

Paradigms of Water Distribution in the Brazilian Semi-Arid: Between Combatting and Coexisting with Drought

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This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text.

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Introduction

This dissertation discusses two different paradigms of water distribution in the Brazilian Northeast Semi-arid: combatting and coexistence with drought. According to Thomas Kuhn, a paradigm is a model accepted by scientific practices of puzzle-solving, that will offer a solution to a problem by a certain period of time. They are embedded with values, beliefs and technics shared by a scientific community. As Kuhn explains:

Paradigms gain their status because they are more successful than their competitors in solving a few problems that the group of practitioners has come to recognize as acute. But more successful does not mean completely successful with a single problem or notably successful with any large number. (Kuhn, 2003, p. 23)

Paradigms are promises of success that are subjected to updates by the enlargement of the knowledge on a certain matter, facts, and predictions of a model.

Historically adopted in the region, the paradigm of combatting drought is characterized by the concentration of water access through large hydric works. It follows a technicist logic of controlling nature and reflects a modernization and civilization development model. This type of intervention relies on emergence strategies, often fragmented and without continuity. Its most iconic intervention, namely the construction of large dams and irrigation channels, is disconnected from the real needs of most of the population and favors wealthy landowners. Due to these attributes, this paradigm reproduces political and social mechanisms that reinforce poverty and inequality in the region, claimed to be caused by droughts.

The paradigm of coexistence with drought, in turn, presents a model of decentralized water access. The perspective of living *with* drought in the Semi-Arid takes into consideration its limits and possibilities. The principles of sustainability and fitted economic activity are the foundations of this paradigm. The coexistence with drought

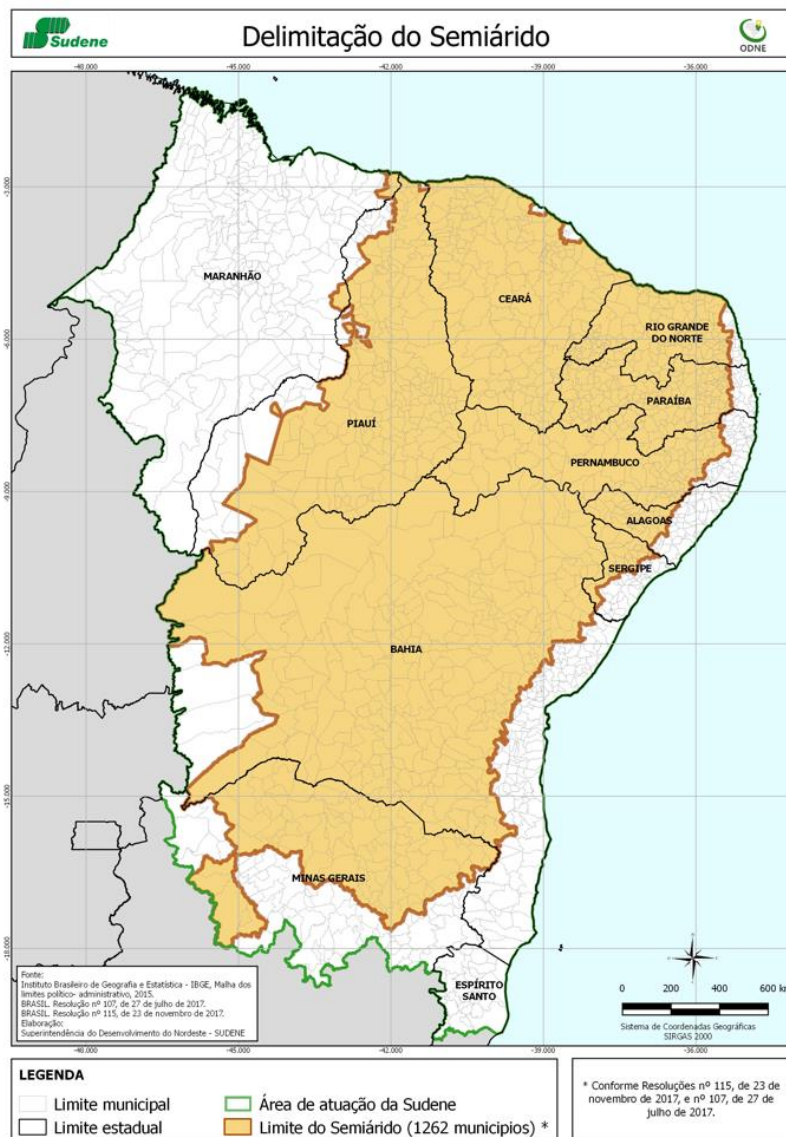
seeks local solutions adapted to the regional specificities. Its central strategy is stocking rainwater in cisterns and reinforcing family farming. This model recognizes that it is not possible to control nature. On the contrary, it seeks to adapt practices and technologies with the participation of civil society and public actors to find solutions to enhance the quality of life of the Semi-Arid population. In this model, each part is interconnected with the whole, marking a global view of the system

