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PUBLIC IRRIGATION POLICIES: ANALYSIS OF THE MODERNIZATION OF THE CRUZETA-RN IRRIGATED PERIMETER FINANCED BY THE WORLD BANK

Políticas Públicas de Irrigação: Análise da modernização do perímetro irrigado de Cruzeta-RN financiada pelo Banco Mundial

Políticas Públicas de Riego: Análisis de la modernización del perímetro irrigado de Cruzeta-RN financiado por el Banco Mundial

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ABSTRACT

This study analyzes the public policy of the state of Rio Grande do Norte called the Program for Sustainable Development and Coexistence with the Potiguar Semi-Arid Region (PSP), financed by a World Bank loan, which had as its Subcomponent 3.4 the Pilot Project for the Modernization of the Irrigated Perimeter of Cruzeta-RN, implemented in 2013. The research, which took a qualitative approach, sought to understand the impacts of this policy based on the experiences and points of view of the local irrigation community. The investigation showed that, although residents recognize the importance of the perimeter and the investments made in its modernization, water scarcity, present before, during, and after the implementation of the policy, combined with the lack of maintenance and continuous management, compromised the use and functioning of the irrigation systems, resulting in the deterioration of the structures. In addition, the lack of coordination between the responsible agencies, coupled with the discontinuity of public policies, contributed to the project's ineffectiveness. The testimonies of the irrigators interviewed reinforce that drought is one of the main obstacles to effective agricultural production in the perimeter. Given this scenario, there is an urgent need for more effective public policies that are capable of considering local geographical specificities, ensuring the continuity of water management, and promoting sustainable access to water. In this sense, the study contributes to the debate on the effectiveness of irrigation policies in the northeastern Semi-Arid region, highlighting the need to integrate technical, social, and environmental dimensions in the process of formulating and implementing these actions..

Keywords: Public Policies, Irrigation Policies, Irrigated Perimeters, World Bank.

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RESUMO

Este trabalho analisa a política pública do Estado do Rio Grande do Norte denominada Programa de Desenvolvimento Sustentável e Convivência com o Semiárido Potiguar (PSP), financiada por empréstimo do Banco Mundial, que teve como Subcomponente 3.4 o Projeto Piloto de Modernização do Perímetro Irrigado de Cruzeta-RN, implementado em 2013. A pesquisa, de abordagem qualitativa, buscou compreender os impactos dessa política a partir das experiências e pontos de vistas da comunidade irrigante local. A investigação evidenciou que, embora os moradores reconheçam a relevância do perímetro e os investimentos destinados à sua modernização, a escassez hídrica, presente antes, durante e após a implementação dessa política, aliada à ausência de manutenção e de gestão contínua, comprometeu o uso e o funcionamento dos sistemas de irrigação, resultando na deterioração das estruturas. Além disso, a ausência de articulação entre os órgãos responsáveis, somada à descontinuidade das políticas públicas, contribuíram para a inoperância do projeto. Os depoimentos dos irrigantes entrevistados reforçam que a seca constitui um dos principais obstáculos para a efetivação da produção agrícola no perímetro. Diante desse cenário, evidencia-se a urgência de políticas públicas mais eficazes, capazes de considerar as especificidades geográficas locais, assegurar a continuidade da gestão hídrica e promover o acesso sustentável à água. Nesse sentido, o estudo contribui para o debate acerca da efetividade das políticas de irrigação no Semiárido nordestino, ressaltando a necessidade de integrar dimensões técnicas, sociais e ambientais no processo de formulação e implementação dessas ações.

Palavras-chave: Políticas Públicas, Políticas de Irrigação, Perímetros Irrigados, Banco Mundial.

RESUMEN

Este trabajo analiza la política pública del estado de Rio Grande do Norte denominada Programa de Desarrollo Sostenible y Convivencia con el Semiárido Potiguar (PSP), financiada por un préstamo del Banco Mundial, cuyo subcomponente 3.4 fue el Proyecto Piloto de Modernización del Perímetro Irrigado de Cruzeta-RN, implementado en 2013. La investigación, de enfoque cualitativo, buscó comprender los impactos de esta política a partir de las experiencias y puntos de vista de la comunidad irrigadora local. La investigación puso de manifiesto que, aunque los residentes reconocen la importancia del perímetro y las inversiones destinadas a su modernización, la escasez de agua, presente antes, durante y después de la implementación de la política, junto con la falta de mantenimiento y gestión continua, comprometió el uso y el funcionamiento de los sistemas de riego, lo que provocó el deterioro de las estructuras. Además, la falta de coordinación entre los organismos responsables, sumada a la discontinuidad de las políticas públicas, contribuyó a la ineficacia del proyecto. Los testimonios de los regantes entrevistados refuerzan que la sequía constituye uno de los principales obstáculos para la efectividad de la producción agrícola en el perímetro. Ante este escenario, se evidencia la urgencia de políticas públicas más eficaces, capaces de considerar las especificidades geográficas locales, garantizar la continuidad de la gestión hídrica y promover el acceso sostenible al agua. En este sentido, el estudio contribuye al debate sobre la eficacia de las políticas de riego en el semiárido del noreste, destacando la necesidad de integrar las dimensiones técnicas, sociales y ambientales en el proceso de formulación e implementación de estas acciones.

Palabras clave: Política Pública, Política de riego, Perímetro de riego, Banco Mundial.

1 INTRODUCTION

Between the late 19th and early 20th centuries, reservoirs in the Northeast Semi-

Arid region were primarily intended for human and animal consumption, livestock farming and subsistence agriculture, with no systematic focus on irrigation. Only after World War II, in the context of the Green Revolution, did these projects become associated with productive modernization, incorporating capital, technologies, and agricultural inputs (Albano, 2022; Oliveira, 1981).

