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Social Technologies and living with semiarid: A relationship between the States of Alagoas and Sergipe / Brazil

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Abstract*— *The present work aims to map the Social Technologies used to live with the semiarid in the states of Alagoas and Sergipe, since both states are areas characterized by water insufficiency, and these technological innovations have been presented as conditions that help in the social improvement and water sustainability. The methodological procedures adopted were documentary analysis of reports presented by public and private agencies and entities that have works and actions in the implementation of the TS in the municipalities affected by drought. Studies show that in the Alagoas semiarid there is a higher concentration of social technologies deployed in relation to the Sergipan semiarid, being the plate cistern, polyethylene cistern, boardwalk cistern and dams the technologies most used by the population that aims to improve the quality of life and that ensures water sustainability.

Keywords*— *drought, technological innovations, water sustainability.

I. INTRODUCTION

In the Brazilian semi-arid region, the low availability of water has been an obstacle to the permanence of families in rural areas [1]. Environmental changes are often imposed by the action of the capitalist system, directly affecting the sustainability of the natural resources and of the societies that depend on them [2].

The search for alternatives or social improvements has become a challenge for social organizations [3]. The use of social technologies has positively impacted social development, focusing on the human factor, due to the involvement of different social actors, and promotion of the dialogue of knowledge, for the realization of efficient solutions where they are developed or reapplied [4].

Life parameters, disabilities and options are numerous in each culture [5]. Therefore, social technologies are their own methodological procedures that respond to the solution of a collective problem of a particular region or community [6].

The necessity of the implantation of technological innovations can help in the water sustainability, being the Social Technologies innovative strategies that allow the country people to live with the semiarid. Therefore, this paper aims to identify the use of social technologies implemented in the semi-arid states of Alagoas and Sergipe, since both have proportional and similar water deficiencies, as well as located in northeastern Brazil, covering the region and the semi-arid climate.

II. THEORETICAL REFERENCE

India is considered the cradle of Social Technologies (TS) in the nineteenth century, where the thought of the reformers of that society was focused on the rehabilitation of traditional technologies, practiced in villages as a strategy to fight British rule [7].

To help the country find alternatives that would lessen British economic dependency, Mahatma Gandhi created the movement that would coin the concept of appropriate technology, which deals with a process of diffusion of technologies from developed countries to developing countries, lowering costs. And the need for investments,

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enabling the development of local industry and agriculture [8].

Gandhi argued that all technology should be contextually "appropriate" in an integrated approach to local social, economic and cultural development [9].

Appropriate Technology was important in order to provoke a deeper discussion about the impact of technologies and their innovations on human life and the planet itself, regarding the relation of production, consumption and exclusion [10]. Other denominations were considered important for their consolidation: Intermediate Technologies, Alternative Technologies, among others [11].

Social technology was introduced in Brazil in the mid-1970s and made public policy since 1981, by the National Council for Scientific and Technological Development, through the Appropriate Technology Transfer Program, which was renamed Social Technology [12].

Although there are several discussions about the concept of Social Technologies, they refer to the set of techniques, transformative methodologies that can be developed or applied in interaction with or even appropriate to the population, and that represent solutions for social inclusion and improvement of living conditions [13].

The Banco do Brasil Foundation [14] corroborates by defining that Social Technology comprises replicable products, techniques or methodologies, developed in interaction with the community and that represent effective solutions for social transformation.

Social Technologies are sustainable local development strategies, as they can favorably affect the living conditions of the communities where they are implemented [15].

Social technology is considered a means of empowerment, defined by products, techniques or methodologies that can be reapplied, developed in interaction with the community and that represent effective solutions for social transformation [16].

It is clear that social technology must include the participation of communities in their process of creation, development and implementation, as well as focus their most relevant needs and be in line with their values, habits and practices [17]. These technologies have played a dual role in contributing to the social and human development of the communities where they are carried out [18].