This dissertation contributes to develop the notion of two different paradigms for water distribution, exploring their dynamics in different periods. It proposes that combatting and coexisting with drought were disputed paradigms along history. These two models resulted in different practices and actors that outline how the right to access water has been conceived over time. Interrogating these disputes, this study aims to investigate what explains the hegemony of the paradigm of combatting drought in the Brazilian Semi-Arid by delving into crucial historical moments. I look at the logic and implications of this model and how it shaped a public policy framework based on the accumulation and empowerment of the elites. Likewise, this work traces the emergence of the paradigm of coexistence with drought as a reaction to the dominant model. It seeks to identify what were the movements that led to a change in institutional arrangements and the limitations they faced.

This theme is particularly important considering the climate crisis. The lack and shortage of water have been an increasing challenge for the development of several communities and regions worldwide, either for agribusiness or industrial production (C. N. D. Castro, 2021b). In the wake of the United Nations Conference on Sustainable Development - or Rio+20 in 2012 and the creation of the Sustainable Development Goals (SDG) for 2030, water and sewage access became a central matter in public policy discussions. The SDG goals represent a particular challenge for the Brazilian Semi-Arid

(See Figure 1). The region extends over one million square meters, occupying 12% of the national territory. It covers 1,262 municipalities in ten states,¹ where 27 million people live (Sudene, n.d.). The annual rainfall average of 200-800mm is concentrated in a few months, while the yearly evaporation index is 3,000mm. This condition, together with recurrent droughts, creates a persistent shortage of water supply to the population.

Figure 1. Brazilian Semi-Arid



Source: (Sudene, n.d.)

¹ The States are: Alagoas, Bahia, Ceará, Maranhão, Minas Gerais, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, Sergipe.

Given its focus on long historical continuities, this analysis relies on the theoretical framework of path dependence and critical junctures. Path-dependence theory and critical junctures are helpful models to explain institutional development and political action. According to Mahoney (2001), “major outcomes cannot always be explained in terms of short-term processes or unique and predictable equilibria” (p.111). Therefore, identifying key historical events is necessary for understanding structural patterns that shape development trajectories. As Paul Pierson (2011) noted, social scientists must acknowledge the importance of the temporal dimensions of real social processes. The critical junctures that lead to a persistent development path are linked to decision-making processes over time. Therefore, this framework offers an explanation for why a certain process happened. It does so by focusing on the dynamics of institutional self-reinforcement, which is responsible for making it particularly difficult to reverse such processes once a path is taken.

Most of on paradigms of water distribution studies tend to focus on actor-network theory and public policy analyses, disregarding the dynamics of decision-making and institutional reinforcements that paved a certain trajectory (Andrade et al., 2013; De Melo Branco et al., 2005; Doss-Gollin et al., 2016; Gnadlinger, 2014; Gomes et al., 2014; Schmitt et al., 2020; Soares & Leitão, 2017). This prevents the literature from addressing the matter under historical lens. Looking the constitution of these two paradigms in a long-term process, it is possible to identify not only the disputed over a political development path, but also the intricated dynamics that shapes social life. Furthermore, when looking at both paradigms, they are frequently taken as two independent and separated processes. In fact, the paradigm of combatting drought is usually taken as a

synonym with the concept of “industry of drought”². Whilst the paradigm of coexistence with drought is frequently represented by cisterns. When viewing these as disconnected processes, sight is lost of the complex constitutions and interactions between them. It is important to notice that, in fact, these are two diverse approaches for a same problem, with implications for one and another.

The literature on the theme of drought is vast and embraces a myriad of areas. Among the studies that provide a historical and more comprehensive analysis of this subject, the works of Roger Cunniff (1975) and Gerald Greenfield (1992, 2001) are worth mentioning for their detailed analyses of the Drought of 1887. For both authors, drought is a central element to think the formation of the Northeast as a region and to understand the nature of the public response to this phenomenon until recent days. In addition, those seminal works discuss representations of and narratives about drought by the elites, providing a comprehensive understanding of the birth of the drought industry.

