

Application of participatory research techniques in the socio-environmental study conducted in the Jacaré-Curituba settlement in Brazil

Aplicação de técnicas de pesquisa participativa no estudo socioambiental realizado no assentamento Jacaré-Curituba do Brasil

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ABSTRACT

This article initially presents reflections on existing qualitative methods and techniques within the social sciences, and subsequently analyses how some of them can be effectively applied in socio-environmental research. The use of these techniques in case studies allows for greater representativeness of the results, considering the descriptive and narrative nature of the data, which contributes to enriching the research processes. The objective of this work is to present some methodological techniques applied in a case study as an example of successful application. For this study, participant observation and data analysis from semi-structured interviews were applied, conducted in the Jacaré Curitiba Settlement, located between the municipalities of Poço Redondo and Canindé de São Francisco, in the high hinterland of Sergipe. The study enabled the identification, based on the population's perceptions, of different socio-environmental problems in the area. The results indicate that prioritising qualitative evaluation methods favours the consolidation of denser, more meticulous analyses. It has been observed that, in many cases, quantitative approaches in the field of environmental sciences face limitations in measuring subjective dimensions, which is a critical factor in identifying problems and estimating their impacts.

Keywords: Qualitative research. Socio-environmental studies. Climate change. Nexus+ approach. Brazilian Northeast.

RESUMO

Este artigo apresenta inicialmente reflexões sobre os métodos e técnicas qualitativas existentes no âmbito das ciências sociais para posteriormente analisar como algumas delas podem ser aplicadas de forma eficaz em pesquisas socioambientais. O uso dessas técnicas em estudos de caso permite ampliar a representatividade dos resultados, considerando o caráter descritivo e narrativo dos dados, o que contribui para o enriquecimento dos processos de pesquisa. O objetivo do trabalho é apresentar algumas técnicas metodológicas aplicadas em estudo de caso como exemplo de aplicação bem-sucedida. Para este estudo, aplicaram-se a observação participante e a análise de dados de entrevistas semiestruturadas, realizadas no Assentamento Jacaré Curitiba, localizado entre os municípios de Poço Redondo e Canindé de São Francisco, no alto sertão sergipano. O estudo permitiu identificar, a partir da

percepção da população, diferentes problemáticas socioambientais existentes no local. Os resultados obtidos indicam que a adoção prioritária de métodos de avaliação sob uma perspectiva qualitativa favorece a consolidação de análises mais densas e minuciosas. Verifica-se que, em diversos casos, abordagens quantitativas no âmbito das ciências ambientais enfrentam limitações na mensuração de dimensões subjetivas, o que constitui um fator crítico na identificação de problemáticas e na estimativa de seus impactos.

Palavras-chave: Pesquisa qualitativa. Estudos socioambientais. Mudanças climáticas. Abordagem Nexus+. Nordeste brasileiro.

1 INTRODUCTION

The use of different types of qualitative methodological research techniques, whether ethnographic or biographical, has gained ground in social science research. Their characteristics make these techniques appropriate for addressing sociocultural and environmental processes, in which social interactions with the environment constitute the predominant object of study, positioning subjects as agents possessing knowledge. In this sense, this work aims to present data collection and analysis techniques used in the social sciences, in order to include them in the environmental sciences, since the interaction between humans and nature has become increasingly intense and complex.

Among the characteristics of this social methodology, the fact that it allows for greater interaction between the researcher and the object stands out, since its construction and understanding presuppose the sharing of experiences and meanings between researcher and subject. In this context, the researcher can immerse themselves in the subjects' universe of action (Bernal, 2024; Costa, 1987; Dalfovo, 2008; Delari, 2015), obtaining a more concrete vision (Woods, 1987) and constituting themselves as the main instrument of the investigation (Bogdan; Biklen, 1994), since the nature of the data collected depends on their stance, the orientations they adopted, and their methodological skills.

In this context, knowledge is constructed collectively, considering the conceptions of social actors and the meanings they attribute to their practices. Therefore, participants are considered sources of knowledge and partners in the process of constructing reality. According to Goetz and Lecompte (1988), human action is explained in terms of the cultural context in which actors construct the meaning of their interactions and their interpretation of reality. The researcher, therefore, needs to be embedded in the context, as it is not possible to adequately investigate a culture through interpreters. The construction of the object implies close, prolonged, and contextualised interaction between the researcher and the subjects, allowing for a more consensual view of the social, environmental, and cultural (Conjo, 2022; Erlandson, 1993; Paranhos, 2016).

Both quantitative and qualitative methodologies have always influenced the social sciences. These fields have witnessed an unprecedented and rapid diffusion of data collection and analysis techniques, especially in the qualitative field. The numerous publications of this nature have contributed to redefining the course of social and human research. Qualitative research encompasses diverse fields of knowledge, including anthropology, sociology, economics, psychology, administration, biology, and education, among others. Data collection techniques include field studies, participant observation, qualitative interviews, case studies, and participatory research.

However, the choice of technique to be implemented in a specific study depends on the nature of the research, its focus, its objectives, and the object of study.