Proper use has the potential to facilitate the achievement of sustainable development goals, but it can also increase existing social disparities or ecological vulnerability when inadequate in context [19].

III. MATERIALS AND METHODS

In the bibliographic research were used as sources institutional and academic websites, articles, dissertations, theses and booklets that addressed the use of social technologies in the semiarid.

The documentary analysis was carried out through study and search in databases, and also in loco in some departments that developed joint works to the semiarid. The selected institutions are directly involved in the implementation of technological innovations that capture rainwater storage, which made available the reports and the use of the database. Like the Secretaries of State, the Brazilian Semiarid Articulation (ASA), the São Francisco and Parnaíba Valleys Development Company (CODEVASF), the Water Resources Development and Sergipe Irrigation Company (COHIDRO) and the Development Consortium of the Ipanema Region (CONDRI).

The identification of the use of social technologies implemented in the municipalities of the semiarid region of Alagoas and Sergipe was carried out through data collected from November 2018 to June 2019, which were tabulated in Microsoft Excel software and with the help of AQGIS, can be distributed in frequency according to your geographical location.

The technical visits were conducted from May to August 2019, to record and understand the operation of technologies as a strategy for living with the semiarid. The municipalities visited in Sergipe were Poço Redondo and Porto da Folha, and in the state of Alagoas were the municipalities Olho d'Água das Flores, Palestine, Sugar Loaf and São José da Tapera.

IV. AREA CHARACTERIZATION

The Alagoas semiarid has a territorial extension of 12,686.86 km2, 38 municipalities, and a population estimated by the IBGE in 2005 of about 838,740 inhabitants, relatively high demographic density [21]. Sergipe has 11,175.64 km2 of territorial area, 29 municipalities, and a population of 396,399 inhabitants, being considered the smallest state of the Brazilian Federation [20] (FIGURE 1).

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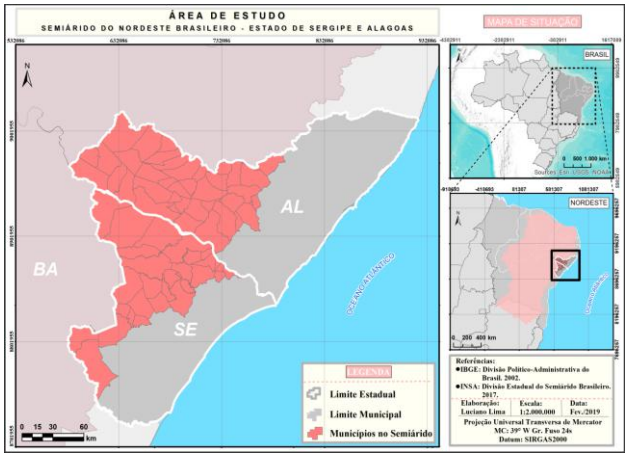

Fig. 1: Geographic localization of the municipalities that make up the semiarid region in the states of Alagoas and Sergipe

V. RESULTS AND DISCUSSIONS

The main proposal of social technologies implemented in the semiarid region aims to solve the problem of water deficiency caused by drought, and these innovations are responsible for capturing and storing rainwater and ensuring the water sustainability of the population throughout the year.

In the mapping of TS, it was identified that the most used by the countryman were the Dairy Cistern (a), Boardwalk Cistern (b), Household Cistern (c), Flood Cistern (d), Polyethylene Cistern (e), Desalination (f), Dam (g), Underground Dam (h), barrier Trench (i) and Stone Tank (j) (FIGURE 2).

The dairy cistern (1a) is a technology used to capture rainwater through the sheepfold roof. Its main purpose is to store the water in a cistern interconnected with the sheepfold and to supply the need for water shortages especially during the dry season.

Fig. 2: Social Technologies implanted in the AL and SE semiarid.

