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PUBLIC POLICIES FOR DRINKING WATER DISTRIBUTION: THE PIPA OPERATION ACTION IN PARAIBA'S CURIMATAU

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Abstract

The water has always had great importance for the populations, especially for those living in scarcity areas, where droughts are common. The dry regions are marked by physical and natural aspects that cause aridity in their landscape. This concern with water resources is growing, given the context of environmental changes. The Brazilian semiarid, where the Curimataú Paraibano is located, is the national example of dry areas. Throughout history, this region has received actions from the Brazilian State that have enabled the provision and supply of water, through water policies such as the weir, the water social technologies, exemplified by the plate cisterns, and, the focus of this research, Pipa Operation (PO). The methodology used was spatial and cartographic analysis, which used information from the Military Command of the Northeast, referring to the PO and through geotechnologies, thematic maps were created that supported the analysis. The results indicate that all municipalities in the region received the OP actions. Altogether 1.283 service points were supplied by 154 water trucks, which collected water from four water sources and used 33 main highways and 763 rural highways, serving a total of 57.482 inhabitants.

Keywords: Water supply; Water tank truck; Pipa Operation.

POLÍTICAS PÚBLICAS DE DISTRIBUIÇÃO DE ÁGUA POTÁVEL: A AÇÃO DA OPERAÇÃO PIPA NO CURIMATAÚ PARAIBANO

Resumo

A água sempre apresentou grande importância para as populações, principalmente para as residentes em áreas de escassez, onde as estiagens e secas são comuns. As regiões secas são marcadas por aspectos físicos e naturais que ocasionam aridez em sua paisagem. Essa preocupação com os recursos hídricos torna-se crescente, frente ao contexto de mudanças ambientais. O Semiárido brasileiro, onde situa-se o Curimataú Paraibano, é o exemplo nacional de zonas secas. Ao longo da história, essa região tem recebido ações do Estado brasileiro que possibilitaram a disponibilização e o atendimento da oferta de água, através de políticas hídricas como a açudagem, as tecnologias sociais hídricas, exemplificadas pelas cisternas de placa, e, foco desta pesquisa, a Operação Pipa (OP). A metodologia empregada foi à análise espacial e cartográfica, o qual utilizou as informações do Comando Militar do Nordeste, referentes à OP e através das geotecnologias, foram criados mapas temáticos que subsidiaram a análise. Os resultados obtidos indicam que todos os municípios da região recebiam as ações da OP. Ao todo 1.283 pontos de atendimento eram abastecidos por 154 carros-pipa, que captavam água de quatro mananciais e utilizavam 33 rodovias principais e 763 rodovias rurais, atendendo um total de 57.482 habitantes.

Palavras-chave: Abastecimento de água; Carro-Pipa; Operação Pipa.

POLÍTICAS PÚBLICAS DE DISTRIBUCIÓN DE AGUA POTABLE: LA ACCIÓN DE LA OPERACIÓN PIPA EN CURIMATAÚ PARAIBANO

Resumen

El agua siempre ha tenido una gran importancia para las poblaciónes, especialmente para aquellos que viven en zonas de escasez, donde las sequías son comunes. Las regiones secas están marcadas por aspectos físicos y naturales que causan aridez en su paisaje. Esta preocupación por los recursos hídricos está creciendo, dado el contexto de los cambios ambientales. El semiárido brasileño, donde se encuentra el Curimataú Paraibano, es el ejemplo nacional de áreas secas. A lo largo de la historia, esta región ha recibido acciones del Estado brasileño que han permitido el suministro de agua, através de políticas de agua

como la açudagem, las tecnologías sociales hídricas, ejemplificadas por las cisternas de placas y, el foco de esta investigación, la Operación Pipa (OP). La metodología utilizada fue la análisis espacial y cartográfica, que utilizó información del Comando Militar del Nordeste, refiriéndose al OP y, através de las geotecnologías, se crearon mapas temáticos que respaldaron la análisis. Los resultados obtenidos indican que todos los municipios de la región recibieron las acciones del OP. En total, 1.283 puntos de servicio fueron suministrados por 154 camiones cisterna, que recogieron agua de cuatro manantiales y utilizaron 33 carreteras principales y 763 carreteras rurales, sirviendo a un total de 57.482 habitantes.

Palabras-clave: Abastecimiento de agua; Camión Cisterna; Operacíon Pipa.

1. INTRODUCTION

The water issue has always been a great importance for the populations, especially for those located in areas where water scarcity in their environment is the main characteristic, in which dries and droughts events are common and recurrent. These regions are called dry lands, which according to the United Nations Convention to Combat Desertification (UNCCD, 2000) are configured as geographical spaces or natural environments that present in their landscapes a high variability and spatiotemporal concentration of rainfall , as well as the high rates of evaporation and evapotranspiration. This concern becomes increasingly growing and continuous in view of the current context of environmental changes imposed by societies, through economic activities and consumption patterns that lead to a situation of exhaustion of natural resources, negatively impacting the behavior and dynamics of environmental and climatic phenomena. According to Black (2016), this scenario provides the intensification of extreme events, which these regions (dry lands) can become increasingly arid, as result of the increasing of temperature, evaporation and evapotranspiration rates, resulting in a decrease in rain.

These regions include the Brazilian semiarid region, notably known as the driest region in the country. Last delimited by Resolution No. 115/2017 of the Northeast Development Superintendence - SUDENE, the Brazilian Semiarid covers 1.262 municipalities, spread over 9 states in the Northeast and one in the Southeast (Minas Gerais), where more than 25 million people resides.

Faced with such characteristics, the region has, over the years, received the action of several public policies that sought to minimize and even the solution to the effects of dries and droughts, with actions that aimed to promote a greater supply of water and that could attend regional water demands. According to Campos (2014), these actions in response to dries and droughts became State policy after the great drought of 1877-79, which the catastrophic impacts on the regional social aspects imposed to the public power the adoption of public policies on the subject .

Since the beginning of its implementation, the water policies aimed at the Brazilian Semiarid have been based on two main ideological concepts. According to Segundo Neto and Vianna (2018) point out that the first one is based on the construction of large water works, represented by dams, water mains, tunnels and open channels, which allow the accumulation of water during the rainy season and/or the water transition between different river basins. This conception is consistent with the periods listed by several scientists such as the “Hydraulic Solution” and the “Developmental Era” (SOUZA E FILHO, 1983; CAMPOS, 2014; BURITI E BARBOSA, 2018; DANTAS, 2018; SILVA, 2018) and has as main representative the large dams and the São Francisco Integration Program - PISF.