It is in this context that the irrigated perimeters policy is inserted, aimed at transforming traditional agriculture into agriculture guided by market logic and intensive production. According to the World Bank (1983, p. 181), many of these programs were co-financed by international institutions, including the World Bank itself, which has established itself as a partner of the Brazilian State in the implementation of agricultural and hydraulic infrastructure projects. The DNOCS (National Department of Works Against Droughts), operating in the Semi-Arid and in the state of Rio Grande do Norte (RN), was one of the main agencies responsible for conducting these public projects. Among its achievements, the construction of the Cruzeta Irrigated Perimeter, located in the intermediate region of Caicó, stands out (Silva, 2019).

The implementation of this project ocurred between 1973 and 1977, with operational activities beginning in 1975, focusing on the production of crops such as macassar beans, herbaceous cotton, tomatoes, and pacovã bananas. However, in the 1980s, reports from DNOCS and the World Bank highlighted technical, structural, and geographic flaws, such as low soil fertility, salinization, poor water management, and successive crop failures, which compromised its economic viability. As a result, the original proposal for modern, intensive agriculture declined, giving way currently to family-based agricultural and livestock practices (Brazil, 1973; Albano, 2022; World Bank, 1983).

In 2013, the Cruzeta Irrigated Perimeter received financial support through the State Program for Sustainable Development and Coexistence with the Potiguar Semi-Arid Region (PSP – P089929). It consists of a state government initiative financed by a World Bank loan, which aimed to modernize and restructure agricultural infrastructure, expand irrigated areas, promote water-saving methods, and ensure water self-sufficiency of irrigation systems (Rio Grande do Norte, 2014).

Therefore, this study has the objective of analyzing the effects of the public policy implemented in the Cruzeta Irrigated Perimeter, based on the perceptions and experiences of the irrigating community, highlighting the structural and productive transformations resulting from modernization initiatives, as well as the limitations faced in their implementation. We also sought to analyze the social, economic, and environmental

implications of these interventions. To this end, this research, of scientific nature, which integrates and results in an investigation to the level of a master's degree, used questionnaires and semi-structured interviews as methodological instruments. Thus, the work contributes to geographical science by fostering a critical analysis of public irrigation policies in the Brazilian Semi-Arid region.

In this sense, the article's structure is organized as follows: the materials and methods used in the research are presented, among which fieldwork as well as the application of questionnaires and interviews stand out. Following that, a chapter then addresses the topic of public policies, addressing irrigated perimeters, the World Bank, and DNOCS. Next, the study área – the Cruzeta Irrigated Perimeter (RN) – is characterized, also including a specific subtopic on the perimeter's modernization process. Subsequently, the results and discussions are presented, and finally, the references that support the article.

2 MATERIALS AND METHODS

The methodology adopted was initially based on bibliographic research, based on sources such as Becker (1986), Carvalho (1988), Pereira (2016), Albano (2022), Saravia (2006) and Teixeira (2002), which offered theoretical support on: public irrigation policies, irrigated areas in the Semi-arid region, irrigated perimeters and the actions of the World Bank as a financier of public policies. Furthermore, official documents, such as Brazil (1973) and World Bank (1983), were considered as sources of documentary research that offered data and information relevant to the research.

Still within this scope, the fieldwork consisted of a qualitative approach, which enabled the understanding of the reality experienced by social subjects, through direct observation and interaction with the space studied.

For the collection of data, questionnaires and interviews were used. According to Cruz Neto (2002), interviews are effective tools for capturing implicit elements in the discourses of social actors, while questionnaires are more objective and involve less interaction in the information gathering process.

This way, this empirical stage of the research consisted of developing and applying a questionnaire composed of 20 questions (10 open-ended and 10 closed-ended) addressed to the 23 irrigators linked to the Cruzeta Irrigated Perimeter. The questions covered various dimensions, such as: infrastructure and operational conditions of the perimeter; perceptions of the investments financed by the World Bank; challenges faced in

daily production; and perspectives regarding the project's viability for local development. The open-ended questions revealed individual and collective narratives, while the closed-ended questions allowed for the quantification of tendencies. The data was categorized, statistically processed, and presented in tables and charts, enabling the identification of convergences and divergences among the irrigators and favoring a critical analysis of the results.

Thus, the interviews were conducted in person in the field, and the answers attained operated as the primary empirical material for analyzing and interpreting the results of this investigation. A total of 29 people participated, including APICRUZ irrigators, retired “colonos”[1] or irrigators, and DNOCS employees.

Next, we will address the public policies for the development of irrigated agriculture, focusing on the irrigated perimeters, the role of the World Bank in financing water infrastructure projects, and the role of the National Department of Works Against Droughts (DNOCS) in managing water resources in the Brazilian Semi-Arid region.

3 PUBLIC POLICIES, IRRIGATED PERIMETERS, WORLD BANK AND DNOCS

Public policies consist of an articulated set of decisions and actions formulated by the State, whether in dialogue with society or not, aimed at organizing collective life, resolving social problems, and mediating divergent interests (Paolinelli, 2022). They can be understood as a stream of public decisions that seek to maintain or modify social reality. They play a fundamental role in guiding State action and mediating relations between it and society, but their effectiveness depends on factors such as target audience, territory, political forces, and institutionalization (Teixeira, 2002; Saravia, 2006).

