups, indicating their understanding of certain factors, mechanisms and processes in relation to the environment around them (SANTOS and SOUZA, 2015).

It should be noted that the sampling of this research takes place from a conceptual perspective called: theoretical, in which statistical representativeness is not sought, but rather a representation of the sample. Therefore, this is a strictly qualitative approach (GIL, 2002).

For the execution of this research , it was decided to combine bibliographic exploration in secondary data and participant observation, which is a technique that consists of the insertion of the researcher within the observed group, becoming part of it, interacting with the subjects, seeking to share their daily life to feel what it means to be in that situation. In the combination of these techniques, we obtained the opportunity to observe the object in its context, analyzing it closely (QUEIROZ, et. all., 2007).

In this way, through critical and inductive analysis, it was possible to interpret the phenomena described, bringing them closer to conceptions of Geography (MATTOS, 2011).

The registration and documentation of these actions were carried out through notes in an electronic notepad, making a collection of digital photos and videos, made by a smartphone cell phone device (*Samsung Galaxy M53*), camera (*Canon T6 Rebel*) and drone (*DJI Mavic Pro*).

2 DEVELOPMENT

A priori, it is pertinent to contextualize in what situation this survey was implemented and, above all, what factors may be influencing, in some way, the social perceptions about contemporary climate change, in these places and in this specific sample.

This time, we must indicate to the reader that the composition of the Pantanal[2] is unique and its landscape is complex and dynamic. This biome aggregates 11 (eleven) sub-regions in Brazil. In Mato Grosso there are 03 (three), in Mato Grosso do Sul there are 08 (eight), in addition to another part in Bolivia and another in Paraguay (Figure 03).

In fact, this cross-border composition is contradictory, since the same biome that is a point of historical convergence is, at the same time, a factor of geopolitical distancing and regulatory incompatibilities between states.

An example of this case is the conception of figures and maps that systematically represent the biome, only "from the Brazilian side", making it difficult to understand and carry out adequate actions for the integrated management of this transboundary watershed. The figure we use to illustrate this characteristic turns out to be an exception - very welcome and well-made - but still unique.

In turn, it is worth noting that, absolutely, all these sub-regions have distinct characteristics. With hydrography, flood pulses, geography, geomorphology, microclimate, fauna, flora, and historical processes of occupation and exploitation of very specific socio-environmental resources (EMBRAPA PANTANAL, 2024; DA SILVA and ABDON, 1998) (Figure 04).

Thus, it should be emphasized that the results achieved in this survey are related to a specific circumstance, which demands an intense and methodical research exercise, so that we can connect additional technical contributions to our findings, in order to provide robustness to the study and its results, and consequently promote its external scientific validation, based on complementary secondary data.

Below, it is appropriate to present to the reader the characteristics of the Pantanal sub-regions of Aquidauana (a) and Nhecolândia (b), both in the state of Mato Grosso do Sul:

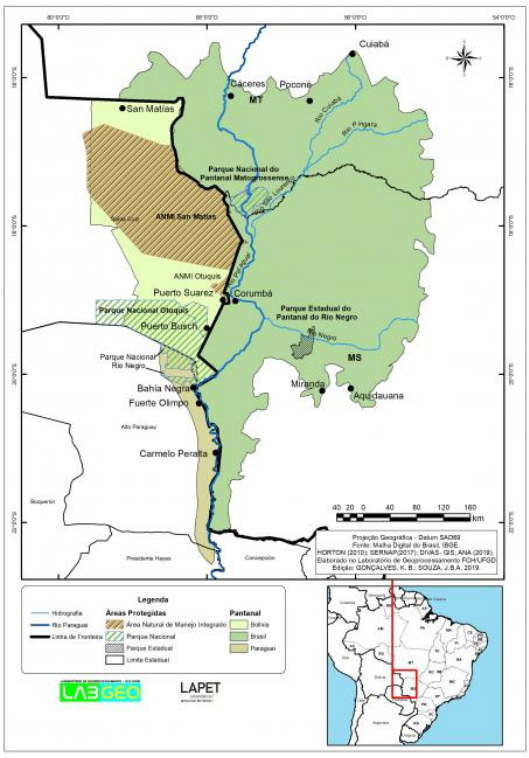
a) The Pantanal of Aquidauana, located in the state of MS, the vegetal physiognomy of the region is of contact (enclave) between the Steppe Savannah and the Seasonal Forest, but it is mostly anthropized and converted into pastures. The climate of this sub-region has characteristics of tropical, megathermic, with a poorly defined winter