2 THE INCORPORATION OF QUALITATIVE AND MIXED-METHODS APPROACHES WITHIN ENVIRONMENTAL SCIENCES

Environmental education, in addition to promoting behavioural changes in environmental care, seeks to establish critical perspectives and actions aimed at promoting transformations in society and the environment, using empirical studies (Bôlla; Milioli, 2011). However, to date, this area of knowledge still needs to demonstrate, in a more consistent way, empirical evidence regarding socio-environmental aspects. In the field of environmental impact analysis of projects, for example, studies with a socio-environmental focus frequently face limitations in determining concrete impacts, as well as in evaluating the effectiveness of projects in mitigating these impacts (Guanabara *et al.*, 2009).

In this context, new evaluation strategies capable of capturing the complexity of the environmental issue as it articulates with social aspects are necessary. The exclusive use of quantitative criteria has proven insufficient in the evaluation of environmental projects, since it does not adequately consider subjectivity, a central variable in understanding the causes and dynamics of the environmental crisis. Thus, the incorporation of qualitative approaches presents itself as a relevant alternative, as it allows for the investigation of dimensions that escape quantitative methods, incorporating aspects related to perception, experiences, and the meanings attributed by the subjects (Silverman, 2001).

Given the contemporary challenges in the social and environmental dimensions, it is essential to investigate, evaluate, and apply various research models within the scope of environmental management. To this end, it is necessary to incorporate multiple theoretical and methodological approaches into the analysis to overcome predominantly strictly economic views, which are limited in understanding socio-environmental complexity. In many cases, such approaches have contributed to the aggravation of environmental degradation problems and the intensification of social exclusion, as observed in populations affected by dams (Bernal, 2021).

In this sense, the present study aims to understand, explain, and describe, with greater precision, environmental problems in a specific territorial context, through the application of qualitative methodology and data collection and analysis techniques in a concrete Brazilian case. It seeks to demonstrate how this approach allows for a deeper understanding of aspects of reality that are not quantifiable, contributing to the comprehension of the universe of meanings, motivations, aspirations, beliefs, values, and attitudes (Minayo, 2014).

2.1 QUALITATIVE RESEARCH: FOUNDATIONS, INTERVENTION, METHOD AND TECHNIQUES

The genesis of qualitative methodology is associated with critiques of positivism and is often referred to as qualitative research. This approach encompasses various types of investigation, supported by theoretical and methodological frameworks such as ethnography, historical materialism, and phenomenology (Godoy, 1995). According to Minayo (2001), qualitative research was initially applied in anthropological and sociological studies as a counterpoint to the predominance of the quantitative approach. Subsequently, it expanded to areas such as psychology and education. Although criticised for its empiricism, subjectivity, and the involvement of the researcher, qualitative research offers relevant contributions to science by enabling the analysis of historically underexplored problems.

According to Godoy (1995), the qualitative approach presents the following characteristics: conducting the study in the natural environment, where social facts must be observed, analyzed, and interpreted in their context; the central role of the researcher in the observation, selection, and analysis of data; the valuing of descriptive data derived from empirical reality; the use of techniques such as interviews, visual records, and testimonies; consideration of the perspective of the subjects investigated; commitment to the reliability of the data; and adherence to ethical principles.

On the other hand, Knechtel (2014) highlights that qualitative research is characterised by understanding reality as socially constructed, by the relationship between researcher and object of study, by the emphasis on processes and meanings, and by the use of interpretive methods, such as interviews and detailed observation. It also includes case studies, an emphasis on in-depth descriptions, and the use of historical narratives and biographical and autobiographical materials.

Gerhardt and Silveira (2009) emphasise that the qualitative approach involves understanding the phenomenon in its totality, articulating the global and the local, respecting the specificities of the social world in relation to the natural world, and valuing the interaction between research objectives, theoretical frameworks, and empirical data. Furthermore, it opposes the idea of a single research model applicable to all areas of knowledge.

In this sense, qualitative methodology presents itself as a suitable alternative for understanding, explaining, and describing environmental problems more precisely in specific contexts, offering a consistent set of theoretical and methodological guidelines.

According to Neves (1996), qualitative research assumes different meanings in the field of social sciences, encompassing a set of interpretive techniques—such as unstructured and semi-structured interviews, participant observation, structured observation, and focus groups—that aim to describe and interpret complex systems of meaning. Complementarily, Alencar (1999) emphasises that the researcher begins fieldwork with theoretical assumptions that guide the investigation.

Qualitative research seeks to understand the complexity of social phenomena, which cannot be measured on a numerical scale (Rosental, 2001). Unlike the quantitative approach, it is not based on statistical instruments and prioritises the interpretation and understanding of phenomena (Dalfovo *et al.*, 2008).

Qualitative data includes information not expressed exclusively in words, such as paintings, photographs, drawings, films, videos, and even soundtracks (Dalfovo *et al.*, 2008). In this context, phenomenology constitutes an important theoretical foundation for qualitative research, seeking to understand the meanings individuals attribute to their experiences in specific contexts and emphasising the relevance of symbolic interaction and culture.