In the context of the Brazilian Semi-Arid region, public policies implemented since the late 19th century are rooted in a trajectory marked by the region's marginalization. Traditionally perceived as a space of natural adversity, the Semi-Arid region has been associated with an inhospitable landscape and water scarcity, which has contributed to the construction of a stigmatized image of the territory and its inhabitants (Carvalho, 2011).

[1] The Executive Group for Irrigation and Agricultural Development’s (GEIDA) central idea was to promote irrigation by expropriating land from irrigation basins, where the "irrigated perimeters" would be established, and dividing it into small lots, where "colonos" would be settled, partly recruited from among the former residents of expropriated private rural properties. The implementation of this model was to be undertaken by the DNOCS, which generated strong antipathy toward the Department among the expropriated landowners (due to the depressed prices paid for the expropriations) and among the residents excluded from the settlement process, who found themselves expelled and without support to rebuild their activities and homes (Almeida, 2009, p. 82).

Even before the formulation of structured public policies, the construction of dams was consolidated as the main strategy adopted by local populations in the Semi-Arid region to mitigate the recurring impacts of water scarcity. This practice was introduced by Portuguese colonizers and adapted by the sertanejos over time, becoming essential for the occupation and permanence in the territory (Neto, 2017).

According to Molle (1994), until the early 19th century, the reservoirs were scarce, reflecting the region's low population density. However, starting in the 1830s, this scenario began to change with the institutionalization of government incentives. This historical context signals not only the recognition of the importance of water for human survival in the Semi-Arid region, but also the beginning of a public policy aimed at combating droughts, which would later expand with the creation of specialized institutions (Silva, 2006; Pereira, 2016).

The policy to combat the effects of drought in the Brazilian Semi-Arid region was institutionalized in a more structured manner with the creation of the Inspectorate of Works Against Droughts (IOCS) in 1909. This federal agency pioneered the planning and execution of systematic actions to address water scarcity, through technical studies and physical interventions in the territory. The IOCS, a precursor to the current DNOCS, worked on the construction of reservoirs, dams, wells, and irrigation projects in public and private areas (Oliveira, 1981; Silva, 2006).

On the other hand, the public irrigation policies in the Semi-Arid region emerged as strategies for development and mitigation of drought. Since the beginning of the 20th century, different federal agencies have been created, but these have often been subordinated to the interests of local elites (Neto, 2017; Mendonça, 2010).

With the reformulation of the IOCS into DNOCS in 1945, a new understanding of how to address regional problems was consolidated. However, the 1958 drought cycle exposed the limitations of palliative policies based on hydraulic projects, highlighting the need to move beyond the logic of "combating drought" through damming and move toward more structural projects (Pereira, 2016).

In view of this, under the government of Juscelino Kubitschek, the Working Group for the Development of the Northeast (GTDN) was created, led by economist Celso Furtado. This group was tasked with carrying out a diagnosis of the structural obstacles in the Northeast and proposing guidelines for a new regional development policy (Silva, 2006; Pereira, 2016).

According to Silva (2006), through the military regime of 1964, a conservative modernization that preserved oligarchic interests was consolidated, marked by the

expansion of water infrastructure, the creation of irrigated perimeters and the actions of bodies such as DNOCS and Sudene (Linhares, 2021).

In this process, irrigation began to be seen as a driver of economic transformation, making the Semi-Arid region a strategic location for the implementation of these public projects (Mendonça, 2010). Furthermore, between the adoption and dissemination of these policies, there was interaction between the Brazilian State and non-state actors, such as the World Bank, which played an important role in the development of public policies in Brazil. This bank acted as co-financier of irrigation projects for the Semi-Arid region, promoting developmentalist ideals and the modernization of agriculture (Albano, 2022).

In this context, during the 1970s and 1980s, several state programs were implemented, notably the Multiannual Irrigation Program (PPI), which prioritized irrigation projects as a central part of the government's agenda. Coordinated by DNOCS, the PPI aimed to establish irrigated perimeters, with state investments in water infrastructure such as canals, dams, and irrigation systems, and in policies to support farmers through technical assistance, rural extension, and access to credit (Coelho Neto, 2010; Bursztyn, 2008).

These projects promoted irrigated agriculture hubs in the Semi-Arid region, marking a technological revolution that amplified productivity, introduced agro-industries and strengthened production directed towards the foreign market (Silva, 2006).

The irrigation policy in the Brazilian Northeast, led by DNOCS, resulted in the implementation of 36 public irrigation projects in humid valleys, later included in the Northeast Irrigation Program (PPI) (Coelho Neto, 2010). In 1980, DNOCS already managed perimeters in the states of: Maranhão (2), Piauí (6), Ceará (14), Rio Grande do Norte (5), Paraíba (3), Pernambuco (4) and Bahia (3) (Buainain; Garcia, 2015).

In the Rio Grande do Norte, the irrigated perimeters managed by DNOCS are located in the municipalities of Pau dos Ferros, Caicó (Sabugi I and II) and Cruzeta. These projects were conceived as a solution to mitigate the effects of drought and boost irrigated agriculture in the state's interior. Initially focused on crops such as bananas, garlic, tomatoes, and vegetables, they have since reverted to the cultivation of traditional rainfed crops such as macassar beans and cotton (Brasil, 1982).

In turn, industrial tomato production in the state's perimeters was prominent, being primarily exported to the Palmeiron industry in Pernambuco. This industry was the main market, especially for Sabugi and Cruzeta. However, the DNOCS projects faced structural and operational problems that compromised their sustainability (Asa, 2014; Albano, 2022; World Bank, 1983).