The second, still according to Segundo Neto and Vianna (*Opus Citatum*), more recent and driven in the late 90s, from social movements and originated from the concept of sustainable development, is based on the attempt to live with the semiarid region. This conception is based on punctual and sustainable actions, promoting a large number of small water works, exemplified by cisterns, with a focus on the rural environment, enabling democratization in access to water, due to its reach and the capture of rainwater. The main policies that represent this concept are the One Million Cisterns Program (P1MC) and the One Land Two Waters Program (P1 + 2).

Silva (2018) highlights that the changes in perspectives in government public policies does not necessarily mean the complete finitude of previous conceptions and actions. On the contrary, these remains in the actions, speeches and processes between the various agents, economic and social groups, which disputes between them, influence the decision making and government guidelines.

However, in years of prolonged dries and, consequently, droughts, when the rains are insufficient to fill the dams and/or allow a greater recharge of cisterns, it is necessary to provide measures that can guarantee access to drinking water and, consequently, ensure social well-being for the populations of the region. Among these actions, Operação Pipa stands out, or also known as Operação Carro-Pipa.

For Farias (2018), the Operação Pipa (OP) is configured as an emergency public policy for the distribution of drinking water to human supply, through water tank trucks, popularly known as “carro-pipa”, to supply the populations of the municipalities that decree Emergency Situation (SE) or State of Public Calamity (ECP) due to dry and/or drought.

According to Revista Verde Oliva (2008), the OP was initially created in 1998 by the Federal Government as a “Drinking Water Distribution Program in the Brazilian Semiarid Region”. Since its origin, the Brazilian Army has cooperated with the actions of this public policy, in principle contributing together with the responsible agencies (DNOCS, SUDENE and Civil Defense), or assuming a greater role, coordinating and supervising, through its Military Organizations, the actions of this public policy, especially since 2012, when it became the current Operação Pipa, through the Interministerial Ordinance No. 1 / MI / MD, of July 25 (BRASIL, 2012).

The use of the water tank truck as a tool for transporting and distributing water is, according to Neto (2019), a practice present throughout the world, being used in various economic activities and mainly to provide water supply for the populations, whether these residents in rural areas or urban areas.

In fact, several studies point to the existence of the water tank truck as a complement to urban water supply in several cities around the world, such as Mexico City (PIKE, 2005); Lima, capital of Peru (FOVIDA, 2004); Medellín, Colombia (WSP,

2008); Cochabamba, in Bolivia (WEST, 2014) and finally, Luanda, capital of Angola (CAIN & MULENGA, 2009).

However, the greater use of the water tank trucks refers to emergency plans and actions in the context of disasters, which impose adversities on local populations, among them the interruption in the supply and access to water. For Wildman (2013) and AECID (2018), this practice has been frequent and is characterized as a short-term intervention with immediate effect, which seeks to ensure social well-being, avoiding the proliferation of diseases and damage to human health , through the rapid service that water tank trucks provides, attending the basic needs and guaranteeing an essential human right, which is access to water.

It is important to highlight that despite having been operating in the Brazilian Semi-Arid Region for over 20 years, there are few studies in which the water tank or Operação Pipa appears as the central theme of their analysis. However, with the intensification of its actions in the region in recent years, this panorama has been gradually changing.

During the period from 2012 to 2016, the Brazilian's Northeast has experienced one of the worst droughts in its history, which in some regions this phenomenon has continued until today (2020). The consequences of this for the region have resulted in a drastic reduction in reservoir levels, considerable losses in agricultural crops and livestock production, as well as negative impacts on social and population aspects in the region.

In view of this scenario, Operação Pipa has become and has increasingly maintained the position of an essential policy for municipalities severely affected by drought, increasing its budget, service flow and its operating radius, redefining new territories from its operation. In view of this scenario, Operação Pipa has become and has increasingly maintained the position of an essential policy for municipalities severely affected by drought, increasing its budget, service flow and its operating radius, redefining new territories from of its actions.

1.1. Study Area

The Paraíba's Curimataú is constituted, mainly after the last regionalization of the Instituto Brasileiro de Geografia e Estatísca - IBGE (2017), as a historical-geographic region where 18 municipalities are located that are subdivided in two microregions: Western Curimataú, which concentrates 11 municipalities, and Eastern Curimataú, with 7, as shown in Figure 1. With the current regionalization, the municipalities of Paraíba's Curimataú are distributed in three immediate regions: Campina Grande (5 municipalities), Cuité-Nova Floresta (5) and Guarabira (8), where a total population of 221,159 inhabitants resides, according to the estimated population of IBGE (2019).

With regard to environmental aspects, referring to the physical-natural configuration, the region is inserted in the climatic context of the semiarid, which according to Becker et al (2011) integrates the rainfall region of Cariri/Curimataú which has an annual average around of 480 mm. The months from February to May constitute the region's rainy season, the acting period of the Intertropical Convergence Zone (ZCIT), the main rain-producing atmospheric system in the region.

According to AESA (2006) the lithological structure of the region is constituted predominantly by the crystalline geological formation, composed by granites, gneisses, migmatites and shales, which does not favor the formation and the existence of aquifers. The region also presents, but in a limited way, sedimentary formations of the Serra dos Martins group, composed by sandstones and claystones, which favors the retention and the presence of groundwater. Also according to AESA (Opus Citatum), the region is located along five hydrographic basins (Curimataú, Jacu, Mamanguape, Paraíba and Trairí) and is part of the vegetative context of the Caatinga biome.