According to Trato (2005), qualitative research works with values, beliefs, representations, habits, attitudes, and opinions, being especially useful for understanding the context in which certain phenomena occur. Instead of measuring variables, its objective is to achieve a deep—and, when necessary, subjective—understanding of the object of study. In this way, it is directed at groups delimited in territorial and social terms, allowing for an intensive analysis of their dynamics.

As noted, qualitative research is not guided by numerical representativeness, but by a deeper understanding of social groups and their relationships with the context in which they are embedded. Researchers who adopt this approach reject the idea of a single model of scientific investigation, recognising the specificity of the social sciences and the need for their own methods. In this sense, the environment constitutes the main source of data, and the researcher can become directly involved in the investigative process.

Finally, qualitative data analysis enables the researcher to interpret the participants' discourses and understand, in depth, complex social phenomena, based on the relevance of the subjective aspect of social action in the face of the configuration of social structures (Haguette, 1997).

2.2 MAIN TECHNIQUES FOR COLLECTING QUALITATIVE DATA USED IN SCIENCE

As indicated, qualitative research does not have a single standardised method. In many cases, it can be characterised by a spectrum of methods and techniques adapted to specific cases, according to the needs and possibilities of the researcher and their object of study. However, the techniques most commonly employed in social research include: case studies, ethnography, interviews (structured, semi-structured, open, and projective), social cartography, observation (simple and participant), life histories and focus groups, content analysis, action research, phenomenology, and the Delphi method, among others.

Once the data is collected, these techniques allow for the analysis of the phenomenon and the organisation of the steps of description, understanding, and explanation, as well as the more precise identification of the relationships between the global and the local. Additionally, they make it possible to observe the differences between the social world and the natural world and to achieve more reliable results.

3 METHODOLOGY

3.1 AREA OF STUDY

This study was conducted in the Jacaré Curitiba Settlement (AJC), located between the municipalities of Poço Redondo and Canindé de São Francisco, in the Alto Sertão region of Sergipe. This area is part of the INCT – Odisseia research project, Catinga site. Specifically, the project's study area comprised the agricultural villages of Braço Erguido, Nossa Senhora da Conceição, São José, and Samariva Daniel. The latter two were considered a single unit due to the absence of clear boundary delimitation, as shown in Figure 1.

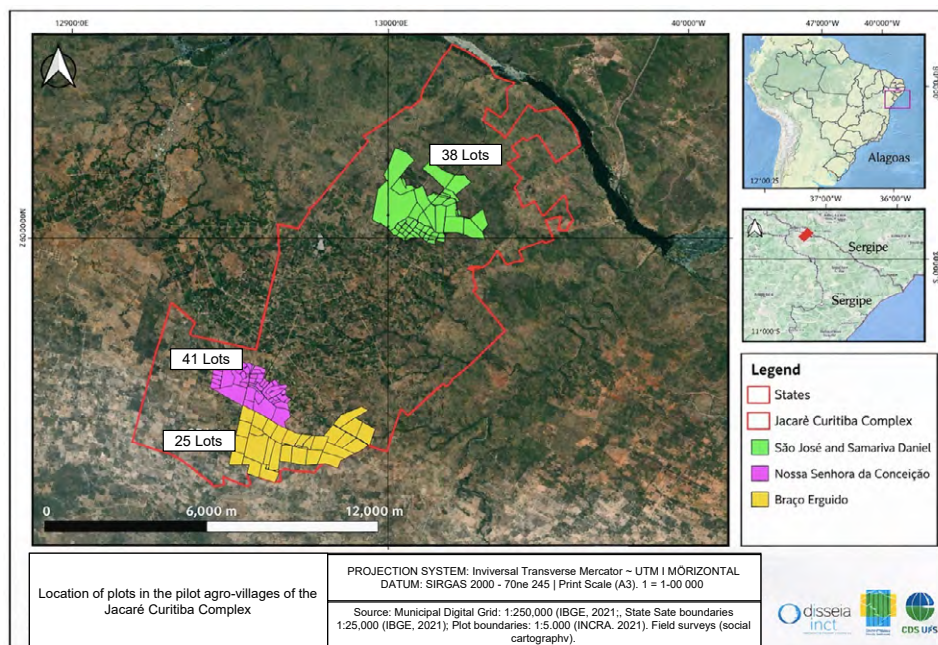


Figure 1 – Location and division of the Jacaré Curitiba Settlement in the State of Sergipe and Brazil

Source: Authors' own work.

3.1 QUALITATIVE METHODOLOGICAL TECHNIQUES APPLIED AND DATA ANALYSIS

In this study, interview and participant observation techniques were applied within the scope of the INCT – Odisseia project, described in the following section. These techniques allowed for an understanding of the study area and its most relevant problems. Both methodological techniques were applied. The interview, in turn, allowed for the establishment of a “process of social interaction between two or more people, in which one of them, the interviewer, aims to obtain information from the other, the interviewee” (Haguette, 1997, p. 86.). Observation, in turn, enabled the collection of information about certain aspects of reality, helping researchers identify and understand aspects of which individuals are not aware but that guide their behaviour (Lakatos, 1996).

