

# Cearense Semi-Alarm Plate Tiles: The Case of IPU, Ceará, Brazil

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**Abstract:** This study is the result of a research carried out in the Acaraú River basin, known as the Vale do Acaraú, located in the state of Ceará, Brazil, which in fact includes a complement of dynamic elements, including human presence that is of fundamental importance in this context, especially in the which refers to the use of natural resources and specifically of water resources. At the outset, we privilege the water resources as object of study, emphasizing the cisterns of plates. As a spatial clipping we have the Municipality of Ipu, inserted in the backcountry surface of pediplanation and sedimentary plateau of Ibiapaba. Therefore, this research aimed at a study of water resources in the semi-arid region of Ceará. The relevance of the research was due to the field activities carried out in the Acaraú valley. The methodology used was based on the Ministry of Social Development and Fight against Hunger. From this perspective, we visited and applied questionnaires with families that were treated with cisterns for at least three years. We find that cisterns raise the quality of life of families. The families show their relevance to alleviate the water shortage in the region. In conclusion, families emphasize that the cistern is of great importance because it is an appropriate reservoir to capture rainwater, so the construction of this reservoir contributes to the permanence of families in a rural environment, offering quality water for humans.

**Key words:** semi-arid, IPU, social technologies

## 1. Introduction

The Brazilian Northeastern semi-arid region is the region that suffers most from the absence of rainfall, placing it in a fragile situation in economic, social and environmental aspects, since rural families living in the so-called “drought polygon” are affected by water scarcity, linking the deficit policies, where they should be able to provide a viable quality of life for the families living in the semi-arid region. According to Silva et al. (2006) [1], “the availability of water in the northeastern semi-arid region is reduced and characterized by marked differences between rainy and

dry periods.”

In this context, “the Brazilian Northeast presents a high climatic variability, which is associated to the occurrence of extreme events of a region with natural aspects of high environmental vulnerability due to the exploitation of natural resources and, in many cases, in humid residual mass environments along the dry northeast” [2].

We emphasize that the forms of water use in a river basin can be diversified according to the interests of each user. According to this, it is necessary that these uses obey a hierarchy according importance/priority of supply. In relation to their geological conditions, these are varied, despite the primacy of the pre-Cambrian terrains of the crystalline basement.

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In this configuration, the basin of the Acaraú valley is inserted, where we have as general scope for our study. In the Acaraú basin, for example, agricultural activity from irrigation represents the largest portion of water consumption in the basin, around 85% [3].

In a watershed approach, Leal (2003) [4], mentions that “the river basin is a good management unit because it allows to understand it as a totality composed of interrelated and dynamic natural and social elements”. Therefore, the use of the hydrographic basin, as a physical-territorial unit for the management of water resources, was legally instituted in Brazil in 1997 with Federal Law n. 9.433, establishing the National Water Resources Policy (PNRH).

According to Suassuna & Audry (1995) [5], “the groundwater of alluvial aquifers also often has high salinity and sodicity; however, alluvial aquifers have relatively rapid renewal and dilution mechanisms when compared to fractured crystalline aquifers, depending on the seasonality of rainfall.”

Thus, due to the characteristics presented in the Northeast, which makes it a dry region, in the last years public policies have been established, in order to build reservoirs for the abstraction of rainwater, such reservoirs include cisterns plates that are built in the rural area, where the needy families are prioritized to be contemplated. In this sense, “rainwater harvesting becomes a viable alternative that, together with other public policies, favors the sustainable development of the region, and the construction of cisterns is one of these alternatives” [6].

During century the water insufficiency or its scarcity in determined moments, was pointed out like great responsible for the socioeconomic backwardness of the northeastern region of Brazil, mainly in the semi-arid portion. With this, water became fundamental and became a relevant resource for society, being important for human and animal consumption, which would provide economic benefits for the population. According to Rebouças (2006) [7], “fresh water as well as being a fundamental element to human supply is

essential for the development of its industrial and agricultural activities”.

However, this research was carried out in the Acaraú river basin, popularly known as Vale do Acaraú, located in the State of Ceará. In relation to the State of Ceará, Souza (2000) [8], “indicates that it occupies a territory of 148,016 km<sup>2</sup> between the coordinates of 3°46'30" and 7°52'54" South latitude and 37°14'54" and 41°24'55" West Longitude Gr. About 92% of its territory, that is, 136, 335 km<sup>2</sup>, are inserted in the semi-arid.