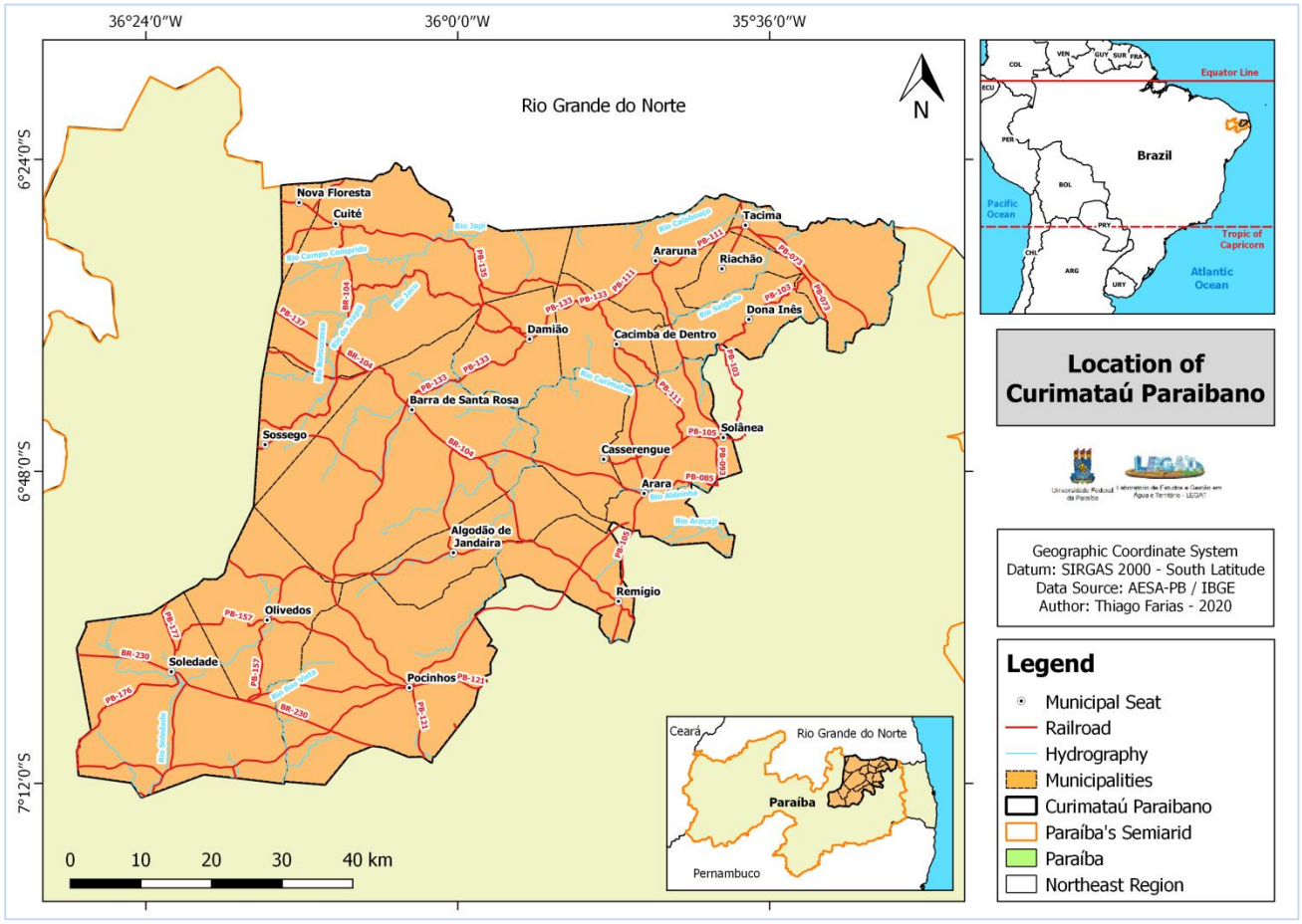

Figure 1 - Location of Curimataú Paraibano. Source: Author.

2. METHODOLOGY

Over the past five years, the Group of Studies and Research in Water and Territory - GEPAT, from the Department of Geosciences (Campus I - João Pessoa) of the Federal University of Paraíba has dedicated, through one of its lines of research, to the study and understanding the public policies for the distribution of drinking water through water tank trucks, especially the Operação Pipa and its actions and coverage in the Paraíba's semi-arid region and Paraíba as a whole. During this period, the group produced several works in scientific events, journals and magazines, as well as a monographic work and a doctoral thesis on the subject.

For the accomplishment of this work, the methodology used was the Spatial and Cartographic Analysis, which were used techniques of Geoprocessing, through Geographic Information Systems (GIS's), which were essential for the methodological approach used. Therefore, the secondary data about Operação Pipa, referring to May 2016, from the Military Command of the Northeast - CMNE, responsible for the management of this public policy, were used. This information consisted of spreadsheets and electronic tables referring to the municipalities served, the amount of population served, water trucks operating, location of service points and water sources used as water collection points to serve each municipality.

The data from the Executive Water Management Agency of Paraíba's State - AESA were also used, referring to the road infrastructure of the state of Paraíba, which, using geotechnology tools, made it possible to extract the main highways used as routes, from the water sources to the municipalities served. The rural highways were mapped using free satellite images, available in the Google Earth Pro software, according to the methodology employed by Farias (2018), which enabled the identification and mapping of the rural highways in each municipality, interconnecting them with the main highways from the AESA database, as shown in figure 2. Finally, after processing and converting the geographic data, using the program QGIS 2.18 "Las Palmas" to the shapefile format, they were used to create thematic maps, in order to spatialize and identify the action and scope of the Operação Pipa in the region.