A semi-structured interview script was prepared, considering the interviewee’s thought process, aiming to maintain the flow of conversation and conduct the interview logically. This instrument contained 18 central questions. In many cases, other questions arose based on statements or themes mentioned by the interviewees. Table 1 below presents a summary of the themes addressed during the interviews.

In total, 10 interviews were conducted. Among those interviewed were representatives and employees of the São Francisco and Parnaíba Valleys Development Company (Codevasf), the National Institute for Colonisation and Agrarian Reform (Incra), the Rural Technical Assistance and Extension Company (Emater), the municipalities of Poço Redondo and Canindé de São Francisco, local cooperatives, as well as residents of the settlement. It should be noted that the interviews were conducted between 2022 and 2023.

Table 1 – List of topics covered in the interviews

	<i>Interviewer identification</i>
	<i>Interview location</i>
	<i>Characterisation of the dwelling</i>
Characterisation of the interviewee	Guys
	Personal mobility
	Activities
Family characterisation	General
	Mobility for children
Family Social Capital	Associativism
Income characterisation	Non-agricultural
	Agriculture
Agricultural Activity	Lot characterisation
	Agriculture
	Livestock farming
	Extractive Activities and Conservation
	Agricultural practices
	Pesticides
	Agroecology
Water system	
Support for producing	Marketing
	Information
	assistance policies
	Credit

<i>Characterisation of the dwelling</i>	
Land Tenure Situation	Regularisation
	Use of other areas
	Own area / third parties (present/past)
	Acquisition of new lands
	Land sale
	Use of the Floodplain
Observed Changes	Abandonment
	Impact of monoculture and large-scale production
	Change
	Impacts of new products: Soybean tickets, among others.
Water, Food and Energy System	Situation and problems
Perceptions	Future
	Climate (precipitation and temperature) / Rainfall and droughts
	Phenology
	Flowmetry
	Climate impacts
	Traditional knowledge
Popular epistemologies	Weather forecast

Source: own

Regarding the observation carried out, the researcher sought to collect and record facts from reality without the use of special technical means, recording facts, elements or situations in field notebooks relating to several of the structural themes mentioned in Table 1. These notebooks were updated daily after the visits to the families carried out in the field.

3.3 REGARDING THE SYSTEMATISATION AND ANALYSIS OF DATA

All interviews were transcribed and compiled into a 105-page document. Data processing was performed using two software programs: NVivo and IRaMuTeQ. The use of these software programs allowed for a more in-depth analysis based on determinant variables, as well as the application of factor analysis, descending hierarchical classification, and similarity analysis.

Factor analysis allows us to observe the characteristics of the text through word frequency and the distribution of forms on a proximity plane, where those located at the centre are the most recurrent and relevant, and are related to other themes identified in the quadrants.

Hierarchical classification allows for the identification of vocabulary present in the text through classes. From the analysis of the words, different themes can be established in each class, facilitating the identification of the main concerns of the population mentioned in the interviews, as well as the relationships between them.

Similarity analysis, in turn, allows the identification of proximity relationships between words organised into communities. At the centre of a word map, the most relevant terms are observed, connected to

other themes discussed throughout the interviews. For coding purposes in the software, numbers and codes were assigned to each interviewee (see Table 2).

Table 2 – Coding of respondents for analysis in the Iramuteq software.

Node	Code	Person
1	**** *Interview_1	XXXX
2	**** *Interview_2	XXXX
3	**** *Interview_3	XXXX
4	**** *Interview_4	XXXX
5	**** *Interview_5	XXXX
6	**** *Interview_6	XXXX
7	**** *Interview_7	XXXX
8	**** *Interview_8	XXXX
9	**** *Interview_9	XXXX
10	**** *Interview_10	XXXX

Source: own

Finally, it is worth mentioning that this research was submitted to the evaluation of the Research Ethics Committee in Human and Social Sciences of the University of Brasilia, under protocol number 01037218.5.0000.5540 and opinion number 3.440.596.

4 RESULTS AND DISCUSSION

The systematic incorporation of qualitative methods in socio-environmental studies is a central strategy for optimising analytical and evaluative outcomes. Delving into the symbolic and contextual allows the researcher to value local knowledge and interpret the symbolic, cultural, and subjective dimensions of the society-nature relationship. Such approaches broaden the explanatory capacity of research and overcome the limitations inherent in exclusively quantitative measurement.

Thus, the application of methods such as ethnography, in-depth interviews, participant observation, and case studies favours more accurate diagnoses, as well as the development of more consistent assessments of socio-environmental impacts, possessing greater legitimacy in their results, since they integrate the meanings, perceptions, and practices of social actors. Consequently, studies that adopt qualitative frameworks tend to produce more integrated, contextualised, and effective analyses for environmental management and for the formulation of transformative interventions.

To validate these assertions, below are some of the results of the applied study, observing the population's appreciation for the economic and productive activities they carry out, the social and environmental problems identified, the marketing of products, and the important role that some state institutions have or represent for the local population.

According to some local residents, a large part of the settlement's territory is dedicated to agriculture and livestock farming in extensive pastures. Regarding agriculture, it is stated that it is predominantly practised using an irrigated farming system and, to a minimal extent, rainfed farming. The population's agricultural production is diversified, with a predominance of vegetables, legumes, greens, and fruits. It is stated that the main crops are okra, cassava, corn, beans, sunflower, guava, passion fruit, lettuce, watermelon, and pumpkin.