Although drought is a natural phenomenon, its impacts on the local populations of the semi-arid regions end up being intensified by anthropic action, or lack of adequate management of available water resources. In order to make feasible the strategies of “combating droughts”, several mechanisms or bodies have been created over the years (SUDENE, DNOCS, CHESF, etc.)

In this context, the Articulation of the Semi-Arid ASA (2000) “is putting into practice social technologies, which are for family supply or production, but some have already become governmental programs, such as plate tanks, which aims to the capture of rainwater for human consumption, which originated from the “One Million Cisterns” Program (P1MC). Broadly speaking, the cisterns of plates were disseminated in the Northeast Region, those promoted to communities suffering from the water deficit. This type of technology, acquired popularity with the emergence of the Training and Social Mobilization Program for the coexistence with semi-arid (P1MC).

In relation to the program, one million cisterns exist in rural communities, this demonstrates a viable alternative that offers families quality water. Also in this sense, the program promotes training courses for families to use the cisterns in a manner required by the Program’s guidelines. According to Bezerra et al. (2010) [9], “the use of cisterns in the Brazilian semi-arid region promotes significant benefits in terms

of the beneficiation of families by facilitating access to water in quantity and quality, potentiating significant improvements in health in the populations' living conditions assisted".

With regard to the problems that are caused by droughts, actions to coexist with the semi-arid environment are often produced and put into practice. Gnaldinger (2000) [11] corroborates, "that the practice of collecting rainwater arose thousands of years ago, independently in various parts of the world, with a wide variety of local adaptations which depended on specific conditions and cultures for the solution of localized problems." However, water social technologies can contribute to improving the quality of lives in semi-arid regions.

The cisterns of plates (as shown in Fig. 1), built by the P1MC, is a reservoir of capture of water of the rain taking advantage of the roof of the house, that drains the water through gutters. "It is a simple technology, adapted to the semi-arid region and easy to replicate, whose purpose is to store water for the basic consumption of rural families." [12]. In this perspective, the cisterns of plaques, are of relevance for the families living in the semi-arid, since these coexist with great adversities, where one must take into account some factors that influence in this situation, when analyzing the water resources in the semi-arid environment the implementation of the has changed the reality of families. In this sense, Silva (2006) [1]



Fig. 1 Plate tank in the district of IPU/CE [10].

points out that even when a screen is used at the entrance of the cistern, it is recommended to deviate the first rainfall to remove the particles deposited on the surface of the catchment areas (leaves, dust and feces of birds and small animals as well as their own, which may reside in spaces between the tiles or inside the pipes).

In relation to its water capacity, it accumulates 16 thousand liters. According to the guidelines of the P1MC, the accumulated water is destined to the total of "five people" during a period of 7 to 8 months. Portaria 518/2004 of the Ministry of Health [13], "defines the quality standards for water intended for human consumption and the procedures and responsibilities related to the control and surveillance of this quality".

Faced with issues related to the Northeastern sertão, water social technologies is one of the most viable alternatives for coexistence with semiaridity, since they are of low economic costs, and access until becomes easy for all. In this approach, Coutinho (2010) [14] states that "Social technologies participate in the process of building citizenship in rural communities and contribute to the solidification of an effective management system, where the community participates as a manager of its resources, not being at the mercy of the oscillations of the predominant management system, nor of changes in rulers." [14]

According to Furtado (1984) [15], "the scourges of the droughts have lasted for some time due to the incongruence of policies to combat drought with the real historical, economic and social context of the Northeast region." Still in this context, "the concern with the provision of safe water in its quantitative and qualitative aspects has stimulated public and private policies to improve and facilitate their access and to regulate this availability, its use and its management." [16].

Thus, this research aims to develop a study aimed at social technologies in the semiarid, prioritizing the cisterns of plates, because they are more noticeable in the Acaraú valley. Regarding the water resources that

belong to the Acaraú basin, as mentioned by Falcão Sobrinho (2008) [17], “we will describe the lowest and highest parts of the basin, the Acaraú valley, the geomorphological compartmentalization that exerts a decisive influence on the characteristics of the resources water.” Then a table with the distributions of the main dams that are inserted along the Valley of the Acaraú.