Another significant contribution is Eve Buckley’s analysis of the history of strategies for combatting droughts (2017). The author proposes a history of science through the actions and ideas of the engineers working for Brazilian institutions to combat drought. In her book, she argued that the technocrats were indeed committed to finding solutions for drought and shows how institutional arrangements often prevented the promotion of major changes. Buckley’s research is an essential analysis to look at the institutionalization of the paradigm of combatting drought not as an essentialist one, but as a narrative that gain hegemony over a disputed conception on types of water distribution.

² A term introduced in the *Chronicles* of the journalist Antonio Callado in the late 1950s. It refers to the social, economic, and political practices used by landowners and politicians to make profits over the drought through clientelist practices.

Regarding the paradigm of coexistence, much has been produced on the Program 1 milhão de cisternas para o Semi-Árido Brasileiro (1 million cisterns for the Brazilian Semi-Arid, P1MC) and the logic of adaptation. The program started with a civil society initiative in the 1990's to construct cisterns in communities in the Semi-Arid. Later, in 2003, the program is institutionalized by the Brazilian government, with a goal of providing five million cisterns in five years. Just as combatting drought and industry of drought are ideas that walk together, so are the logic of coexistence and the P1MC. Among them, the recent works of César Nunes de Castro (2021b) and Arsky (2020) bring a vast analysis of the cistern programs in Brazil, including an extensive literature and data review. Castro's article shows the positive impacts of this public policy and its contributions toward achieving the SDG goals. Meanwhile, Arsky provides a broader look at the cisterns' effectiveness, arguing that, despite its benefits, this technology still presents some drawbacks, such as the quality and availability of water, not to mention the political uses of this policy. As shown in his article, despite the achievements of the P1MC, due the program limitation, old clientelist practices still take places. This is the case in the dry years when there is not enough rain to fill the cisterns, and the population is constraint to appeal to water tank trunks, usually associated to local power dynamics.

This study uses an exploratory and interpretative approach for a documental analysis in the form of historical descriptive-analytical research. Therefore, the documental corpus for this dissertation is broad and diversified, as described in the list below:

1. Official documents: laws and ordinances, federal's government budgets, ministry reports, studies and research from public institutions, and presidential and parliamentary discourses.

2. Personal narratives, especially regarding the Great Drought of 1877 and its effects.
3. Newspaper articles

The choice of such a variety of sources allowed me to process, track and capture the different political discussions to tackle the drought. In addition, they reflect the varied development ideas that permeated the water management debate in the Semi-Arid. Furthermore, looking at a diversified range of sources provides a broader understanding of processes that are not always linear or homogenous, but is always conflictive.

This dissertation is divided into two chapters, besides this introduction and conclusions. Using the path-dependence structure proposed by Mahonney (2001), the first chapter address three of the five analytical steps. The first are the antecedent conditions that set the stage for the emergence of the paradigm of combatting drought. Next, it tracks the historical facts and key moments that defined the available choices and shaped the selection process. In this chapter, I identify the Great Drought of 1877 as the critical juncture that led to selecting a particular option among other alternatives. Next, it presents the different debates on tackling the drought and what factors allowed the paradigm of combatting drought to become hegemonic. Finally, by identifying three key development periods (1915, 1950, and 1964), I analyze the institutional reproduction of this policy framework materialized in public institutions for combatting drought.

Chapter two is concerned with the rise and the ephemeral life of the paradigm of coexistence with Drought. It is structured following the last two steps on Mahoney's (2001) path-dependence framework: the reactive sequence and the resolution fo the conflict. In this part, I discuss the reactive sequence of the institutional reproduction presented in chapter 1. I argue that the emergence of the coexistence model was a reaction

to the structural pattern of combatting drought. Through the analyses of the P1MC, I seek to identify the key moments that allowed such a policy to emerge, but also the dynamics that led to its decline.

Finally, I conclude with an analysis of different categories embedded in each paradigm, looking at the different realities and achievements of both. I discuss the distinctive water distribution practices within the logic of centralization/decentralization, public power/civil society, and accumulation/stock. I conclude that, although the paradigm of coexistence has emerged as an innovative solution for tackling drought, it was always part of a contested space. Specific solutions for coexisting are presented at each historical moment, and always portrayed as a novelty, but whilst they do have their innovations and so on, they have been present in disputes from the very beginning. The failure in reversing the institutional arrangement of combatting drought shows how inequalities of power are also reinforced.