Evaluation documents elaborated by institutions such as the World Bank indicated that the socioeconomic objectives of these investments in the Northeast Semi-Arid region were not fully achieved, highlighting limitations in public policies aimed at irrigation (World Bank, 1983).

Starting in the late 1980s, these areas began to show signs of exhaustion, with declining productivity and a loss of economic relevance, a scenario that also affected the Cruzeta Irrigated Perimeter. The decline in irrigated agriculture was boosted by factors such as the cessation of institutional purchases, water shortages, low market prices, and soil degradation resulting from gravity-fed irrigation (World Bank, 1983).

Thus, these irrigated areas fell far short of achieving projected goals, both in terms of job creation and income growth. The 1983 World Bank report was incisive in highlighting deficiencies such as low soil fertility, inefficient water management, lack of technical assistance, salinization of the land, and the absence of effective marketing strategies (Albano, 2022; World Bank, 1983).

Therefore, since the end of the 1980s, these public projects began to face serious limitations, such as the lack of adequate technical assistance, insufficient resources, soil salinization and failures in water management, factors that contributed to the discontinuity and loss of efficiency of the irrigated perimeters (Silva, 2006; Mendonça, 2010).

Accordingly, given this scenario of the regression of public perimeters in the Semi-Arid region and the growing public debt that affected the Brazilian State, the latter, in turn, began to encourage privately managed irrigation. Studies were conducted to transfer the administration of the perimeters to irrigators through their respective associations (Sousa, 2005).

Characterized as a perimeters emancipation policy, this movement intensified from 1985 onwards, with the redemocratization of the country, when programs such as PRONI and PROINE emerged, both with financial support from the World Bank, aimed at structuring a new logic for irrigation in the Northeast (Mendonça, 2010).

Despite these efforts, the Federal Court of Auditors (TCU) expressed concerns regarding the activity of the autarchies, highlighting problems such as unfinished projects, poor water resource management, defaults, and political choices regarding project locations, which hindered the expected emancipation of these perimeters. Even so, the State continued investing in the restructuring of these areas, especially to meet the demands of irrigated fruit farming (Sousa, 2005).

In the Rio Grande do Norte, there was the case of investments being made through

public policies coordinated with international capital, through financing by the World Bank, which were allocated to the "Program for Sustainable Development and Coexistence with the Potiguar Semi-Arid Region". The objective was to modernize the infrastructure of irrigated areas, promote the rehabilitation of existing systems, expand irrigable areas, and implement technologies for water self-sufficiency in production units (Rio Grande do Norte, 2005).

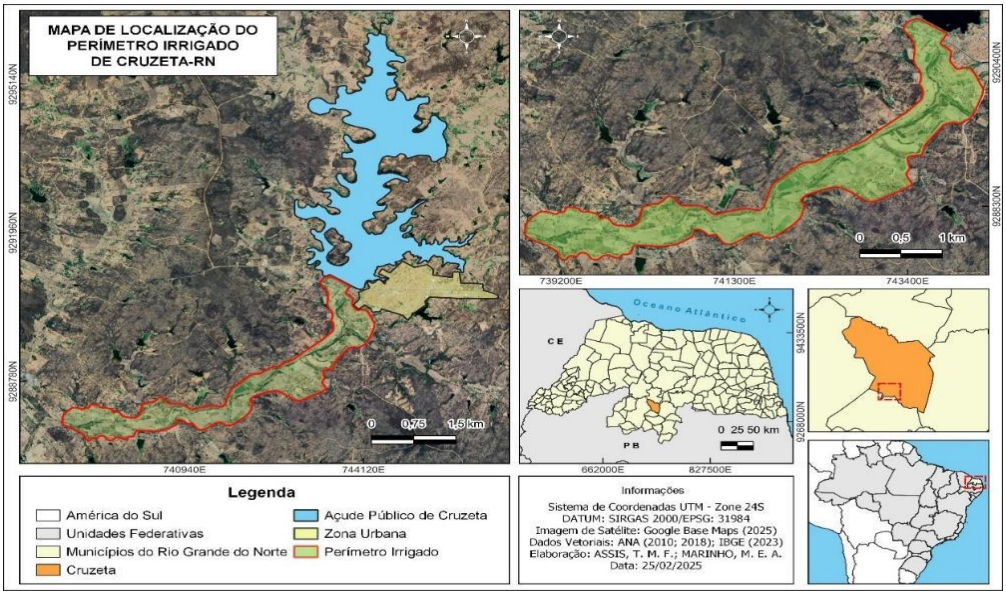
Among all the state's irrigated perimeters, Cruzeta was the only one to receive structural actions under this program, a fact that reinforces its strategic importance in the context of irrigation policies aimed at the Potiguar Semi-Arid region (Rio Grande do Norte, 2006). The initiative, starting in 2013, represented a millionaire investment directed towards revitalizing the structure created in the 1970s, which for decades had faced physical deterioration, adverse weather conditions, and political and administrative obstacles (Rio Grande do Norte, 2014).

Thus, this article brings together the results of a scientific survey with irrigators from the Cruzeta Irrigated Perimeter, aimed at understanding their perceptions about the project, their experiences and knowledge, as well as the impacts of the modernization financed by the World Bank in 2013, analyzed in light of the local geographic context.

4 CHARACTERIZATION OF THE STUDY AREA: IRRIGATED PERIMETER OF CRUZETA (RN)

The Cruzeta Irrigated Perimeter, located in the municipality of Cruzeta (Figure 1), in the state of Rio Grande do Norte, is located in the Seridó Potiguar region and the Piranhas-Açu River basin. It was constructed between 1973 and 1977 and inaugurated in 1978. With a total area of 416.27 hectares, of which 141.84 hectares are irrigable, this public project consists of 23 lots occupied by farmers, known as Colonos or irrigators. They are organized through the Cruzeta Irrigated Perimeter Association of Irrigators (APICRUZ), which is responsible for the operation and maintenance of the perimeter in partnership with DNOCS (Brasil, 2007).