It is observed that rural families, in addition to the various agricultural crops they cultivate, also, in parallel and to a lesser extent, engage in beef and dairy cattle farming. This activity contributes to local families' income. On the other hand, it is stated that a large part of the settlement's production is marketed through intermediaries, who transport and sell their products in different parts of the country.

These were some of the most important general elements identified in the interviews. However, once the interviews were entered into the aforementioned software and a factor analysis was applied, a large number of themes were identified that are clearly of concern to the population, including: *land title, access to water/irrigation and consumption, water charges, production and marketing/cooperatives*, as well as general problems (See Figure 2).

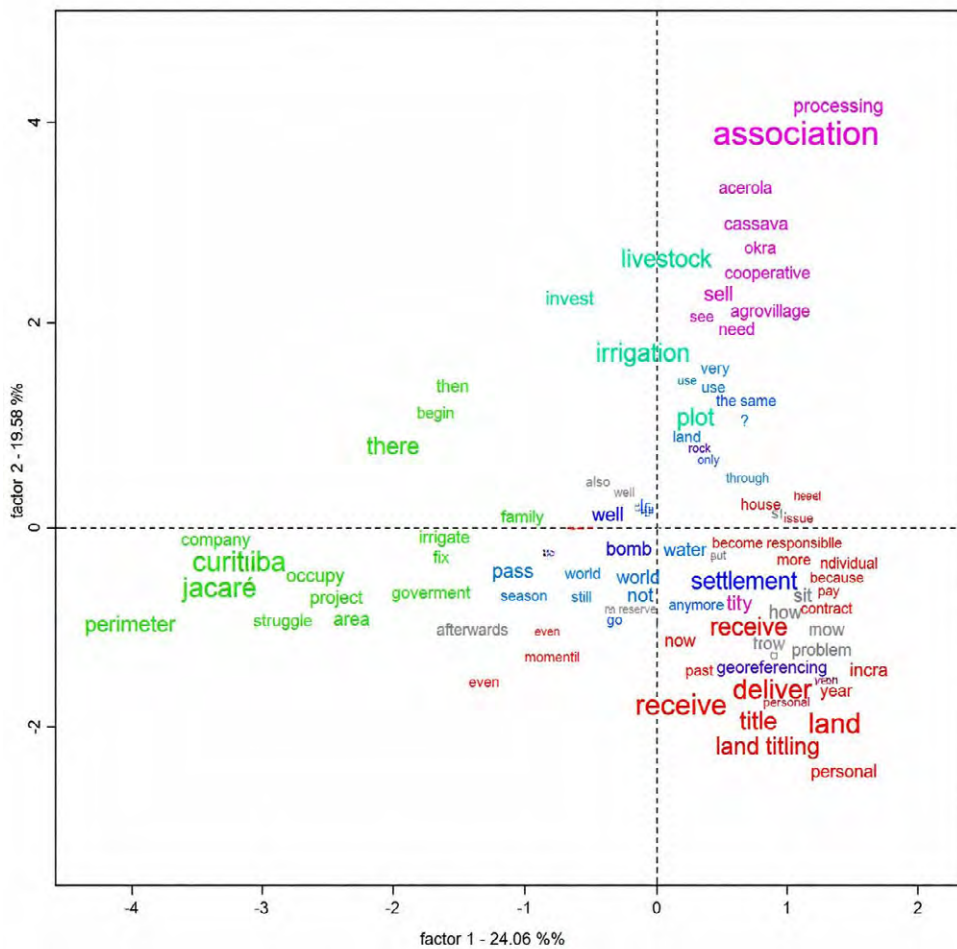


Figure 2 – Identifying the most frequently discussed themes in the interviews.

Source. The authors

These themes were verified through the implementation of descending hierarchical classification, which allowed for the identification of vocabulary within the text through classifications. It is observed that different themes emerged within each classification, facilitating the identification and validation of the population's themes and concerns.

Regarding the topic of land, for example, it can be observed through people's statements that this element is treated in terms of conquering territory for production, as well as being a determining factor in internal difficulties and disparities related to access to land, water, production, and environmental pollution.

“Those who chose to keep the irrigated plot would stay here because it has irrigation, and those who chose the dryland plot would go to another area or camp so they could acquire those lands. [...] Many people talk about the issue of land titles, but the decree that exists is for those who have eighty tarefas (a local unit of land measurement), it’s for those who can afford all the investments. And here, nobody can afford to make investments.”

Testimonials from residents of the Settlement

Analysing the interviews, it is observed that the settlement faces greater difficulties in areas categorised as rainfed, a factor mainly due to the quantity of production and commercialisation. This area largely depends on rain or artisanal irrigation, limiting production for family consumption and, in part, for commercialisation. The area’s population, as well as other interviewees, reports that large-scale production is compromising soil quality and accelerating salinisation due to excessive irrigation and fertiliser use. These data validate the results of soil analysis carried out by the INCT-Odisseia project (Oliveira, 2024). In this study, of the 104 plots analysed in the study area (22 intended for irrigation, 47 for livestock, and 35 for rainfed activities), 64 exhibited problems due to soil salinity, with 63 plots classified as saline and 1 as saline-sodic. Of these, 41 plots were identified in the Braço Erguido agricultural village, while the remaining 23 were in the Nossa Senhora da Conceição agricultural village.