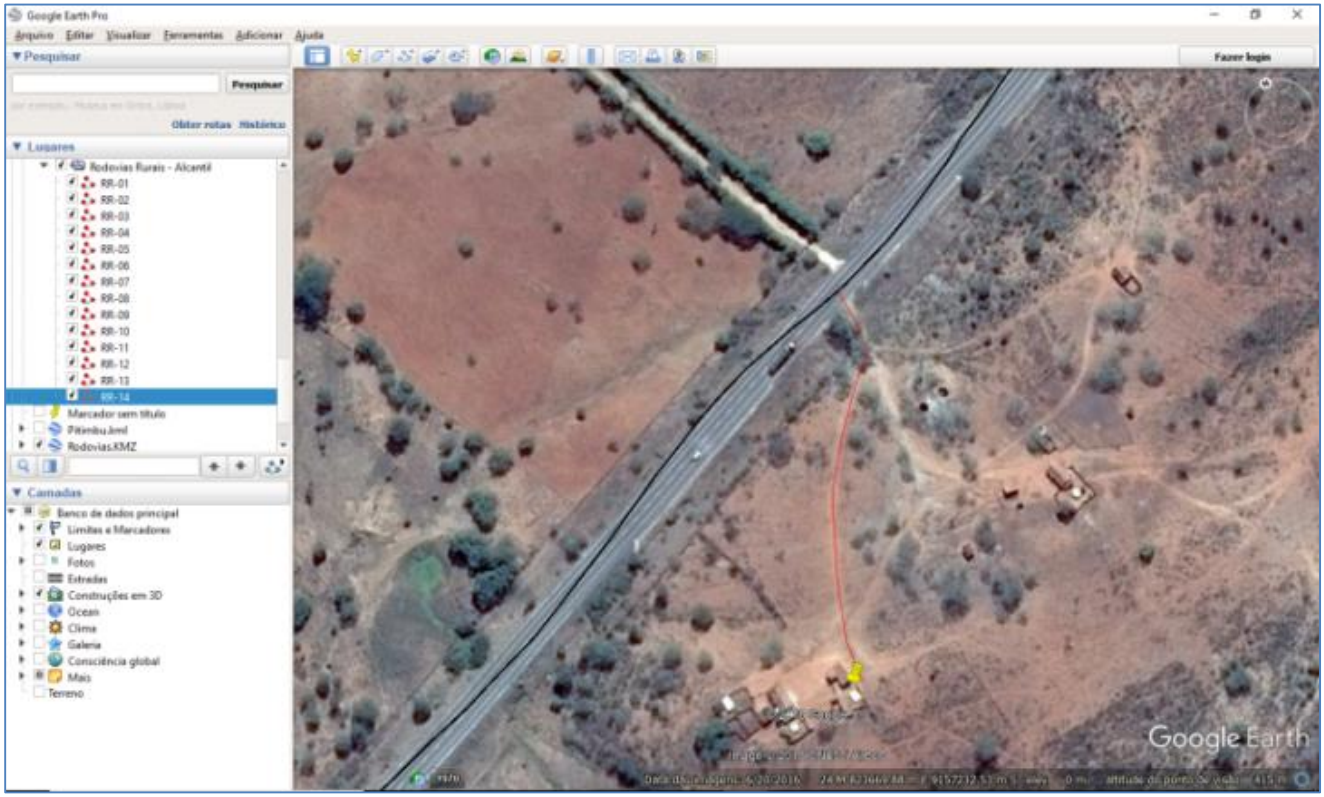

Figure 2 - Spatialization of Service Points and Mapping's process of Rural Roads by Google Earth Pro. Source: Farias (2018).

3. RESULTS AND DISCUSSIONS

The results obtained indicate that all 18 municipalities of the Paraíba's Curimataú were being served by Operação Pipa in the analyzed period. Two military organizations were responsible for monitoring the actions of the program in the region. Altogether 154 water tank trucks were responsible for collecting water from 4 springs and, subsequently, distributing it to 1.283 service points, which supplied a total population of 57.482 inhabitants. The road infrastructure was composed of 33 main highways, 4 federal and 29 state, and 763 rural highways.

Four water sources in Operação Pipa that served the municipalities of Curimataú Paraibano, two were reservoirs (The Epitácio Pessoa and Saulo Maia weirs) and the other two were Water Treatment Stations - ETA of the state water company (CAGEPA). All the catchment sources were located outside the study region, 3 of which (The Saulo Maia reservoir and the Mari and Sapé ETA's) located outside the limits of the Paraíba's Semiarid at the time. Only the Epitácio Pessoa reservoir in Boqueirão, belonged to the Paraíba's semi-arid region, as shown in figure 3.

The Saulo Maia reservoir, located in Areia, was the source with the highest municipal demand for Operação Pipa in the Paraíba's Curimataú, in the period analyzed, it was at 100% of its capacity. This was responsible for serving 9 municipalities in the region (Algodão de Jandaíra, Barra de Santa Rosa, Cuité, Damião, Nova Floresta, Pocinhos, Remígio, Soledade and Sossego), where 91 water tank trucks distributed water to 909 service points, which supplied a total population of 35.749 inhabitants. With regard to road infrastructure, there were a total of 15 main highways that were used by water tank trucks, two of which were federal (BR's 104 and 230) and 13 state highways and 525 rural highways.

The Mari's ETA, located in the municipality of the same name, was the second source with the highest municipal demand for OP in the region, with 8 municipalities served (Arara, Araruna, Cacimba de Dentro, Casserengue, Dona Inês, Riachão, Solânea and Tacima). In this source, 53 water tank trucks were responsible for collecting and distributing water to 281 service points, which supplied 18.797 people. Regarding to the road network, the water tank truckers used 18 main highways, all of them was a state character and 177 rural highways.

The Epitácio Pessoa reservoir, located in the municipality of Boqueirão, was the only source that served the municipalities of the region through Operação Pipa to be located in the Paraíba's semi-arid, at the time it had 38.218.750,01 m^3, which was equivalent to 9, 28% of its capacity. The weir was responsible for supplying the water demand of a municipality (Olivedos). In this source, 10 water tank trucks were responsible for distributing water to 89 service points, which supplied 2.936 people. With regard to road infrastructure, 6 main highways were used to bring water to the local population, where two were federal (BR's 230 and 412) and four state highways (PB's 148, 157, 160 and 176), while rural roads totaled 51.

Finally, the Sapé's ETA was responsible for assisting the service of the municipality of Solânea, with only 4 service points. As the data referring to water tank trucks and population served are reported by municipality, it was not possible to identify the scope of these service points. With regard to road infrastructure, 10 roads, all of which are state roads, were the main highways and 10 side roads were rural highways.