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**Table 1** Distribution of the large weirs in the Acaraú Valley (Source: COGERH. 2017).

Weir	County	Accumulation Capacity(m <sup>3</sup> )
Acaraú Mirim	Massapê	52.000.000
Araras (Paulo Sarasate)	Varjota	891.000.000
Arrebita	Forquilha	15.600.000
Jaibaras (Ayres de Souza)	Sobral	104.430.000
Bonito	Ipu	6.000.000
Carão	Tamboril	26.230.000
Taquara	Cariré	320.000.000
Edson Queiros	Santa Quitéria	254.000.000
Farias Lima	Nova Russas	12.300.000
Forquilha	Forquilha	50.130.000
São Vicente	Santana do Acaraú	9.840.000
Sobral	Sobral	4.675.000
Carminha	Catunda	13.628.000
<b>Total</b>		<b>1.763.763.000</b>

## 2. Characterization of the Study Area

In an approach of geomorphological compartmentalization, the municipality of IPU is

inserted in the sertaneja surface of pediplanation, and sedimentary plateau of Ibiapaba. According to Souza (2006) [8], “inland areas are between sedimentary or crystalline plateau levels, with altitudes below 400 m

and with marked lithological diversification, widely subject to hot semi-arid conditions with strong rainfall irregularity; fluviometric network dense, weak and moderately notched on the surface and with fluvial channels endowed with seasonal intermittence; mosaic of soils with great variety of associations, being common the existence of shallow soils, rocky outcrops and rocky grounds, extensively covered by caatingas that bear great variety of physiognomic and floristic patterns and different levels of degradation; current use with predominance of agricultural activities. High vulnerability to drought due to the small potential of deficit water resources, during most of the year.”

In this sense, it is still interesting to point out, according to Falcão Sobrinho (2008) [17], that the “sertaneja” surface is a depressed area located between elevated environments. Its extension in the state of Ceará corresponds to a total of 92% of the total area of the state. In the valley of Acaraú, its occupied size approximately the same percentage. Within this discussion, we can list the Ibiapaba plateau, which includes the area covered by the eastern portion of the sedimentary basin of Parnaíba. This geomorphological unit is composed of sedimentary rocks of the Serra Grande formation.

“The relief is dissymmetric consisting of an alternating succession of layers with distinct wear resistance sloping in one direction, forming a gentle slope on the reverse, and an abrupt or steep cut on the so-called front of the slope [18].” In relation to its vegetation, prevails the Open Shrub Caatinga, Thorny Deciduous Forest, Tropical Rainfall Subcaducifolia, according to IPECE (2016) [19].

The municipality of Ipu, is located in the Northwest region of the State of Ceará, with the geographical coordinates 4°19'20" Latitude (S) and Longitude (W) 40°42'39". The municipalities that are at their limits are: To the North, Pires Ferreira, Reriutaba and Guaraciaba do Norte, to the South, Ipueira and Hidrolândia, to the East, Hidrolândia and Pires Ferreira and to the West, Guaraciaba do Norte, Croata and Ipueiras [19].

### 3. Methodology

The applied methodology consists of a guided bibliographic survey, beginning with the theoretical approach based on a systemic view of the study area. In this context, we have as a spatial clipping the municipality of IPU. The methodology was adopted by the Ministry of Social Development (MDS) (2006). Regarding the activities, field surveys were carried out, where it was possible to apply questionnaires to families that have plate cisterns. For the procedures, some questionnaires were selected, namely; a) conditions of housing; b) family's average monthly income c) alternatives for water acquisition.

Regarding the structural effects, we also analyzed: d) the cistern already presented some problem in the structure. e) the cistern by the one who implemented it. For the execution of the research, we have the support of the Laboratory of Pedology and Erosive Processes of Geographical Studies - LAPPEGEO, which is located on the Junco campus, at the State University of Vale do Acaraú - UVA. In agreement with the number of questionnaires, 40 questionnaires were applied. In addition, the families assisted with the cisterns were accessed for at least three years. “We can point out that other experiences we have already experienced in research along the Acaraú Valley [20, 21].”