1. The paradigm of combatting drought

This chapter examines how the paradigm of drought combat became dominant in the Brazilian Semi-Arid and the outcomes of this framework. To start, I identify the Great Drought of 1887-80 as the critical juncture that defined the public-policy options to tackle drought in the Northeast. Key actors made a choice to combat drought through massive hydraulic and infrastructure works, such as building dams and investing in railroads as opposed to more local and specific measures. These choices shaped how public power would address the problem in the following decades. As a result, I argue this led to the establishment of a paradigm of combatting drought and set the conditions for developing enduring public institutions to address water distribution in the Northeast. This paradigm was institutionalized with the creation of the *Inspetoria de Obras Contra a Seca* (Inspectorate for Works against Drought, IOCS) in 1909, later replaced by the *Superintendência do Desenvolvimento do Nordeste* (Northeast Development Authority, SUDENE), which still exists.

1.1. The Great Drought of 1877 and the rise of the drought combat paradigm

The Brazilian Semi-Arid is historically affected by great droughts. The earliest documented accounts are found in Jesuits' reports and date back to the 16th century. The severest episode was the drought of 1583, which lasted for three years and affected sugar cane plantation and cassava production in the State of Pernambuco. As a result, farms ran out of water, and around 5,000 indigenous people left the *sertão*³ towards the coast to avoid starvation. The effects of this drought were reported by Fernão Cardim (1540-1625), a Portuguese Jesuit who spent many years in Brazil during the sixteenth century, in his

³ Dry hinterland in the Northeast of Brazil

epistolary correspondence *Tratados da terra e gente do Brasil*. (Cardim, 1925 [1625], p. 331).

Several were the droughts in the *sertão* along the centuries, registered in memoirs, travel reports, and official documents. One of the most severe, though, was the Great Drought of 1877-1880, which hit the State of Ceará and other provinces of the *sertão* relentlessly, sparing only the sugar plantations in the coastal strip of the Northeast. The main economic activities were devastated, such as cotton farms and cattle-raising. Subsistence farms were utterly dead (Greenfield, 1992). Journalists from all over Brazil and even other countries visited the area to cover the event. One of them was the American reporter Herbert Smith, from the New York magazine Scribner's. Smith visited the region in 1878 and published his travel memoirs a year later. With a rich narrative, he reported the long-lasting phenomenon that dragged on throughout winter and summer⁴, and the government's negligence toward those affected by the tragedy:

Long, long was the summer of 1877. Drought blazed in the sertao; the birds fell dead from leafless trees; foxes and armadillos died in their holes; insects disappeared. Drought withered the sea-coast woods, dried up the streams, brought thousands of refugees to Fortaleza and the interior towns. Drought sent famished cries to Rio, but the mad Government could not believe that its people were starving: cried back through its journals that the whole story was a political scheme, with hardly a foundation of facts. (Smith, 1879, p. 412)

When the drought came, the emperor Dom Pedro II was away. He had traveled to the United States in 1866, followed by a visit to Europe. He would only be back in Brazil by September 1877. While the Northeastern provinces' presidents tried to address the crisis with sparse funds from private charities, given the scarcity of the imperial relief funds, Brazilian newspapers were targeting the indifference of the emperor and the central government. On April 8th, 1877, the newspaper *O Cearense*, a liberal publication,

⁴ In the Brazilian Northeast the climatic year is divided in two seasons only: winter (from January to June) and summer (from July to December). The winter is the rainy season. Drought occurs when the winters are dry.

described the situation in the region affected by the drought as a horrible calamity. The plantations were lost, and there was mass migration to the coast and the higher areas—those who could not leave died from starvation and disease. The accusation to Pedro II comes with irony: “E não temos secca! Tudo isso não passa de especulação política do Cearense, grita o Pedro II!” (‘A Grande Secca’, 1877, p. 3).

Months later, another important newspaper from São Paulo, *Correio Paulistano*, in face of the rising number of deaths by starvation and multiple diseases, called public power to action: “se o poder público não tomar de prompto sérias medidas, em ordem a socorrer a população indigente, teremos certamente de lamentar a perda de muitas vidas que inevitavelmente sucumbirão à fome e à miséria” (‘A Secca Nas Províncias Do Norte’, 1877, p. 2). Historical sources refer to up 500,000 deaths during the two years of drought, not to mention the mass migration of almost 100,000 people to Fortaleza, Ceará’s provincial capital,⁵ increasing by four times the city’s population (Secreto, 2020; Smith, 1879). Meanwhile, the government’s response was slow and unsatisfactory. Having been alerted of the drought by mid-February, it was only on May 19th that both houses of Parliament approved the first emergency aid, much motivated by the migrant masses arriving in Fortaleza and the pressure of the opposition Liberal Party (Cunniff, 1975).