Figure 01 – Location Map of the Cruzeta Irrigated Perimeter – RN



Source: Elaborated by the authors (2025).

As for the recommended irrigation method, for a long time, flooding or furrows were used, having the Cruzeta Public Reservoir as the water source, with a current estimated capacity of 23 million m³ and approximately 850 meters long, built between 1920 and 1929 by the former IFOCS (Brazil, 1982; Brazil, 2007).

The Perimeter irrigation system is characterized by the absence of pumping stations and pressurized piping networks, which reduces operating costs but limits the efficiency and flexibility of water use. The water is distributed through a 9-km main adductor canal, supplemented by secondary and tertiary systems, with an estimated flow rate of 400 liters per second, meeting the water demands of irrigated plots and agricultural activities (Brasil, 2007).

Similar to the various projects in the Semi-Arid region, the agricultural production results in this perimeter fell short of initial expectations, culminating in the structural collapse of the project, according to documents issued by the World Bank and DNOCS (World Bank, 1983).

In the perimeter's recent production configuration, a clear adaptation to environmental limitations is observed, with a predominance of subsistence activities and family livestock farming. Below, we can get a sense of production in recent years (Table 1).

Table 01 – Summary of crops planted between 2006 and 2017 in the Cruzeta Irrigated Perimeter

Cruzeta	Perímetro / Área (ha)					
Ano	**Frutas (kg)**	**Hortaliças (kg)**	**Grãos (kg)**	**Pastagem (kg)**	**Milho Industrial**	**Total**
2006	11,80	52,10	20,10	15,20	0,00	**99,20**
2011	24,70	67,40	86,60	15,50	0,00	**194,20**
2017	7,50	0,00	23,10	24,40	0,00	**55,00**

Source: Elaborated by the authors based on data from the DNOCS Irrigated Perimeters Information Synthesis (Guazzelli, 2006; 2011; 2017).

The lack of detailed information compromised the analysis of agricultural development, suggesting the possible abandonment or disorganization of the official monitoring system, with the last record being in 2017. Since the implementation of this perimeter, the project's sustainability has faced challenges, especially during periods of water scarcity, given that water supplies have historically fluctuated.

Between 1976 and 1988, water use was normal, but there was rationing (1989-1992) and suspensions (1993 and 1997-2003) due to lack of rainfall. Irrigation resumed in 2004 but faced legal limitations in 2005. In 2006, DNOCS obtained authorization to supply water again after good rains. In 2012, water supply was interrupted due to drought and prioritization of urban water supply, marking the last time water was released from the local public reservoir in the last thirteen years (Brasil, 2007; PDSCSP, 2010).

Faced with this problem, the Cruzeta Irrigated Perimeter was included in the "Sustainable Development and Coexistence with the Potiguar Semi-Arid Region Program", funded by the World Bank. The program aimed to modernize the perimeter's infrastructure, expand irrigated areas, and make the system self-sustainable, with the goal of reducing conflicts between urban water supply and irrigation water availability (Rio Grande do Norte, 2014).

Therefore, this article sought to evaluate the effectiveness of this public policy and the actions implemented within the aforementioned perimeter, investigating how they were perceived by the local community and analyzing the social and productive impacts. Furthermore, it examined the challenges faced to democratize the benefits promoted, considering the specific geographic context of the Semi-Arid region of the Rio Grande do Norte. This way, it aims to contribute with a critical reading of the limits and potential of state intervention in the context of irrigated perimeters of the Brazilian Semi-Arid region, focusing on the Cruzeta perimeter – RN.

4.1 Modernization of the Cruzeta Irrigated Perimeter – RN

The modernization of the Cruzeta Irrigated Perimeter was a gradual process resulting from institutional collaborations built up over decades. Prior to this policy, the irrigation community had already undergone studies conducted by public agencies and funding institutions, such as the aforementioned World Bank (Brazil, 2007).

Since the early 2000s, diagnostics conducted by the Ministry of National Integration, the Rio Grande do Norte Secretariat of Environment and Water Resources (SEMARH), and the World Bank have highlighted the strategic potential of the Cruzeta Irrigated Perimeter for the local economy and the urgent need for restructuring (Rio Grande do Norte, 2005). Based on these studies, in 2012, SEMARH developed a pilot project to restore and modernize the perimeter through the "Program for Sustainable Development and Coexistence with the Potiguar Semi-Arid Region" (Rio Grande do Norte, 2014).

In this context, the restructuring of the perimeter emerged as a strategic public policy, whose focus was on the incorporation of efficient technologies, aiming to reduce water consumption, in addition to technically qualifying irrigators for the adoption of modern practices. In this way, the experience in Cruzeta would serve as a basis for new public policies for the other perimeters of the region (Rio Grande do Norte, 2014).

From an infrastructure perspective, the modernization of the Cruzeta Irrigated Perimeter required investments on two main fronts: collective infrastructure and subdivision infrastructure. The old infiltration furrow irrigation methods were replaced by more modern systems, including the construction of water storage structures and the implementation of drip irrigation systems. This technology aimed to reduce water consumption by approximately 50% compared to previous gravitational methods, promoting efficient use of the public reservoir's water resources for irrigation (Rio Grande do Norte, 2014).