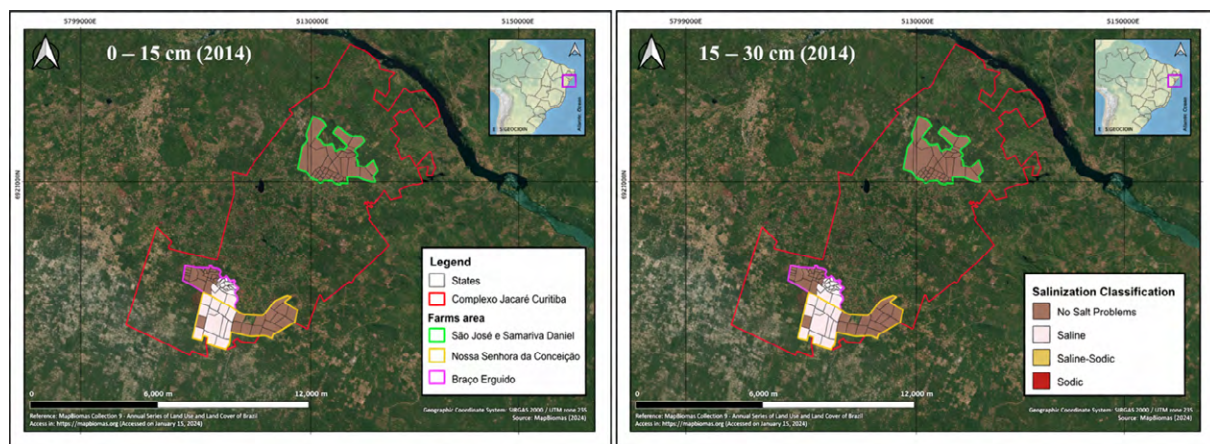


Figure 3 – Classification according to the level of salinity in the plots of the studied areas.

Source: Oliveira (2024)

On this point, it is noteworthy that the population indicates that, in addition to compromising environmental health, this practice also affects the health of various residents, causing a range of illnesses and, in some cases, death.

“All of this happens in the settlement: silting, salinisation of the land, land that no longer produces, but there is still no awareness that the land is not producing because too much fertiliser and chemicals were used, so there is no knowledge about this. Our biggest concern is with the environment, which has suffered, but mainly with life [...]. We have many people who have died here in the settlement because of pesticides. Unfortunately, medicine doesn’t tell us about pesticides; when we look at the history, it reports deaths from leukaemia, cancer, blood problems, and we know that the person used a lot of pesticides, was continuously in contact with this type of substance.”

Testimonials from residents of the Settlement

At the same time, it is observed that many families in the agricultural villages indicate a commitment and effort towards agroecological production. However, although the practice is growing, residents indicate that the benefits and accelerated production are much more attractive to some families, hindering the transition to this type of production.

Regarding access to water in the settlement, this is mainly addressed from two perspectives: the quality of water for consumption and water for irrigation. On the first point, it was observed that only three of the 36 existing agricultural villages in the Jacaré-Curituba settlement have potable water, with the others being supplied by water intended for irrigation. To lessen the health impacts of consuming this water, the population opts to add chemical products such as “*sodium hypochlorite and pills distributed at health centres*” before consuming the resource. However, it is reported that these methods are not always effective, affecting the health of the most vulnerable, including the elderly and children.

“Now, drinking water is a problem because the same water being used for irrigation is also being used for consumption. The agencies that assess water quality are reporting it as okay, but that’s not the case. And we don’t have any projects that attempt to improve the water distribution situation [...] we’ve raised the issue of drinking water and the intervention of the Sergipe Sanitation Company (DESO). People treat water at home with chlorine and hypochlorite, but they don’t have water from DESO because all the pipes are connected. Some people say they have water from DESO, but they already know that all the rural villages have connected pipes. There was a court order to remove the pipes and have DESO put them back, but it’s been two years and nothing has happened.”

Testimonials from residents of the Settlement

Regarding irrigation water, the population indicates that there are not many problems, apart from some cuts in the resource. They state that the biggest difficulty lies in the established irrigation period, which is not respected by some families, affecting the irrigation of others. The greatest concern is the power cut that supplies the irrigation pumps, which to this day is paid for by the São Francisco and Parnaíba Valleys Development Company (Codevasf). According to the population, there is already an association that is responsible for the gradual collection of charges for water and energy consumption in the irrigated perimeter of the settlement, since these represent an expense of approximately R\$ 60,000.00 per month for the institution.

“They had to reduce irrigation, they had to stop irrigating one day. On Wednesdays we couldn’t turn on the water; they went two years without being able to irrigate on Wednesdays. Now, because of the reduced irrigation, Jacaré Curituba Settlement doesn’t suffer as much, but if the pump breaks, then there’s a problem, they lose a lot of money.”