### 4. Results and Discussions

According to the results obtained, we verified in the field that the cisterns are significant for the families that have this reservoir in their residences. Regarding housing conditions, in the semi-arid region has always raised a lot of concern in public agencies, at least at the level of political discourse. In order to reverse this situation, several masonry houses were built, excluding the mud houses, and this is very noticeable in the municipality of IPU. We point out that in the face of this situation, the abandonment of rural families, due to the characteristics of the climate, and the condition of subsistence, sometimes occur. In studies carried out by Falcão Sobrinho (2014) [22], “in the Acaraú Valley it

is observed that in the area of the humid residual mass, there is a greater permanence of dwelling, the author emphasizes that such change occurs in relation to the conditions of nature favorable to the use of the soil agricultural.” In this way, there is a greater permanence of dwelling (Fig. 2).

Even with the implementation of cisterns by the PIMC Program, no significant improvement in the economic income of households was recorded. “Therefore, any distribution of rainfall or rainfall reduction, which disables agricultural activities, destabilizes economic activity, compromising family income and above all generating a crisis in subsistence agriculture, causing social calamity [2, 23, (FURTADO; MOLION);

A large proportion of respondents reported having a family income below a salary. In this sense, some benefits that come from the Government prevail, such as the Bolsa Familia, Bolsa Selva, Brasil Carinhoso, Garantia Safra. We should also point out that some people did not disclose their rents for fear of losing their benefits (Fig. 3).

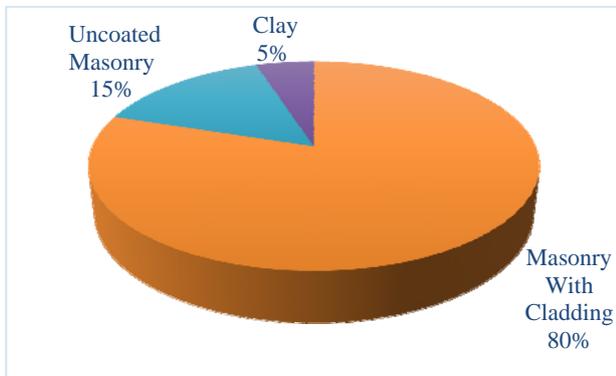


Fig. 2 Physical structure of residences.

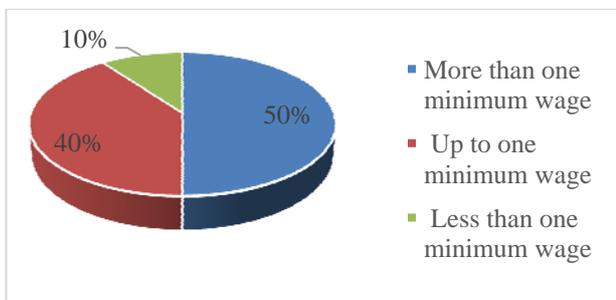


Fig. 3 Family's monthly income.

Regarding the physical structure of the cisterns, we verified in the field that the majority of the reservoirs did not present any type of problem. According to the residents, sometimes there are some simple leaks, several reasons can cause the cistern to crack, more common is the temperature rise in the semi-arid. According to Fajardo Pineda (2003) [24], “most of the factors that may compromise the integrity of the cistern are associated with the constructive process. It has been found that the problems that arise are some simple leaks, where they are arranged by the residents themselves, who brush the cisterns”. Also in this sense, “this happens because of the failure to follow all the recommendations during the construction of the cistern, there may be leaks (ASA [S.D.], [24, 25]FEBRABAN, 2003)” (Fig. 4).

Regarding the educational levels of assisted families, they end up compromising a low educational level. In this sense, education is relevant so that there is an apprenticeship with regard to cistern care and water treatment for drinking. The lack of quality education ends up compromising the learning of families, and many times they seek faith to face certain difficulties. This statement was also verified by Falcão Sobrinho (2014) [22], “the author associates the lack of information to the fact that the man of the field (the farmer) uses the land in an emotional way, sustained in the faith” (Fig. 5).

In accordance of the chart most families clean the cisterns with the aid of a brush, which is the most viable way for people. Some still clean the reservoir with the broom, but say that cleaning is not considered adequate, since the dirty is not absorbed by the broom.