Scholars such as Roger Cunniff (1975) and Gerald Greenfield (1992) underline that, despite the criticism and the idea of abandonment, it was not the lack of financial aid that allowed the social crisis to take place during the Great Drought. The Brazilian Constitution of 1824 already provided relief funds in case of emergencies. Moreover, public expenditure for the three years of drought amounted to one-fifth of the total imperial revenue (Cunniff, 1975, p. 66). The problem was, in Greenfield’s claim, that “the positive impact of those actions [the central relief commission and the expenditure

⁵ In 1887, Fortaleza had 19.000 inhabitants.

of enormous sums of money] seemed negligible when compared to the magnitude of the suffering” (Greenfield, 1992, p. 376). In fact, most of the public aid was not used directly to alleviate the suffering of those most affected by the drought. Instead, those funds were mainly used to finance major public works, such as railway and road constructions, carried out by wealthy entrepreneurs with the cheap labor force from the drought migrants, the *retirantes*⁶. Within this logic, according to Cunniff, the Drought Industry⁷ was born. Instead of looking for more specific measures to assist the victims of this disaster, the province’s presidents saw an opportunity to access public funds to invest in infrastructure.

It is possible to argue that a logic of “aid through development” started to take shape from this point. This ideology would emerge in the 1950s only and set the tone for economic and social policies in Brazil. It advocated that economic growth and industrialization would be able to solve social inequalities. Using Le Goff’s idea of a common mental universe, Greenfield identifies how the elite’s speech embarked on a broader notion and called for reform. For them, what should be discussed was not the specifics but the problems that prevented Brazil from fulfilling its destiny as a great nation, such as low productivity and the poor transport and communication network (Greenfield, 1992). They also leaned on moral imperatives to justify the use of drought victims’ labor in railroad constructions and even in agricultural colonies. The Sociedade Auxiliadora da Indústria Nacional (Society for Aid to National Industry) was one of the leading institutions to support that idea. They advocated not only for the use of *retirantes*’ paid labor force but also for establishing a commission to address the problem of drought

⁶ Term that appeared during the Great Drought of 1877-1879. Refers to the migrants from the Northeast that were fleeing from the drought towards the coastal areas.

⁷ A term introduced in the Chronicles of the journalist Antonio Callado in the late 1950s. It refers to the social, economic, and political practices used by landowners and politicians to make profits over the drought through clientelist practices.

and strategies for regional development (Cunniff, 1975). Much influenced by the ideas of evolutionism and social Darwinism, two intertwined solutions were proposed: to the social emergency, the dignification of man through work, crystallized in *retirantes* labor; to climatic events construed as solvable problems, technique and science materialized in investments in infrastructure and the construction of massive dams.

By 1880 the imperial government had ceased relief payments, declaring the Drought's end despite the unstable climatic conditions and the persistent social crises of *retirantes* (Greenfield, 2001). From this calamity, however, for the first time is possible to identify a public policy to tackle drought. During the drought years, many scientific and technical commissions elaborated solutions to deal with the matter. In 1877, Conde D'Eu (Dom Pedro's son-in-law) hosted a series of meetings held at the Polytechnical Institute in Rio de Janeiro focused on the Great Drought. The solution to tackle the problem was rather bold: constructing dams large enough to alter the climate by enhancing humidity and thus making rain. The Engineering Commission found a similar conclusion sent by the central government to Ceará in 1878 and the Dams Commission in 1879. In 1877, the geographer and senator Thomaz Pompeu de Sousa Brasil published a book explaining the idea of making rain:

A construção de açudes em maior escala, sobretudo de grandes represas nas correntes ou ribeiros, que façam alargar maior extensão do terreno por todas as ribeiras [...] dariam à região uma considerável massa líquida, ainda dispersa em pequenas porções.