season - or absent -, heavy annual precipitation with summer rains and average temperature of the coldest month, below 18ºC, with an average temperature of 24ºC and average annual precipitation between 900mm and 1,100mm/year (SANESUL, 2016);

b) the Pantanal of Nhecolândia is also located in the state of MS, congregating areas of the municipalities of Rio Verde de Mato Grosso, Aquidauana and Corumbá-MS. It is bordered to the west by the Taquari River and the Paraguay River, to the south by the Negro River, to the east by the Serra de Maracajú and to the north by the Taquari River. The main economic activity developed in this region is livestock, followed by tourism and fishing. The sub-region is characterized by an extensive fluviolacustre area, whose main characteristic is the presence of lagoons, as well as flood areas (weak, medium and strong), which affect economic exploitation, especially in periods of flood (RODELA and QUEIROZ NETO, 2007). The climate is considered subhumid and megathermal, with generally high air temperatures (19°C to 28°C), dry season with more than four months a year, with an average rainfall of 1200mm/year (GARCIA and CASTRO, 1986).

Figure 3

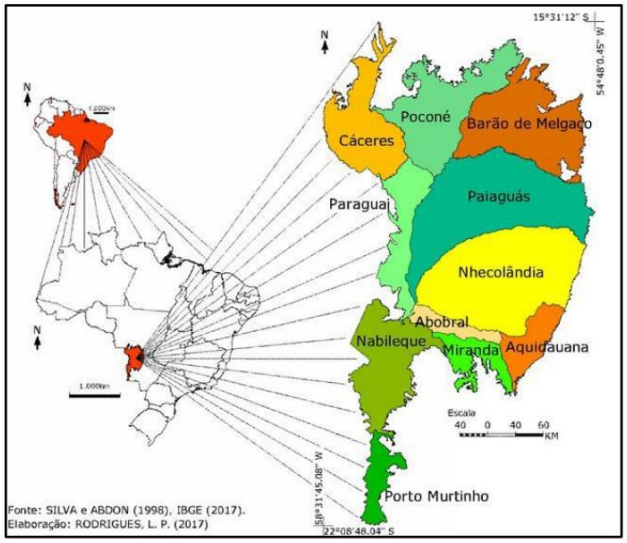
The cross-border Pantanal



Source: Moretti and Gonçalves, (2020).

Figure 4

Sub-regions of the Pantanal, according to DA SILVA and ABDON



Source: Carvalho; Pereira and Leite, (2018).

This time, due to the experience acquired throughout the process of data collection and analysis, we can make some considerations based on the discourses of the groups of residents to whom we had access in the field research, both in the sub-region of Aquidauana and Nhecolândia.

Regarding point (1): "general perception about the climate", there is a common and evident understanding of these social actors about climate change in the biome over the last decades. Since their productive activities and ways of life are/are essentially linked to the exploitation and management of natural resources, any modification in the normal/historical dynamics is readily perceived, since there are objective implications in this case. Within this aspect, the changes in the seasonality of the rainy and dry periods draw the attention of the focus group, due to their "new variations".

On this occasion, a speaker, Lady of one of the properties visited, the banks of the Rio Negro (Figure 05), said in her presentation:

> “(...) low river, everything very dry! For a long time! In the past, when fire came, we made the 'firebreak' and hoped to calm the flames. Now, we have a management plan, prevention actions, recovery, a brigade installed inside the property, with new and trained equipment and, even so, when the fire comes, it is uncontrollable! It burns everything! Now, our work and our lives are always at risk here in the Pantanal (...)".

Regarding these arguments, we can indicate that the Pantanal was the Brazilian biome that "dried up" the most in recent years (1985-2023). At the same time, it has 61% less water surface over its territory than the historical average (MAPBIOMAS, 2024). Later, one of the "Pantanal men", present at the event - at the height of his age and biography - declared to the group, adding his testimony to the arguments of the main speaker:

> "(...), before. Everyone knew! The rains were from October to March. We prepared ourselves. He prepared the farm, the troops, the ranch, the employees, the cattle, everything... Now, we pray to St. Peter! For the saint to send water to the Pantanal. But he must be busy with another corner... (laughs!)".

Since the early 2000s, considerable and constant decreases in precipitation levels in the biome have been recorded. This time, in 2020, for example, there was 26% less precipitation than the historical average, coinciding with extreme events related to forest fires. In 2024, the situation is even more delicate, since the accumulated levels of precipitation are even lower than in 2020 and the fire outbreaks started months earlier (MAPBIOMAS, 2024).