The collective investments focused on modernizing the water and electrical systems, including the restoration of distribution channels, the replacement of floodgates, and the reorganization of the electrical grid. Prior to the interventions, water collection was done in an informal and ineficiente manner, resulting in significant waste. To optimize distribution, individual floodgates were installed per lot, allowing for more precise flow control (Rio Grande do Norte, 2014).

The construction and implementation of the modernization project was completed in 2014 (Figure 02), after approximately two years of work. However, although this

infrastructure was ready for use, the persistent drought in the region prevented full use of the new irrigation system.

Figure 02 – Excavation, lining and construction process of reservoirs and pump houses

Source: Rio Grande do Norte (2014).

This way, producers had to wait for a more favorable period to activate the equipment and begin cultivation, postponing the full operationalization of the newly implemented infrastructure, since there was, at that time, no prospect of the waters from the public reservoir reaching the lots.

The initial results of this modernization demonstrated advances in the perimeter, with a projected increase in cultivable area from 8 to 51 hectares dedicated to perennial crops when irrigated (Rio Grande do Norte, 2014).

However, this investment made in 2014, while significant, was compromised by the drought, as water did not reach the perimeter lots – a situation that continued for nearly a decade in the following years. In this context, many irrigators were unable to utilize the modernized system.

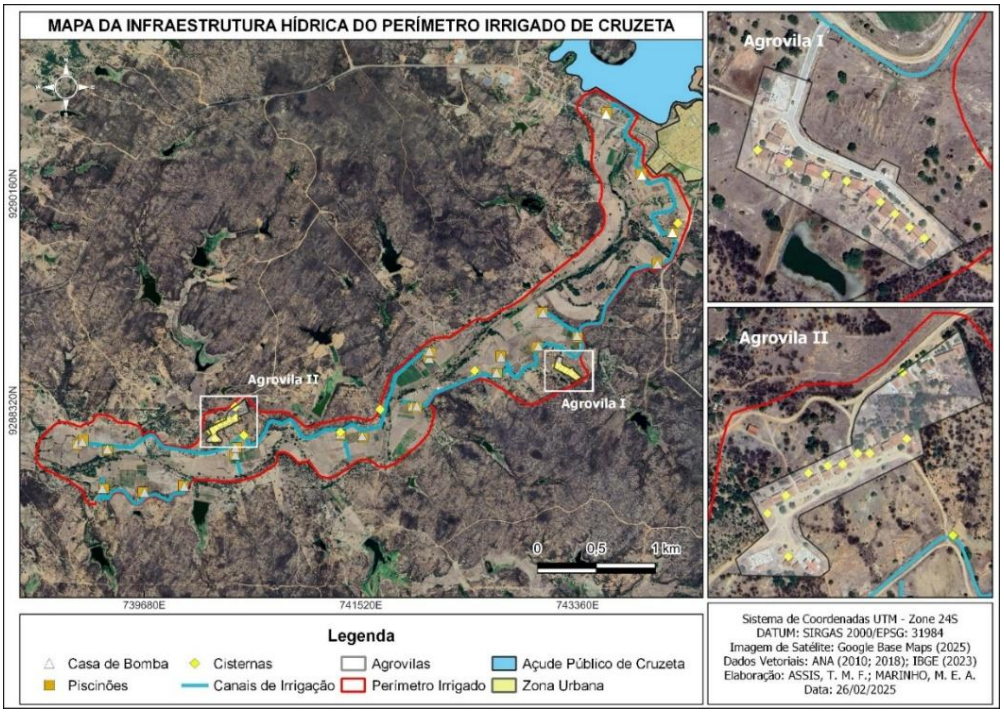
This water shortage scenario has led many irrigators to resort to alternative solutions, such as drilling wells and collecting water from intermittent rivers for dryland farming. However, these sources were not included in the modernization policy, nor did they guarantee regular access to water resources.

Even with rainfall in subsequent years, the Cruzeta reservoir remained underfilled until 2024. Only in that year did the reservoir reach adequate levels for water release. However, the structures were compromised due to the prolonged period of inactivity and

continued exposure to inclement weather, which currently demands new repair and maintenance interventions. Thus, despite the expansion of the area planned for cultivation, the system has not been effectively used.

Below, we present the map of the perimeter's water infrastructure (Figure 03), which illustrates the spatial distribution of the irrigation structures and the main components of the water system.

Figure 03 – Map of the Water Infrastructure of the Irrigated Perimeter after the implementation of the Public Policy



Source: Elaborated by the authors (2025).

In addition to climate limitations, we highlight the lack of technical support after project implementation, the lack of monitoring by public agencies, and the distance from the professionals responsible for implementation, which weakened the support needed to ensure the system's sustainability. This institutional gap is not unique to Cruzeta, but it reveals a recurring structural weakness in irrigation policy models in the Brazilian Semi-Arid region.

Thus, although the Cruzeta Irrigated Perimeter modernization project represents a significant and well-structured technical effort, its consolidation has come up against historical obstacles to water resource management and climate unpredictability, reiterating the need for policies that are more adaptive to local realities, which geographically and

historically lack sustainable investments and effective management of natural resources.