Ora, esses açudes ou represas seriam outros tantos focos evaporantes e condensadores que, atraindo os vapores pelágicos, contribuiriam para a condensação e chuvas mais regulares e constantes. (Brasil, 1877, p. 60)

That is an emblematic example of the positivist spirit of the time. In the absence of an effective political response to the catastrophe, science and technology assumed an essential role in the minds of decision-makers. They were part of a whole civilization

project endured by the Brazilian elite, materialized in railways, ports, roads, and, from then onwards, dams.

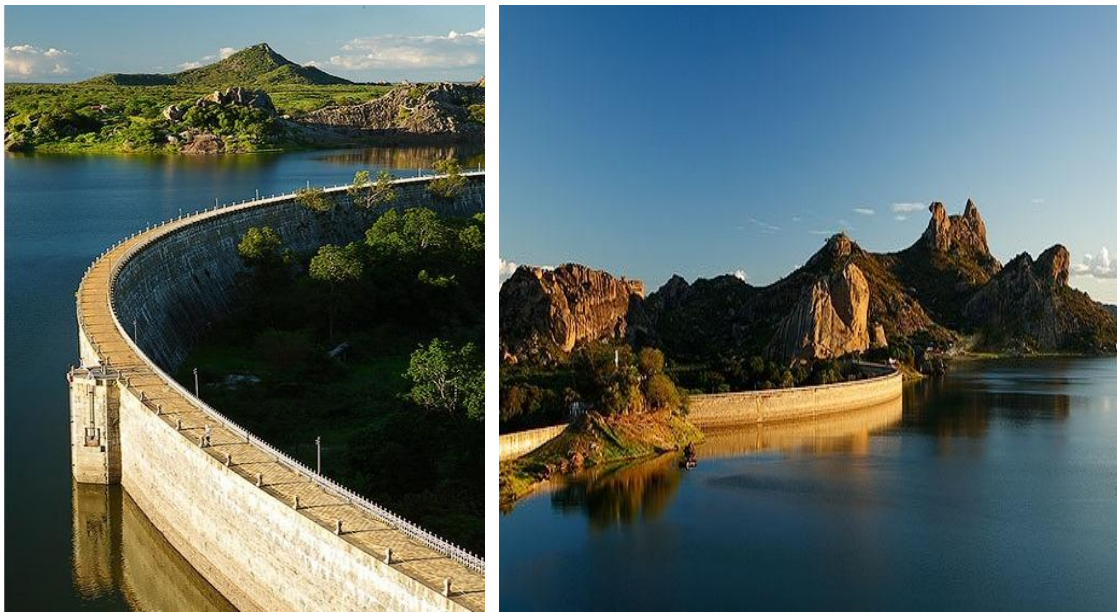
In contrast to what became (pejoratively) known as the “*escola pluvívera*,” or the “rainmakers,” a group headed by Guilherme Capanema, a member of the extinct imperial scientific commission, proposed drought was not a climatic but an attitudinal problem. Like his fellows, Capanema believed in scientific and technological responses to tackle drought. However, he was more concerned with preventive measures, such as grain storage, stock raising, and the establishment of a cattle complex, including dairy and cheese factories and facilities for making dried beef (Capanema, 1878). He was not against the construction of dams. Still, He recognized that this strategy would benefit only one group of the population, such as cattle owners or those who practiced flooded farming or melon-growing – i.e., wealthier landowners that did not live on subsistence agriculture, as most *sertanejos* did.

Meanwhile, Capanema introduced an inventive solution to guarantee water to a more significant portion of the population. Inspired by cowboys’ water storage practices in clay pots, he proposed the construction of small reservoirs for rainwater, with a capacity of 200,000 liters, made of stone and lime, closed by a dome (Capanema, 1878, p. 2). The central government did not move forward with Capanema’s suggestions for the small reservoirs. Nonetheless, Capanema proposed a much more universal and integrated way to tackle drought than the one pursued by the government.

In 1879, Dom Pedro II sent to Ceará the newly created Commission for Dams. They were in charge of identifying the ideal location for constructing the first public dam. Given the proximity to Fortaleza, which would facilitate transporting material and hiring labor, the municipality of Quixadá was elected as the most favorable to receive the dam. The work started in 1844, led by the English engineer Jules Jean Revy. The construction

took 22 years to be completed due to frequent shutdowns over allegations of lack of resources and workforce, especially during the 1888/89 drought. With a capacity of 126 million liters of water, Açude do Cedro was inaugurated in 1906 by President Afonso Pena, when Brazil was already a Republic (see figure 2) (Monteiro, 2020).