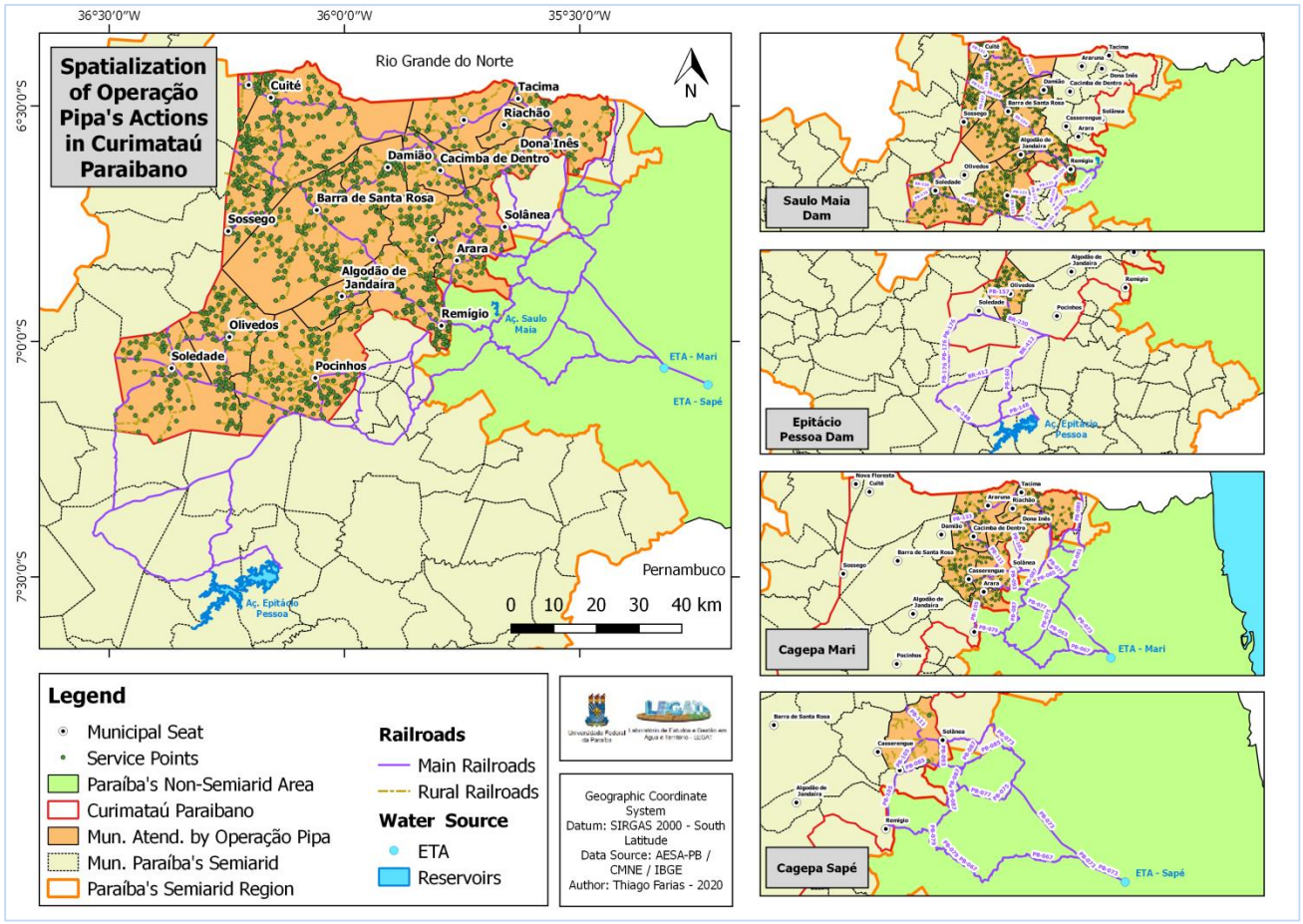

Figure 3 – Spatialization of Operação Pipa's Actions in Curimataú Paraibano. Source: Author.

The 7 main dams in the region, monitored by AESA, presented at the time or critical situation (below 5% of their capacity or even their total collapse) or close to the observation situation (below 20% of their capacity). The Algodão reservoir (0%), located in Algodão de Jandaíra, the Curimataú (3.13%) and Poleiros (2.77%) resevoirs, both located in Barra de Santa Rosa, the Boqueirão do Cais reservoir (0.05%), located in Cuité, the Olivedos weir (0%) and the Soledade weir (1.93%) were the reservoirs that were in critical condition at the time and even completely collapsed, making municipal supply systems and their uses as a pickup point for Operação Pipa unfeasible.

Only the Cacimba de Várzea reservoir, located in the municipality of Cacimba de Dentro, was out of the critical stage, with 20.94% of its total capacity, however, according to the AESA classification, it was close to the observation level (below 20%), as shown in table 1.

Table 1 – List of dams monitored by AESA in Paraíba's Curimataú. Source: AESA.

Reservoir	Municipality	Watershed	Total Volume (m^3)	Volume in May/16 (m^3)	%
Aç. Algodão	Algodão de Jandaíra	Curimataú	1.025.425,00	0	0%
Aç. Curimataú	Barra de S. Rosa	Curimataú	5.989.250,00	187.575,00	3,13%
Aç. Poleiros	Barra de S. Rosa	Curimataú	7.933.700,00	219.706,00	2,77%
Aç. Cacimba da Várzea	Cacimba de Dentro	Curimataú	9.264.321,00	1.940.044,80	20,94%
Aç. Boqueirão do Cais	Cuité	Jacu	12.367.300,00	6.700,80	0,05%
Aç. Olivedos	Olivedos	Taperoá	5.875.124,00	0	0%
Aç. Soledade	Soledade	Taperoá	27.058.000,00	521.600	1,93%

The low levels of reservoirs in the region are one of the reasons that explain why the collection points and water sources used by Operação Pipa to serve the Paraíba's Curimataú municipalities are located outside of the region and, mainly, outside of the Paraíba's Semiarid territory (with the exception of the Boqueirão reservoir, which has a large storage capacity), naturally more humid, with more water availability and recharge of its reservoirs.

With regard to the municipalities served by the Operação Pipa, those with the highest numbers of population served were: Cuité (7.045), Barra de Santa Rosa (6.414), Damião (5.394), Pocinhos (5.363) and Casserengue (3.441). Those with the lowest number of people served were: Riachão (795), Nova Floresta (804), Arara (1.375), Remígio (1.943) and Araruna, with 1.986 people served, as shown in figure 4.