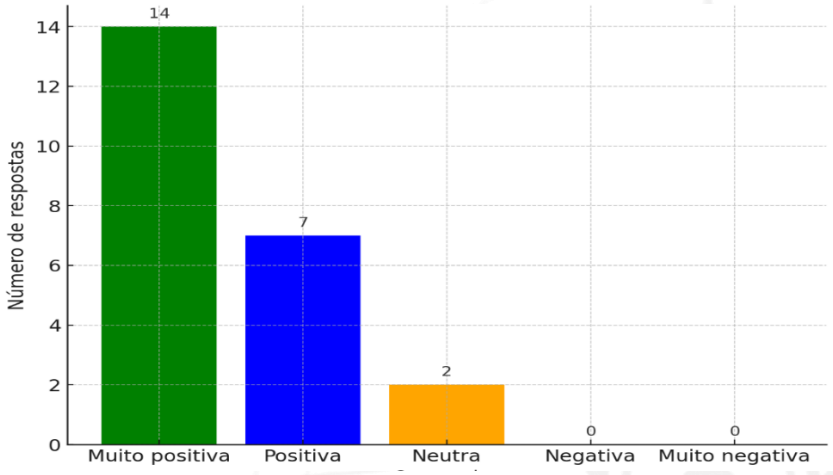
5 RESULTS AND DISCUSSION

The local community attributes multiple meanings to the Cruzeta Irrigated Perimeter and the World Bank-funded public policy, reflecting different viewpoints and expectations regarding the outcomes of irrigation infrastructure modernization, as evidenced by questionnaire and interview responses. According to Gil (2008), it is the data collection from individuals within the empirical context that allows us to grasp both subjective and objective aspects of the reality under investigation.

The farmers demonstrate prior knowledge about the socio-productive function that the perimeter performed in the past, as well as recognize and evaluate the relevance of investments made through World Bank financing, within the scope of the PSP, aimed at modernizing infrastructure.

Most of those interviewed directly associate the resources with the implementation of the irrigation system, reservoirs ("piscinões"), besides improvements to the electrical and hydraulic structures (see Chart 01). However, while there is recognition of the financial contribution and the implementation of the works in the geographic area, reports emerge indicating frustration regarding the project's effectiveness, with mentions of inactive or underutilized equipment.

Chart 01 – Irrigators' assessment of the World Bank-financed public policy for the Cruzeta Irrigated Perimeter



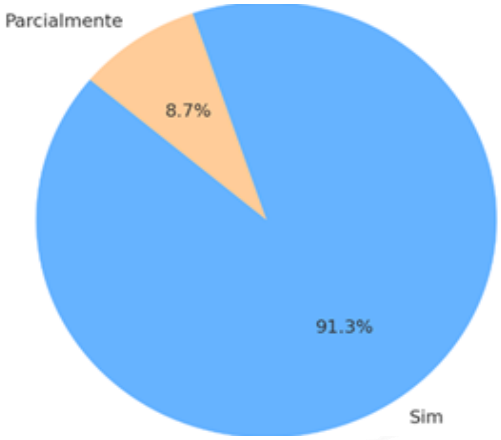
Source: Elaborated by the authors (2025).

The irrigators' views on the public policy linked to World Bank financing are mostly positive, with more than 90% of responses indicating satisfaction with the proposal, with no records of negative or very negative responses.

This way, the community recognizes the importance of the intervention in the territory, especially in the face of water scarcity. Although tangible results have not been fully achieved, there is symbolic appreciation among the beneficiary population in face of this intervention.

However, the presence of "neutral" assessments indicates a gap between expectations and the implementation of promised improvements. Such disparity is explained by difficulties in maintaining infrastructure, management failures, and challenges in water supplying (Chart 02).

Chart 02 – Irrigators' viewpoints on the benefits of modernizing the Cruzeta Irrigated Perimeter



Source: Elaborated by the authors (2025).

The experience analyzed indicates that, although the policy's structural objectives were only partially achieved, the initiative is considered relevant given the vulnerability of family farming and regional water scarcity. Thus, the beneficiaries' perception reinforces the importance of rethinking the formulation and implementation of public irrigation policies in the Brazilian Semi-Arid region to ensure greater effectiveness, sustainability, and social ownership of their results. The following chart reveals the perception and return this program has brought to irrigators to date (Chart 03).

Chart 03 – Irrigators' viewpoints on the return of the modernization policy

Source: Elaborated by the authors (2025).

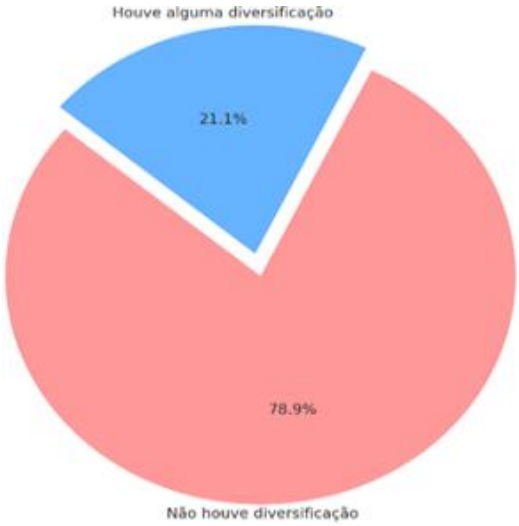
It is observed that, for approximately one-third of the interviewed (Chart 03), although there is recognition of a return, this is often subjective and more associated with expectations than with concrete results. However, both the interviews and the questionnaires revealed that this recognition coexists with significant limitations.

The field observation and complementary studies confirm that although the project presents a technically promising model, its effectiveness is compromised by operational difficulties, such as irregularities in the water supplying and the lack of adequate maintenance of the structures.

In face of the water shortages in the public reservoir, many irrigators were forced to resort to alternative sources, such as drilling private wells and accessing rivers and other water sources not linked to the modernization policy in question.

As a result, two-thirds of irrigators were unable to fully benefit from this action, which reveals not only the fragility of the aforementioned public policy, given the real conditions of the Semi-Arid region, but also the need for these farmers to find their own solutions to access water resources.