Figure 2: Açude do Cedro, Quixadá (CE)



Source: (DNOCS, 2021)

The Great Drought of 1887-80, which culminated in the construction of Açude do Cedro, is a milestone for the establishment of a lasting paradigm of combatting drought. For the first time, a public policy to tackle drought was outlined. The mass *retirantes* migration and the starvation and death among the poorer, combined with a slow and unsatisfactory response from the central government, made it impossible to ignore the irruption of a social crisis. Much influenced by the Brazilian elite mentality at that time, shaped by the ideas of positivism, it relied on technical and scientific measures whilst guided by moral imperatives. In other words, it was a process led by engineers, focused on constructing dams and railroads, financed with public funds, and built with *retirantes*

workforce. The outcome of such choices was the institutionalization of a public policy focused on the specificity of the climate problem, without being able to find viable solutions for those more directly affected by drought.

1.2. Institutional production and reproduction

This policy framework, which I characterize as the paradigm of combatting drought, was institutionalized in 1909 with the creation of IOCS. Then, in 1919, the word “Federal” was added, becoming IFOCS (Federal Inspectorate for Works against Drought). Finally, in 1945, it was renamed Departamento Nacional de Obras Contra a Seca (National Department for Works to Combat Droughts, DNOCS).

Despite the name changing over the years, the agency’s core was consistently anchored in the idea of progress as a development model over its trajectory. The drought crisis was perceived as a climatic problem rather than a social dynamic. For that reason, the situation should be addressed under a scientific lens, using maps, hydrology, geography, engineering, and, naturally, building dams. The intellectual elite was convinced that social progress would come with science, and science meant engineers at the federal government’s service. The Polytechnical Institute, which hosted the most important debates during the Great Drought, long advocated that engineers should replace the hegemonic knowledge of priests and lawyers and create a new category of intellectuals to foster industrialization (Buckley, 2017, p. 86). Indeed, IOCS was much embedded with this ideology, rooted in the positivism of Augusto Comte. This current shaped the First Republic (1889-1930) in Brazil with an appeal to a strong and interventionist executive power that would foster social progress (J. M. de Carvalho, 2017).

The creation of IOCS was an opportunity to plan and execute systematic policies to tackle drought. However, the institute's regulation focused only on technical and physical interventions. Among the services commissioned to the agency, the construction of railroads and roads, dams, irrigation channels, and works to modify rainfall patterns were the first listed. There were also provisions to conduct meteorology and forest conservation studies (*Brasil. Decreto 7619, 1909*). However, no social measures were envisaged, such as aid relief for the drought victims. The lack of such policies became apparent when the Drought of 1915 came, leaving behind 30,000 deaths in Ceará only. By then, IOCS' approach to the victims was to hire *retirantes* at minimal daily wages, often in the form of a credit to obtain food from middlemen (Buckley, 2017, p. 83). This strategy would only reinforce the logic of a drought industry, enriching the wealthier and keeping the poorer stuck in the *sertão*, hence guaranteeing cheap workforce for public works and profit-making activities such as *carnauba* farming and cattle-raising.

IOCS did little to tackle the effects of the 1915's drought. Most of the actions were concentrated on emergency responses to the several droughts that hit the *sertão* in the first three decades of the twentieth century. A 1917 report (referring to 1915) by the Ministério da Viação e Obras Públicas (the ministry under which IOCS sat) lists the services undertaken by the agency to tackle the impacts of drought in the region. The main works focused on hydraulic solutions, with the construction of three dams and 12 more under construction, mainly in the states of Ceará and Rio Grande do Norte.

Interesting, however, is to notice that, in 1915, 21 reservoirs were under construction in private lands (Brasil. Ministério da Viação e Obras Públicas, 1917, p. 204). As a matter of fact, the construction of those reservoirs was subsidized by IOCS with technical assistance for the projects and financial aid to the landowners. That is, for each reservoir built on private land, the landowner was reimbursed for up to 50% of the

total spend. According to Buckley (2017, p. 85), those small reservoirs (some with a water capacity of more than 1 million m³) resulted from a well-succeeded lobby from landowners as an alternative to larger reservoirs surrounded by irrigated channels and small agriculture colonies, as proposed by some engineers. In a zero-sum game, landowners eliminated not only the need to expropriate land in order to build larger reservoirs, but they also guaranteed an increase in the land value and the staying of rural workers in the region.