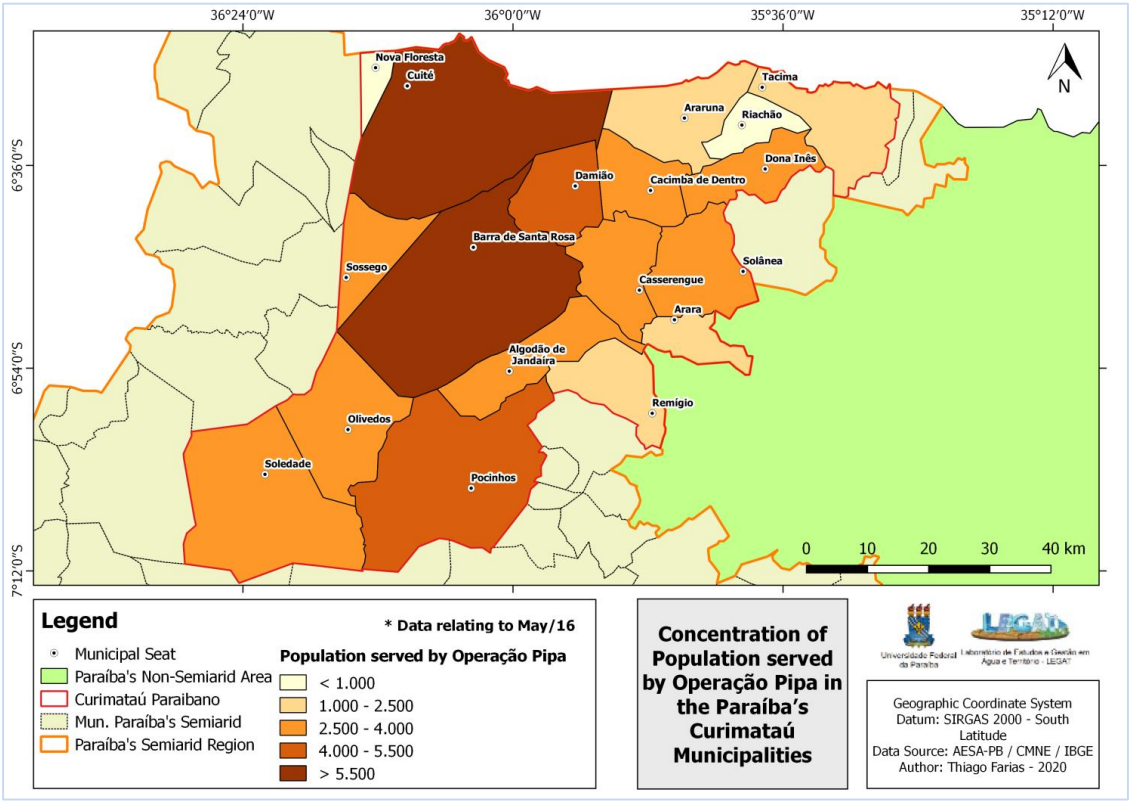

Figure 4 - Concentration of Population served by Operação Pipa in the Paraíba's Curimataú Municipalities. Source: Author.

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The number of 57,482 inhabitants served by Operação Pipa in the region represents about 26% of the total population of Curimataú Paraibano. These values indicate how comprehensive and important has been the actions of this public policy for the populations of the municipalities in the region. When comparing with the data of Souza et al (2016), which presents information referring to the number of people served by water tank trucks in Rio Grande do Norte, this indicate that 72.527 people received water through water tank trucks. This quantity indicates that only Curimataú Paraibano represented 79.25% of the number presented for the state of Rio Grande do Norte, however, it is important to highlight that the data presented by Souza et al (Opus Citatum), refer to the IBGE Census of 2010, and in the period of May 2016, the time scale adopted in this study, the numbers in the state may be higher.

The study by Farias (2018), which addressed the actions of Operação Pipa in the Semi-arid Region of Paraíba, identified that this public policy served a total of 351.250 inhabitants in the region, when comparing with this study, the population served by this program in Curimataú Paraibano represented 16,36% of the population served by the Operação Pipa in the Paraíba's Semiarid.

However, by relating the number of people served by Operação Pipa with the total population of the municipalities, it is possible to identify a change in the municipalities that had higher and lower percentages of the population served, indicating which of these were more or less dependent on OP actions. The municipalities that had the highest percentage of population served were: Algodão de Jandaíra (131%), Damião (110%), Sossego (86%), Olivedos (81%) and Casserengue (49%). Those that present the lowest percentage of population served were: Nova Floresta (8%), Arara (11%), Remígio (11%), Solânea (13%) and Cacimba de Dentro (15%), as shown in Figure 5.

The data referring to Algodão de Jandaíra and Damião had percentages of population attendance above 100%. These informations, coming from the responsible agency, shows inconsistencies in the records of these locations, as well as indicating that possibly the Operação Pipa's performance included data and values from surrounding municipalities.

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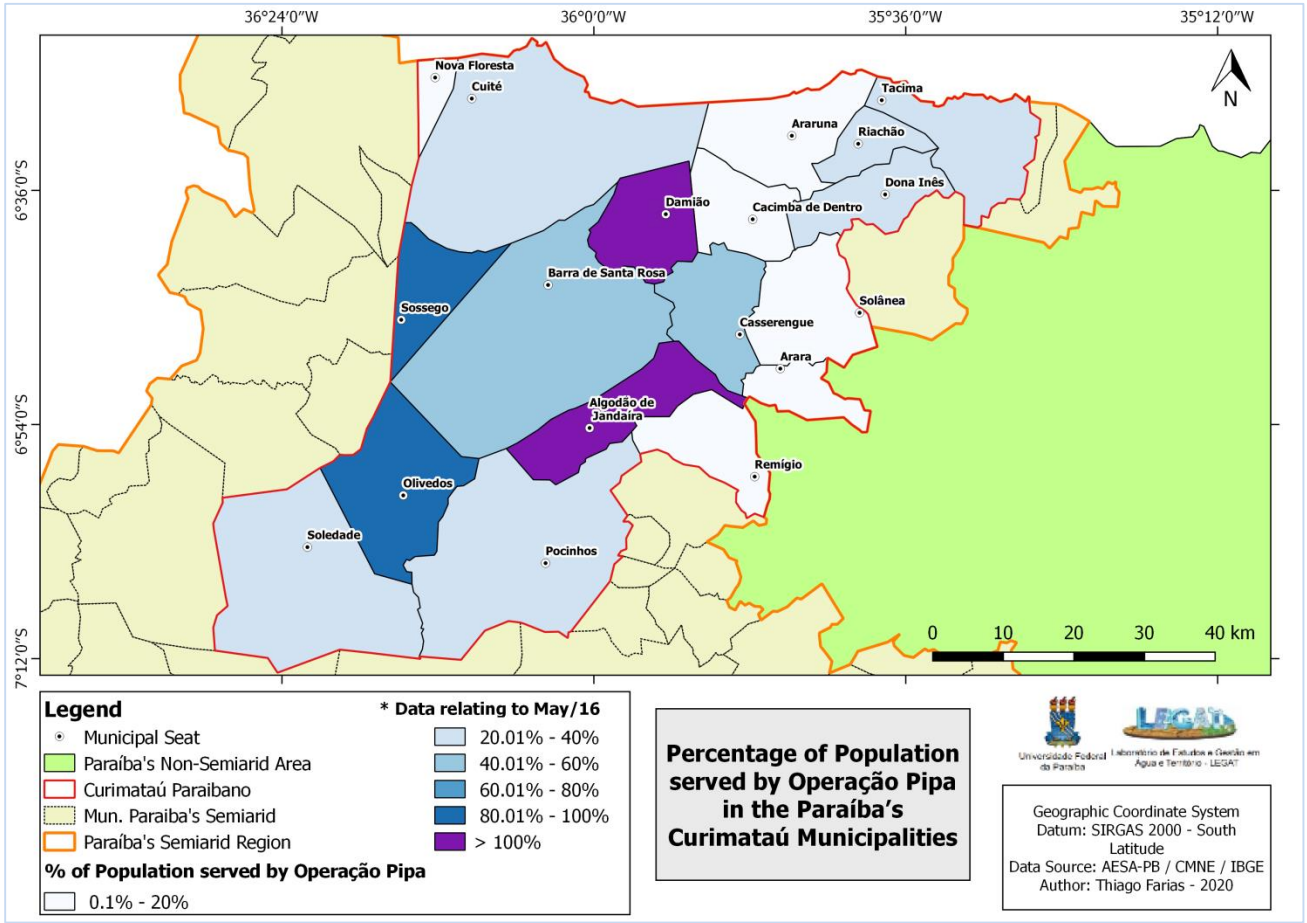

Figure 5 – Percentage of Population served by Operação Pipa in the Paraíba's Curimataú Municipalities. Source: Author.