The Boardwalk Cistern captures (1b) all rainwater through a sidewalk and is connected by piping that directs the water to be stored in a cistern that provides 52,000 liters of water for families to use during the drought period to enable the production of vegetables, fruit trees and small animal husbandry, and also improve the quality of food of these families, as it can enable the generation of income by selling the surplus, expanding its possibilities in the agricultural sector [21] .

Plate cisterns (1c) capture rainwater through the roof of the residence [22]. It is made of mortar slabs, and two thirds of the cistern is buried in the ground, which helps to counteract the internal water pressure, giving stability to the walls [23].

Flood cistern (1d) is a social technology that closely resembles the boardwalk cistern, and all water stored in the cistern comes from runoff, whose purpose is to contribute to the guarantee of food and nutritional security through the production of agroecological food. With the flooded cistern it is possible to store rainwater and not let it evaporate, to ensure water for small animals during the dry season and to take it to the homes of farming families for food production [24].

The polyethylene cistern (1e) has the capacity to accumulate 16,000 liters of water, installed on the ground, close to the households in rural areas. It is a clean and ecological technology, since the raw material has good performance and durability, is non-toxic, odorless, waterproof and of good resistance [25].

Desalination is a process carried out by technology called desalination (1f) that involves the transformation of brackish water into drinking water.

Dams (1g) are small reservoirs of about 3,000m³, intended for storing rainwater; Its purpose is to enable watering in critical periods of rainfall irregularity, in case water is lacking, for example, during the initial development of the plant or in flowering [26].

Underground dams (1h) are total or partial flow sealing devices built across the alluvial valleys to intercept subsurface runoff. Underground dam [...] is a water structure that aims to intercept the flow of surface and underground water through an impermeable septum (plastic tarp, wall of stones or compacted clay, etc.)[27], which serves as a technological alternative for the use of rainwater, avoiding erosion to the soil surface, where they can cause erosion, and cannot be used later [28].

The trench barrier (1i) also called “caxio” consists of an open reservoir [29]. Trench barriers are long, narrow, deep tanks that are dug into the ground. This social technology takes advantage of soil impermeability in the semiarid for rainwater harvesting and storage.

The cauldron or stone tank (1j) is a natural cave, excavated in slabs, which represents an excellent reservoir

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for storing rainwater for human, animal and agricultural use [30].

It is noticed that social technologies are related to local public policies, and the common characteristics between both are: meeting the demands of society; stimulate social interactions; promote sustainable development; involve public and private social actors; strengthen social and political participation; provide social inclusion through the generation of work and income [31].

The municipalities of Canapi, Girau do Ponciano, Poço das Trincheiras, Santana do Ipanema and Igaci, all from the semi-arid state of Alagoas, had the highest frequency of deployed technologies, ranging from 3.80% to 5.45%. % of other municipalities. It is believed that they stood out for having the territory affected by drought, water scarcity, larger territorial area, high population coefficient, and large losses of agricultural crops, but mainly that there was great influence of public policy actions related to technologies and strategies. water security in the region (FIGURE 3).

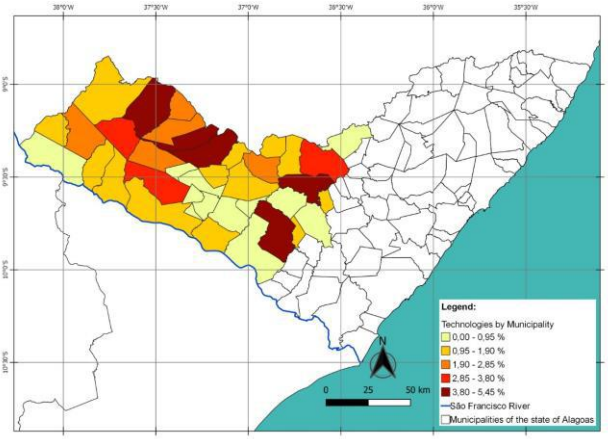

Fig. 3: Distribution of social technologies in the semiarid region of Alagoas.