Testimonials from residents of the Settlement

On the other hand, socially, it is evident that from the moment irrigation arrived in the studied area, individualism began to prevail among people, leading each family to produce on their own plot, consolidating a distancing in internal relations. This fact, it is stated, was not evident in the cohesive groups of the initial MST, compromising production, associativism and cooperativism, and with that, innovation, growth and commercialisation.

Regarding the production, marketing, and presence of cooperatives, it is observed that the products predominantly produced in the Jacaré Curituba Settlement are: cassava, okra, cowpeas, acerola, guava, onion, and garlic, among others. And on a smaller scale, more backyard production includes cilantro, chives, and tomatoes, among others.

“Right now, we are working with cassava, okra, cowpeas, acerola, and guava. Many of the proposals from the settlement focus on fruit growing for acerola and guava production, milk production, and the installation of a dairy cow [...]. In the backyard, we grow cilantro, chives, and tomatoes for consumption.”

Testimonials from residents of the Settlement

The population expresses that the production and profit of families is an achievement of the people, a result of struggle, prevalence, and effort, bringing a feeling of gratitude and belonging in relation to the territory and the Landless Rural Workers Movement (MST). It is noted that families recognise the change in the perspective of work, distinguishing that today they are owners of their territory and their production, but not from commercialisation, regarding their products. On this last point, it is considered a serious problem by the population, since a large part of the production is frequently delivered to so-called “middlemen”: people who collect the products from the production areas at prices low compared to the market.

It is also observed that the problem of marketing through intermediaries occurs for three reasons: first, the lack of options for selling their products, such as fairs, local commerce, sales centres, etc. Second, due to a lack of internal cooperation, the organisation of marketing procedures is limited not only at the local level but also at the municipal and state levels. This factor encourages the population to hand over the product to intermediaries, without knowing where their product is destined or what the final market value is (See Figure 4). In some cases, the population indicates that the amount received does not reach 10% of the value sold in other states.



Figure 4 – Okra harvesting within the AJC by middlemen

Source: Authors (2024)

Third, the population highlights the lack of transportation for producers, limiting the movement of products for sale. It is indicated that there were efforts to commercialise the products; however, these were limited to the sale of only a few products, such as cassava (or manioc).

“Most of the settlement sells through middlemen, a few sell directly at the market, there are also cooperatives, some farmers are members and take their produce to the cooperative so that it can market it [...] we don’t have transportation for the settlers to go and sell their own produce. Since they don’t have credit to invest in farming and don’t have transportation to take it, what they produce is taken by the middleman.”

Testimonials from residents of the Settlement (2022)

On this point, the population indicates that some residents prefer to deliver their produce to middlemen because it facilitates marketing, even if the producer receives a much lower price than the final market value. Here, it is observed that the producer thus avoids the work of selling at fairs and the expenses of transporting the product. Although this practice is more common within the settlement, it is one of the least profitable.

Inkra technician goes to the settler's house to deliver the contract and release the benefit [...] Incra has always worked on this, including in the application of the 'Fomenta Mulher' credit program, we held numerous meetings with groups of women, talking about its importance, and we discussed this with the Incra technicians, and that's when we really started working on the issue of gender, on empowering women to be active in the development process of their plot."

Testimonials from residents of the Settlement (2022)

Indeed, the actions of Incra and Codevasf have become quite important in terms of women's empowerment. Over the years, many women have reported feeling freer to speak and act in their daily work, a situation that was not possible in previous generations. This transformation has enabled women to position themselves at the centre of decision-making and action. It is observed that their role has become fundamental in relation to structural issues within families, such as: water consumption and quality, production and marketing, management of cooperatives and associations, children's education, food provision and preparation, productive economy, family health and well-being, environmental care, among others.

The theme of cooperatives emerges as a structural element in the analysis by similarity, since it constitutes the primary means of food production and commercialisation. It is evident that currently there are several associations and cooperatives within the settlement, the most representative being Unituba and Coopac, which make it possible to add value to certain products.

"There are several associations and cooperatives here, but the most important are Unituba and Coopac. Unituba coordinates the factory, processes the cassava, makes cassava cakes and sells them in the markets, while Coopac is more involved in the production side, for the..." The Food Acquisition Program (PAA) and the National School Feeding Program (Pnae). Currently, it's at a standstill; everything is reduced. What they used to do, today you see fifteen, twenty, which is already a lot.

Testimonials from residents of the Settlement (2022)

It should be noted that the role of cooperatives was once much more important, but today they are forgotten and abandoned. This fact demonstrates a limited internal organisation and cohesion, making it impossible to balance social justice with economic prosperity and internal sustainability. As a result, the achievement of tangible financial results is restricted, the emergence of collective interests is inhibited, and the possibility of individual aspirations prevailing is opened.

Regarding DESO, the institution is identified as crucial to regional development and as a generator of local well-being due to its role as a distributor of potable water. However, the institution is considered deficient in terms of water supply, as it only covers 20% of the settlement. This fact causes a series of impacts on the population, such as water insecurity and an increase in human health problems. To date, several local actions involving municipal authorities have been undertaken to address this situation, but they have not yielded concrete results and have left the population reliant on water consumption for irrigation.