Regarding the number of water trucks operating by Operação Pipa in the region, of the 154 water tank trucks distributed across the 18 municipalities of Curimataú in Paraíba, Cuité presented the highest demand for water tank trucks with 20, followed by Soledade with 13, Barra de Santa Rosa and Pocinhos with 12 each and, finally, Damião with 11, were the municipalities in the region that most concentrated water tank trucks operating in their territories. The ones with the lowest numbers were: Riachão and Nova Floresta with 3 each, Arara and Araruna with 5 water trucks each an, finally, Algodão de Jandaíra, Damião and Sossego with 6 water tank trucks working in their municipal territories, as indicated figure 6.

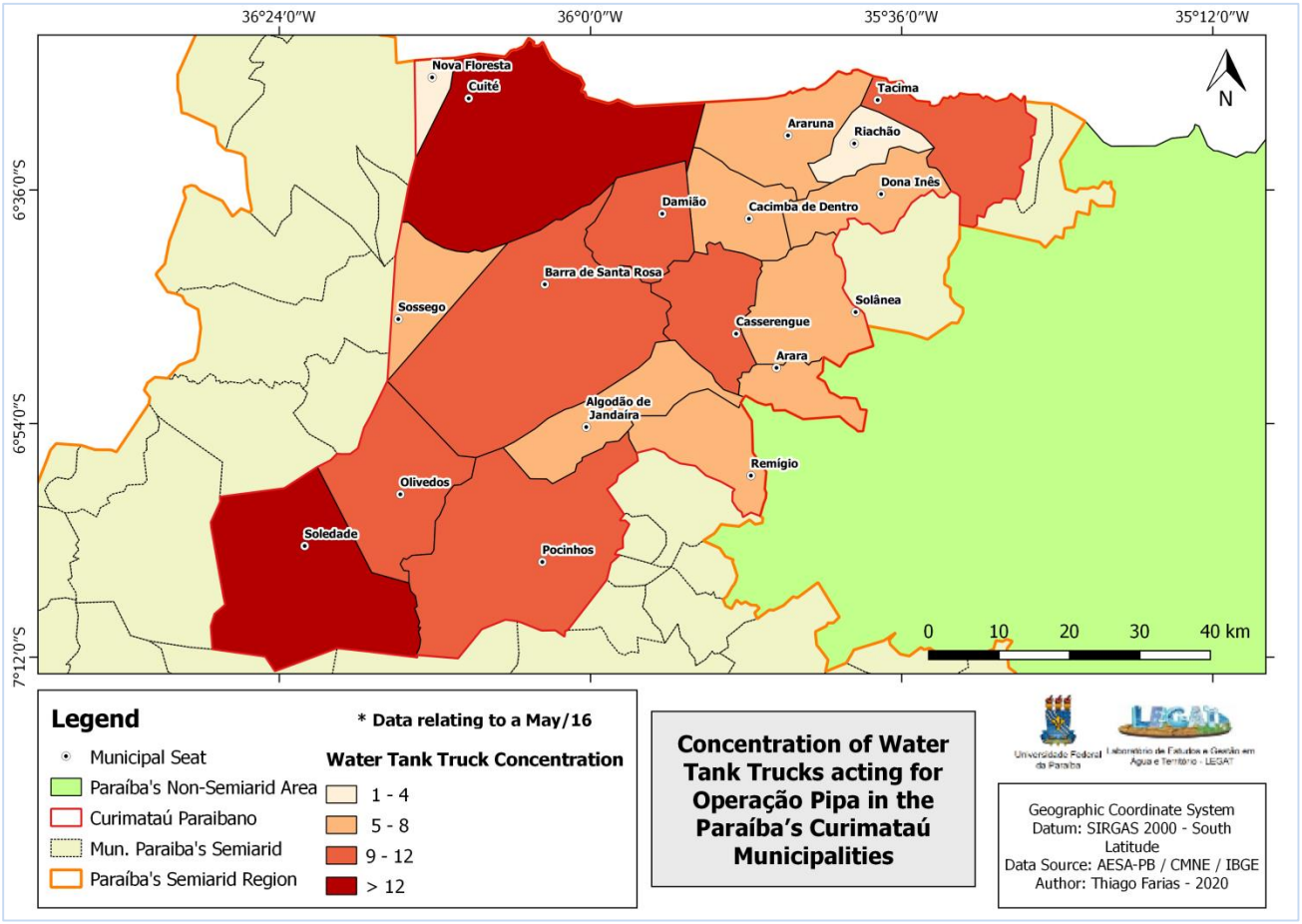

Figure 6 – Concentration of Water Tank Trucks acting for Operação Pipa in the Paraíba's Curimataú Municipalities. Source: Author.

When comparing with the data of Souza et al (2016), which presents the information referring to the number of water tank trucks operating by Operação Pipa in Seridó Norte-Riograndense, which comprises 23 municipalities, these had a total of 145 water tank trucks operating in the region. Although there are more municipalities than Curimataú Paraibano, the municipalities of Rio Grande do Norte's Seridó had less water tank trucks operating in their territories than Curimataú Paraibano, which had 154 water tank trucks operating across 18 municipalities. This behavior may be related to the number of population and communities served, as well as the number of service points, however the study by Souza et al (Opus Citatum) did not provide the total population served by the Operação Pipa in the region.

The study by Farias (2018), which addressed the actions of Operação Pipa in the Paraíba's Semiarid Region, identified that this public policy had a total of 962 water tank trucks operating in this territory. When relating to Curimataú Paraibano, this region represented 16% of the number of water trucks operating in the Paraíba's Semiarid.

Finally, two Military Organizations were responsible for the management and inspection of Operação Pipa's actions in the region. The 15th Motorized Infantry Battalion, based in João Pessoa, the state capital, was responsible for 17 of the 18 municipalities in the region. The 16th Mechanized Cavalry Regiment, located in Bayeux, was in charge to monitoring only one municipality in the region (Olivedos), as shown in figure 7.