In the state of Sergipe, the reality is not in opposition to that of the state of Alagoas, with the municipalities of Poço Redondo, Tobias Barreto and Simão Dias presenting the most prominent social technologies. Since these municipalities have as their main feature the low incidence of rain and a water deficit during most of the year, justifying the need to implement these instruments and effective strategies to mitigate and ensure the food security of the population (FIGURE 4).

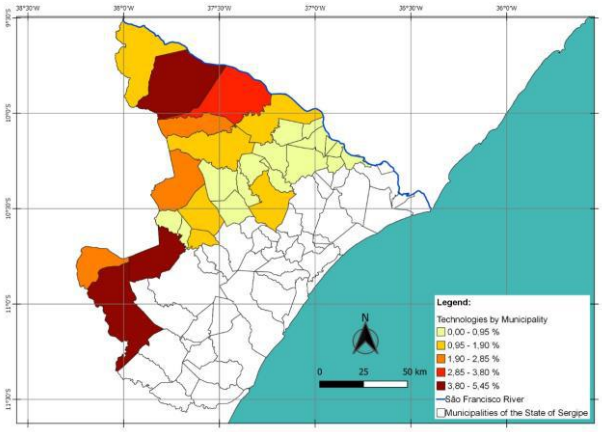

Fig. 4: Distribution of social technologies in the semiarid region of Alagoas.

Amparo do São Francisco is the only municipality in the state of Sergipe that has not been found in any of these deployed technologies, a fact justified by its territorial size, and by having water supply system throughout its territory.

In this sense, [32], presents that the use of social water technologies aims at food production and also help to reverse the negative situation of poverty and misery built on the semiarid region, social technologies aimed at the management of productive resources have led to a significant improvement in household food and nutritional security levels.

Of the 38 municipalities that make up the Alagoas semiarid, the home cistern, the polyethylene cistern, the dam, the boardwalk cistern and the sheepfold cistern predominate throughout the Alagoan semiarid (FIGURE 5). The region of Ipanema stands out for presenting the folding cistern as the main alternative to live with the Alagoas semiarid, social technology not found in the other municipalities surveyed.

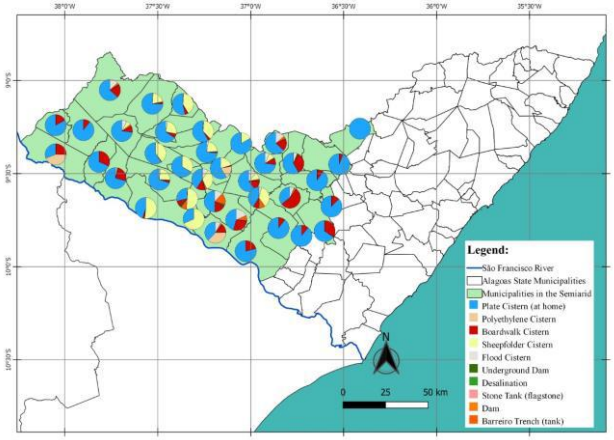

Fig. 5: Mapping of social technologies in the semiarid region of Alagoas.

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In the state of Sergipe, this representation does not differ greatly, being the plate cistern, the polyethylene cistern, the boardwalk cistern and the dam that are most representative and help in living with the semiarid (FIGURE 6).

These technologies, in addition to providing water for families, bring the feeling of comfort, dignity and independence of the public power supply, representing a relief during drought periods.

The TS presented here are excellent tools to ensure access to quality water, as well as improving the quality of life in rural communities, as social technologies enable the countryman to develop activities such as animal husbandry and agricultural production with the possibility of marketing the products.