"80% of the settlement doesn't have treated water; it's irrigation water from Codevasf, and Codevasf isn't obligated to treat water for everyone. The company that treats the settlers' water is called DESO; it's responsible for the settlers' water, but that water never arrived. Then, when the Codevasf pipeline arrived, the population improvised, and now everyone uses non-potable water because the potable water is the responsibility of another company."

Testimonials from residents of the Settlement (2022)

Regarding the family as a basic and initial social institution, it is responsible for the so-called socialisation or primary interaction of the individual in society through language teaching, the transmission of values, and the teaching of basic norms of social interaction (Bauman, 1998; Stewart; Glynn, 1978; Vaitsman, 1994). In the settlement, it is observed that this is the basis of agroecological production. According to members of the agro-villages, some families are increasingly concerned with agroecological and sustainable production and, in turn, are promoting the articulation of local bases to advance aspects such as organisation, sustainable peasant production, and reducing the impact of climate change on production and the population, among others. Likewise, there is a concern to propose public policies that help improve the local situation in relation to the various themes presented so far.

Another important element regarding this aspect is observed in the families' concern to establish productive family units. In this sense, many of them have been carrying out productive activities in the same backyards as their homes, taking advantage of family labour, space, and the agricultural knowledge of each member. Among these, we can mention the efforts of entrepreneurial women who, based on local needs, began producing cakes, ice cream and popsicles from local fruits, dairy products, jams, liqueurs, pulps, among others. Products that today already form part of the basis of local production and family income.

As observed so far, the qualitative analysis of the data has made important contributions to the project's research, allowing us to delve meticulously into certain facts from the perspective of the population. Themes such as water security (in terms of resource quality), production processes, and marketing were those that attracted the most attention. The importance of the first... One reason is the high degree of vulnerability of the residents in relation to health, and the second is the lack of investment for the adequate sale of local products, an aspect that, in turn, is exploited by external marketers.

The detailed analysis of the facts was achieved through the use of qualitative techniques and methodologies, developed from records of perceptions, beliefs, representations, habits, attitudes, and opinions. As some authors previously noted, this data was useful for understanding the context of the phenomena; in this case, several factors became evident, including production, soil salinisation, and commercialisation through intermediaries.

In summary, the analysis of qualitative data, as well as participant observation, through the tools and software used, allowed for a deep understanding of some latent themes and problems within the settlement.

In this sense, it is argued that the use of this methodology within environmental sciences can be quite useful, as it allows one to delve into the subjectivity of phenomena. Environmental problems need to be increasingly evaluated from a social perspective, analysing issues arising from production, population, gender issues, generational issues, health, discrimination, social and environmental injustice, among others.

Many of these topics were not addressed in this work due to the scope of the research, but they are considered of paramount importance. Therefore, it is believed that addressing them in future studies may bring relevant analyses and debates to society and science.

5 CONCLUSIONS

The results demonstrate that prioritising qualitative data evaluation methods tends to yield deeper, more detailed analyses. In many cases, quantitative studies in the field of environmental sciences have limitations in measuring subjective aspects, a factor that restricts the understanding of phenomena and can introduce biases into the results.

It is observed that qualitative research allows for the analysis of subjective aspects and broadens its representativeness, especially due to the proximity between researcher and participants, as well as the descriptive and narrative nature of the data collected. The critical perspective adopted in this study regarding the application of quantitative techniques in environmental sciences is directed towards questioning the interpretations used to infer effects of diverse nature on the social characteristics of certain populations. In this sense, more in-depth analyses, which incorporate the participation of social actors, become fundamental for understanding such aspects.

Thus, the need to expand spaces for dialogue, interaction, and the collection of qualitative data—such as interviews and observations—becomes evident, which can contribute to a more accurate understanding of the real impacts of large-scale projects on local populations.

Therefore, it becomes essential to expand impact assessment strategies, as well as diversify the methodological techniques adopted, advancing the implementation of more robust and consistent approaches. The findings of this study indicate that qualitative research promotes a significant appreciation of social phenomena and processes, by considering motivations, beliefs, values, and representations present in social relations.

The results discussed throughout this study demonstrate that the adoption of qualitative methods in socio-environmental research significantly expands analytical and interpretative capacity, especially given the complexity of the society-nature interface. By incorporating symbolic, cultural, and subjective dimensions—often rendered invisible by exclusively quantitative approaches—qualitative methodology allows for a deeper understanding of the social processes that condition environmental dynamics.

The researcher's contextual immersion, the valuing of local knowledge, and direct interaction with the subjects being investigated strengthen the production of more consistent diagnoses and more reliable assessments of socio-environmental impacts. Furthermore, such approaches contribute to the formulation of environmental management strategies that are more sensitive to territorial realities and the socio-cultural specificities of the groups involved.

It can be concluded, therefore, that the systematic integration of qualitative techniques in socio-environmental studies not only improves the quality of the results obtained but also promotes more integrated, contextualised, and socially legitimised analyses, thereby constituting a relevant methodological approach for addressing contemporary sustainability challenges.

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STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

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