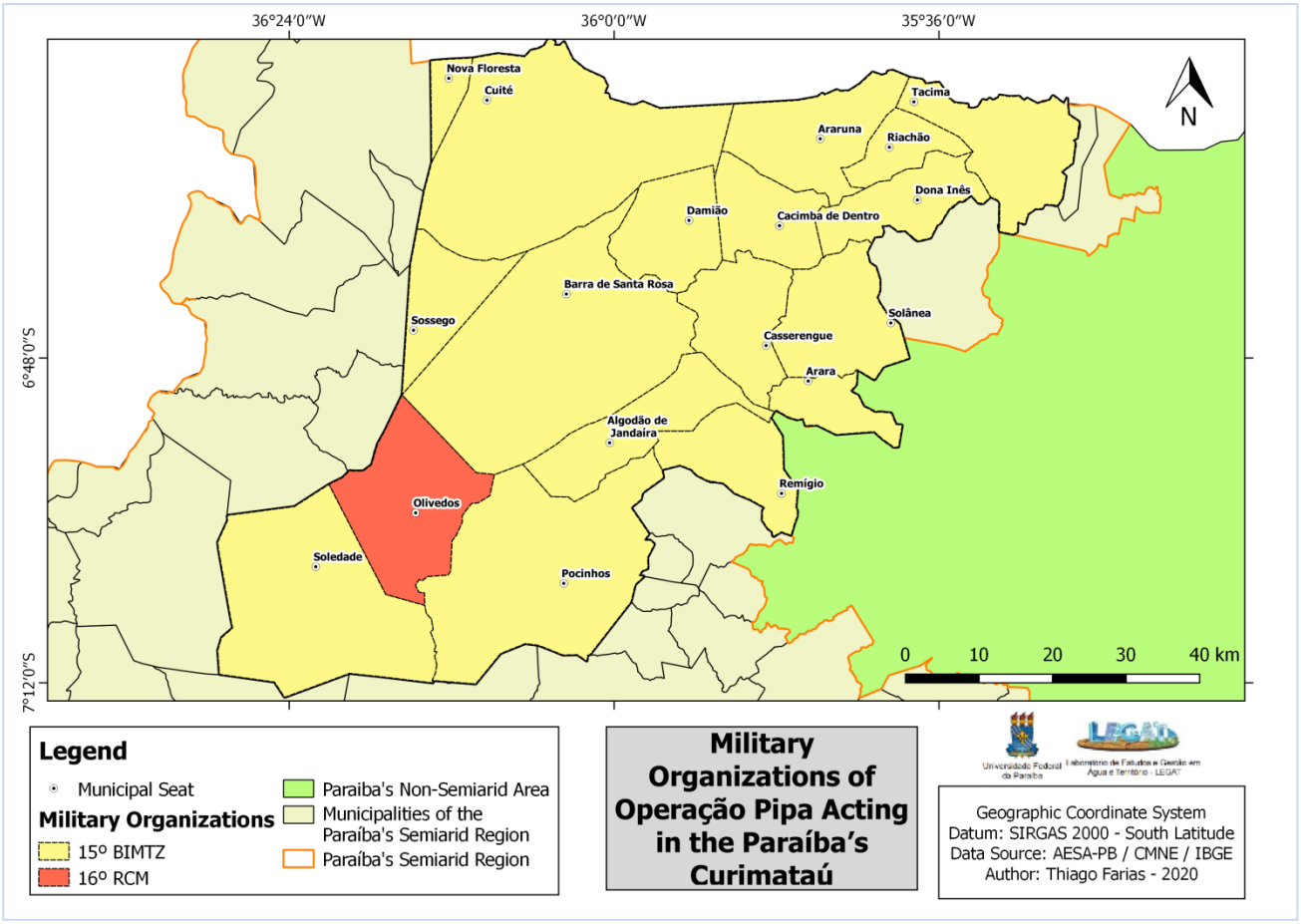

Figure 7 – Military Organizations of Operação Pipa Acting in the Paraíba's Curimataú. Source: Author.

The data presented in the studies by Neto (2019) and Farias (2020) highlight that throughout 2012 to 2016, the actions of Operação Pipa were intensifying not only in the state of Paraíba, but also in the national territory. The indicators such as municipalities and population served, number of water tank trucks, operating costs and quantity of water distributed have been growing year after year, as a result of the effects of the great and intense drought period in the Brazilian Semiarid Region.. The actions of this public policy, as well as other water policies implemented throughout history in the region were fundamental to enable, in one of the worst droughts in history, the effects of this were much smaller than other droughts that occurred previously in the region and caused far more severe consequences for the local population.

4. FINAL CONSIDERATIONS

The results of this study highlight the importance of drinking water distribution policies, such as the Operação Pipa, for municipalities within the context of the Brazilian Semi-arid and/or are regularly affected by climatic phenomena that result in water scarcity, such as dries and droughts. These policies, combined with other policies to respond to drys and droughts, such as Bolsa Estiagem and Garantia Safra, as well as existing social policies in the region, such as Bolsa Família, constitute institutional actions aimed at providing security and a welfare state for local populations, especially to the most vulnerable.

The water tank trucks have great importance and capacity to distribute drinking water, due to the wide road infrastructure in the region, especially those existing in the rural area, enabling the service of rural populations in the municipalities served. The water tank trucks assumes this role due to the inexistence and even the collapse of regional reservoirs and municipal water supply systems, enabling the interconnection between large and small water works, represented mainly by dams and cisterns, respectively.

It is also important to highlight the need for maintenance, especially in times of scarcity, as well as the expansion of water infrastructures in the region, from large to small water works. These measures aim to ensure a higher regional water security, enabling greater access to water and resilience for municipalities in the face of periods of scarcity, caused by dries and droughts.

With more than 20 years of institutional activity as a public policy, through Operação Pipa, and for more than 50 years in

which water tank trucks are used as a tool to combat drought, it is of fundamental importance the development of studies that have the water tank truck and the public policies that use it, with the objective of documenting its actions and understanding its functioning and its relations and impacts in space.

Finally, the great importance and contribution of geotechnologies and cartographic products is highlighted for the understanding of the phenomena that manifest themselves in the geographical space, as well as for the territorial planning and the management of natural resources, especially water resources, which have a great relevance in regions with water scarcity characteristics. These tools make it possible to acquire and spatialize informations that helps to improve water management in the region.

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