Figure 5

Banks of the Rio Negro. Pantanal da Nhecolândia

Source: The author, (2024).

Regarding question (2): "general perception of the territory", an argument was repeated along the paths and farms, evidently through different narratives, but which show equivalent perceptions about the rapid "transformations" of the Pantanal landscape and, specifically, in the sub-regions analyzed.

A couple, owners of a cattle ranch and hotel, residents of Nhecolândia since the 1970s, tell us that:

> “(...) Where there used to be water, it has been dry, for years! Lagoons and salt pans that have always had water, are only in the dust and there is no sign of filling up again. What did not turn into sand, became dry and caught fire. It's a shame for all of us here."

This perception fully follows the findings of Barnes et. all., (2024), which showed that the weather conditions of June 2024 were the most conducive to the spread of fires ever recorded in the region, with the month being the driest, hottest, and windiest since observations and records began in 1979.

Another farmer, from a traditional family, with the lineage of a historical figure to the settlement of the Pantanal, in which the property has been the family's, for at least 100 years, laments that:

> "With the constant 'dryness', the plants and the animals change. We have to clean the fields and it is increasingly difficult and expensive. There are farmers who are not interested in having this job, abandon everything! Houses, mango trees, pastures, everything is over (...), there is an emptiness!"

It is worth noting that this observation is aligned with a global objective demographic fact and that manifests itself in Brazil in an even more severe way: internal migration and emptying of rural areas. In this case, in addition to the more traditional issues linked to the theme (employment, education, public health, etc.), it is observed that the climate crisis has become a preponderant factor in this movement (IBRD, 2023; IBRD, 2022). And, this time, this phenomenon can also be observed in the Pantanal.

Further on, and in relation to the question (3): "general perception about the rivers", there are unison discourses regarding the loss of water volume in the main rivers of the region studied, and the negative outcome of this fact is that their tributaries, ebb and flood, end up being impacted and, so many times, ceasing to exist, permanently modifying the landscape

and the ecological relations that occur on it. In addition to impacting the human use and occupation of this same territory.

On this subject, a "Pantanal peon", for 45 years traveling "*this Pantanal of ours!*", indicates that, in the sub-region of Aquidauana:

> "We believe that the waters will return, but maybe we don't know where it will run, where it will stop or where it will arrive. It's been five years of a lot of drought, things are changing and we who have always known about the rivers will not know".

The Pantanal is increasingly dry, which makes it more vulnerable, increasing the threats to its biodiversity, its natural resources, and the way of life of the Pantanal population (DIAS et. all., 2024).

In the sub-region of Nhecolândia, a couple who made a family in the place, comments: "*(...) silted rivers, a lot of sand, little water. This is our reality now!"*element.

On this point, it is pertinent to indicate that the silting processes, in the case of the Pantanal, are due to the economic activities developed in its surroundings, in the plateau areas, where the sources of the rivers are located (CUNHA and JUNK, 2019).

3 FINAL CONSIDERATIONS

There is a significant amount of current scientific research, developed from different methods and techniques that show us that the succession of years with few floods, prolonged droughts and extreme forest fire events could permanently change the Pantanal, with drastic consequences for the supply of species of fauna and flora, with great impacts also on the local economy. In this context, too, human beings are inserted. It is worth noting that the Pantanal is a landscape, above all, cultural. Therefore, the human presence in this geographical space is important.

This time, in view of the arguments presented throughout the text, resulting from applied research, using recognized scientific techniques, we can safely affirm that climate change is being perceived by the residents of the sub-regions of the Pantanal of Aquidauana and Nhecolândia.

The environmental perceptions collected in the field and backed by consistent secondary sources show us that there are three objective aspects of evaluation: 1) general

perception of the climate; 2) general perception of the territory; 3) general perception about rivers, the emitters perceive, describe and point out objective and symbolic differences between the climate condition in the short past and the present. Pointing out the changes in the landscape over time and, above all, the uncertainties regarding the future of those who live in these places.

Therefore, we understand that the objective of this work was achieved and this text can be used as scientific evidence about the social perception of climate change in the sub-regions of Pantanal de Aquidauana and Nhecolândia, in the state of Mato Grosso do Sul, Brazil.

There are eleven sub-regions to be studied in Brazil and two more in foreign territory, so that we can infer (or not) that the residents of the Pantanal perceive climate change. Therefore, the research effort continues, we already have a "Pantanal" trail to follow in favor of this greater design. "We continue on the stretch".

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