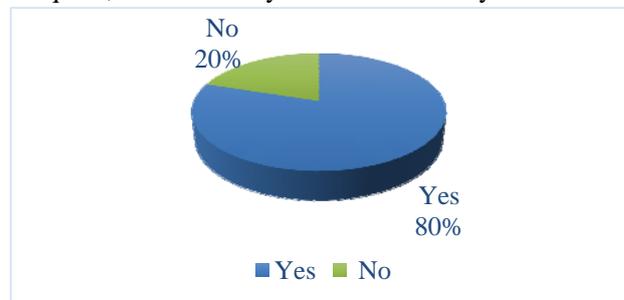


Fig. 4 Does the cistern have any problems with the structure?

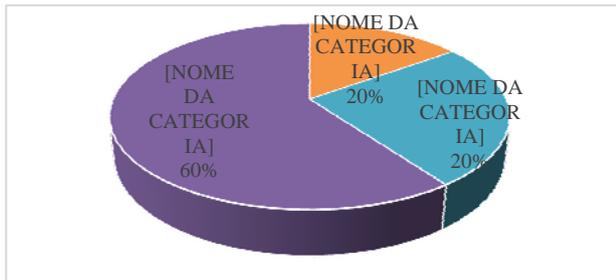


Fig. 5 Schooling level of families.

As for painting, “the white color of the paint with supercal or similar is very important for the conservation of the reservoir, in addition, the white absorbs less heat, and, because it is less hot, prevents cracking due to thermal strains [26].” (Fig. 6).

With reference to the water security offered by the cisterns to the families, they point out that the implantation of the cisterns by the PIMC program in their residences results in the quality of life of the families, the reduction of the indexes of gastrointestinal diseases, such as diarrhea, and many times the flu. Prior to the installation of cisterns, such cases of disease were frequent. In this context, Rebouças (2002) [7] states that “the vital water element, purifying water, natural renewable water resource are some of the meanings in different mythologies, religions, peoples and culture, in all epochs.” (Fig. 7).

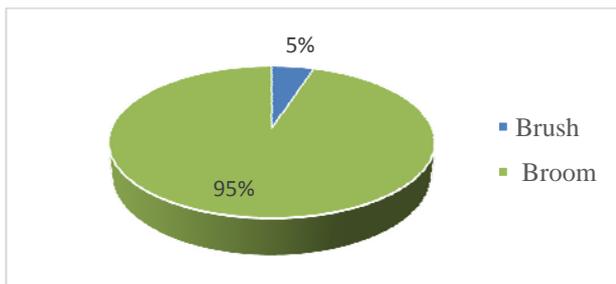


Fig. 6 Material used for the cistern cleaning.

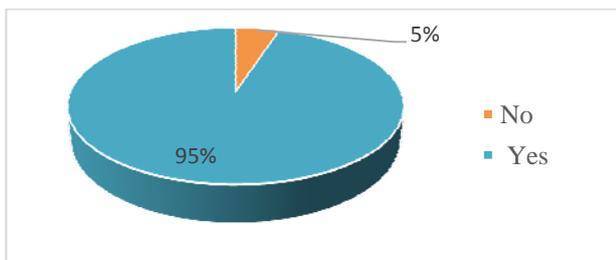


Fig. 7 Does the cistern has broght hydric security to the families?

## 5. Concluding Remarks

The acquired data indicate that the majority of households have masonry houses with lining, being a concern of the federal agencies, which replaced the houses of mudflats with masonry houses with lining. With regard to the income of families, these have incomes of less than one minimum wage, benefiting from government-directed programs such as family grants, dry-money scholarships, among others.

Regarding the problems presented in the physical structure of the cisterns, the families record that, most are leaks, but these are repaired by them. With regard to the level of schooling of the families, it was verified that they only have the reading as educational base. However, in families there are always some who can read and write.

It is pertinent to emphasize in relation to the cleaning of cisterns, that the families make use of brushes, to clean the reservoirs, thus maintaining a zeal and hygiene with the water to be consumed. Therefore, it was evidenced that the arrival of cisterns has been significant for the supply to human consumption, causing families to consume good quality water, and even improved life, reducing the rates of diseases directed to the intestine. It was verified that the families that often moved to fetch water for human consumption, and with the emergence of the reservoirs these end up gaining time for other activities due to the reduction of the long displacements in the search of water resources.

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