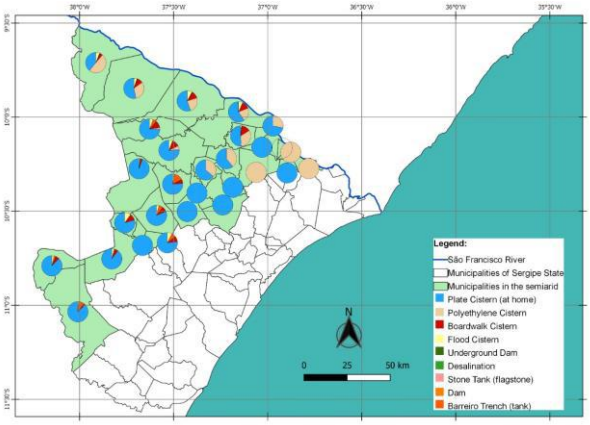

Fig. 6: Mapping of social technologies in Sergipe semiarid.

The State of Alagoas presented higher concentration of TS implanted in the Alagoas semiarid, a percentage of 68.81%, this result may be related to the number of people living in the Alagoas semiarid being higher than the Sergipan semiarid. The frequency distribution presented in the Sergipan semiarid was 31.19% of ST implanted in the studied municipalities (FIGURE 7).

All the predominant social technologies were implemented in the semiarid region of Alagoas, except for the trench barreiro, although existing in some municipalities in Alagoas, this technology only stood out in Sergipe state. This fact can be explained by the geological formation of the surface being favorable to crystalline subsoil regions, as in Sergipe, but the same does not happen in subsoil regions of sediments such as limestone and sandstone, because the water accumulated in shallow reservoirs gradually infiltrates and significantly reduces the amount of water stored in a short time [33].

The plate cistern is responsible for 38.02% of the TS implanted in the state of Alagoas, while the state of Sergipe presented a percentage of 22.75% (FIGURE 7).

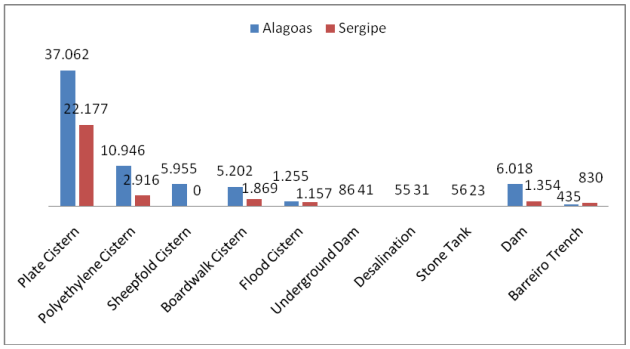

Fig. 7: Comparison of Social Technologies implemented in the semi-arid states of Alagoas and Sergipe.

The smallest TSs outside 0.13% underground dams, the desalination plants (0.08%) and the stone tank (0.08%), these low percentages are related to the natural and operational problems of their implementation.

Difficulties in the implementation of underground dams include the type of soil suitable for the construction of the system, impervious sites to prevent infiltration and distancing with the sewage system. The main reason for desalination was the fact that it required a large financial investment for its installation and maintenance, and finally the stone tank because it depends on the geological formation of the land to use it.

Highlight the advantages of using social technologies, because the low investment and capital cost for each tank produced can create jobs in the construction of these technologies, as well as small-scale organizational simplicity, facilitating the process of adaptability to the socio-cultural environment, generating economic development, local and regional self-sufficiency through the use of natural resources and the practice of social control [34].

VI. CONCLUSION

Both states located in the northeast region of Brazil are affected by a natural factor, water insufficiency, which generates negative consequences for the population, social technologies are innovative alternatives that enable the population to live with the semiarid.

The application of these technologies broadens the development prospects, as they are mechanisms that enable access to quality water, whose main purpose is to improve the population's quality of life.

The State of Alagoas presented a higher concentration of implemented social technologies aimed at water sustainability compared to the State of Sergipe, perhaps due to its higher population concentration in the semiarid.

Among the technologies most used by states are technologies that are easier to deploy and maintain. Thus, it is clear that the use of these technologies ensures access

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to quality water, in addition to contributing to the permanence of the population in the area affected by drought, positively impacting local development.

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