Chart 04 – Regarding new crops planted after modernization



Source: Elaborated by the authors (2025).

The irrigators' responses regarding the variety of crops after the implementation of the "piscinões" (Chart 04) reveal low productive diversification, associated with the difficulty in accurately measuring the volumes cultivated, due to the lack of systematic records and the sporadic nature of agricultural activities, strongly conditioned by climate variations and the availability of resources.

Added to this is the lack of updated data from the responsible institutions, especially the DNOCS, which has not published information on production in the Cruzeta Irrigated Perimeter since 2017. This gap highlights the fragility of production management, resulting from the discontinuity of public policies focused on technical assistance, the lack of training for irrigators, and insufficient institutional monitoring.

Thus, most of the interviewed reported not having made any changes to their production systems, maintaining traditional crops adapted to the Semi-Arid region, such as beans, corn, grass and sorghum, the latter strongly associated with cattle farming, revealing the priority given to the production of forage for animal feeding.

Approximately 60% of the perimeter's lots are dedicated to grass cultivation and 30% to forage cactus, essential inputs for sustaining livestock. Since livestock farming is the most important economic activity in the perimeter, this practice not only proves well-adapted to water scarcity but also plays a fundamental role in the local economy.

Despite the concentration of livestock farming and these crops, smaller-scale records of acerola, tomato, papaya, pumpkin, guava, and cotton were also observed. Only three of the farmers mentioned any crop changes, two of which were related to the

intensification of existing crops, indicating that the introduction of the new infrastructure stimulated productive transformations only for a small portion of the irrigators.

Chart 05 – Current status of reservoirs installed in the lots of the Cruzeta Irrigated Perimeter

Source: Elaborated by the authors (2025).

In regard to the conservation status of the reservoirs, this research demonstrated operational disparities, ten years after the implementation of the public policy, because there is heterogeneity in the functioning of the systems, while 43% of the interviewed state that the equipment works adequately, another 26% indicate partial functioning (Chart 05).

Conversely, 17% report damaged systems and 9% abandoned (Figure 04). These data demonstrate not only inequalities in infrastructure preservation but also weaknesses in technical support, as well as collective and private management. Furthermore, approximately 30% of respondents stated that they had never been able to fill their reservoirs. In some cases, farmers did not even use the reservoirs, opting to maintain their own irrigation systems or wait for seasonal rains.

In this sense, the precarious condition of the “piscinões” and pump houses highlights the lack of ongoing maintenance policies, an essential element for the sustainability of public policies in the Semi-Arid region. The lack of technical assistance and water management contributed to the deterioration and inoperability of part of the infrastructure, showcasing both the State's limitations in ensuring adequate support and APICRUZ itself, which has faced bureaucratic and financial obstacles since the process of emancipating the irrigated perimeters. Thus, the World Bank-funded PSP, under the guise of sustainability, demonstrated a neoliberal logic by transferring infrastructure management to irrigators, imposing on them responsibilities incompatible with their technical and financial conditions.

Figure 04 – Public policy materialized in unused space, reservoir and pump house

Source: Elaborated by the authors (2025).

In this way, it is clear that public policies aimed at irrigation need to go beyond the physical implementation of structures, as operational sustainability, through training, ongoing education, technical support and efficient management, becomes fundamental to guarantee the effectiveness and durability of investments.

The experience of irrigators shows that without these actions, even modern systems tend to become obsolete, compromising the policy's objectives and generating frustration among its beneficiaries, especially since they have not yet fully enjoyed the benefits proposed by the policy.

6 CONCLUSION

During the interviews, the irrigators recognized the potential of the irrigation technologies implemented by the public modernization policy, as well as the revitalization of the perimeter's infrastructure. However, they also expressed frustration at not being able to benefit from the implemented systems.

Water scarcity was identified as the main obstacle to the consolidation of these practices. Even with the infrastructure installed on all lots, water resources, essential to the system's functioning, were not guaranteed within the perimeter, not only due to the region's climate conditions but also due to the state's inefficiency in ensuring access to this resource.

As a result, the community's expectations were dashed after more than ten years of waiting to use the implemented infrastructure, which is now, in some cases, deteriorated. Therefore, the lack of sustained policies, obsolete infrastructure, inadequate management, and the government's fragility in providing or participating in technical assistance to beneficiaries significantly compromised the operationality of this public irrigation project.

However, this territory continues to be an alternative source of subsistence for irrigators, through the predominant livestock farming practices, as well as family farming adapted to the specific conditions of the geographic context in which they operate.

In face of this, a public policy approach based on integrated management is urgently needed, capable of coordinating water resources, ongoing technical support, and effective social participation. Such perspective is crucial to ensuring the appreciation and sustainability of irrigated agriculture, especially in a context marked by climatic and structural challenges.

Thus, the collected data highlighted the need to foster critical reflections on the representations of the Cruzeta Irrigated Perimeter, both among irrigators and the local community, and within academia. This debate should consider its economic, social, and geographic relevance, as well as the limits and potential arising from the modernization process. It was observed that, in previous periods, the irrigated project and the irrigators themselves enjoyed greater social visibility, which favored the mobilization of public authorities to address its challenges, such as the modernization policy itself for this perimeter, given that it was the only one in the state to be included.

In this context, it is fundamental to broaden the discussion on the current reality of the perimeter, in face of the other perimeters, as well as to promote the dissemination of its conditions to public entities and contribute to the formulation of more effective and contextualized policies, which incorporate the geographic and social specificities of the Brazilian Semi-Arid region.

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