Some may argue that the institute's lack of funds – about 1% of federal revenue - was to blame for failing to address drought effects and victims. But even during Epitácio Pessoa's mandate (1919-1922), when IOCS's budget increased five times to reach 15% of federal revenue (Buckley, 2017, p. 111), drought works were insufficient to solve the problem. Indeed, Pessoa tried to implement an irrigation policy with land expropriation to avoid what became known as a “dam lottery.” That is, the exponentially overnight increase in the land value many landowners had seen just by the fact that suddenly their land would benefit from irrigation. Despite the numerous commissions created over different governments to study alternatives to tackle drought, IOCS/IFOCS/DNOCS had persistently put dams over irrigation or agricultural projects, disregarding social aspects within the policies.

It was only in the 1950s that the public discourse on drought acquired a social dimension. At the beginning of the twentieth century, the shared mentality among engineers concerned over the drought in the Northeast was mainly focused in technicist solutions, such as railroads and dams. However, IOCS/IFOCS/DNOCS rising advocacy for smallholder irrigation is noticeable, decade after decade, as Buckley (2017) accurately reported. Much of this shift was due to Celso Furtado's ideas.

Celso Furtado (1920-2004) was one of the most influential economists in Latin America for his studies on economic development. He was the director of ECLAC's development division (1947-1959), where he worked close to the Argentinian economist Raúl Prebisch in the formulation of the structuralist approach to the socio-economic reality of Latin America. In 1958 he was appointed as director for the Banco Nacional do Desenvolvimento Econômico (National Bank for Economic Development, BNDE), and was the minister of planning during João Goulart's government (1962-1963). With the military coup in 1964, Furtado had his political rights revoked, and went in exile to the United States and then Europe.

In 1959, Furtado elaborated a diagnosis for the origins of the "Northeast problem" that became known as *Operação Nordeste*. The aim was to expose the Northeast reality to the point that there could be no more excuses to justify the use of public funds to perpetuate the "anachronist and anti-social structures" in the region that, when reaching such a point of economic inequalities, becomes institutionalized (Furtado, 1959, 1989, p. 56).

Furtado believed drought and famine in the Northeast were a symptom of the historical social inequality kept in place and deepened by the Northeastern elites. Many years later, in an interview on the drought of 1998 – the decade's worst event – , asked about the responsibility of the then government of Fernando Henrique Cardoso, Furtado outlined his view on the matter:

O drama que estamos presenciando é o da falta de renda de uma população miserável, que passa a morrer de fome porque depende, para comer, dessa pequena renda que tem. Isso tudo é sabido, conhecido. (Furtado, 1998, p. 17).

This is a simple excerpt, but it contains the fundamental social problem: with no income, there was no food. The structural problems responsible for drought as a social and humanitarian matter can be summarized in three branches. The first is the regional

elites' capture of projects and drought works for their own benefits. It mainly prevented more collective and sustainable practices from taking place through IOCS/IFOCS/DNOCS, such as irrigation channels and smallholder agriculture. The second is the historical “emergency” approach embedded in the institution’s operation. No longer-term projects were foreseen, except for dams. Most actions simply reacted to drought crises, with little effect on the poorer. Finally, the strategy of continually hiring drought victims for public work at low wages not only generated a permanent state of low income but also deprived these people of seeking alternatives in other parts of the country.

Another Great Drought came in 1958, exposing the failure of DNOCS strategies. As a response, in 1959, president Juscelino Kubitchiski (1958 – 1961) launched SUDENE. The scope was “estudar e propor diretrizes para o desenvolvimento do Nordeste” (Lei No 3.692, 1959). The agency was led by Celso Furtado and had DNOCS under its structure. Initially, it was established as an autarchy, providing autonomy and a weightier budget. Then, its operational area was enlarged to what is today the new drought polygon, incorporating parts of Minas Gerais, as well as the nine other states, which were already under DNOCS jurisdiction.

SUDENE had multiple focuses. The strategy was not only combatting the drought, but also promoting industrialization and income generation. In sum, Celso Furtado’s plan for SUDENE was to rearrange the agriculture towards food production, generate jobs through industrialization, and enhance investments in infrastructure – roads, ports and hydraulic works – to facilitate the flow of production. At the end of his mandate, two-thirds of SUDENE’s budget were spent on road construction and power generation. Only 14% of total revenue was allocated to agriculture and food supply (Buckley, 2017, p. 202). Despite a progressive social government and Celso Furtado’s strategy for development through an integrated economic system, old structures for water distribution

persisted. However, it is important to recognize that SUDENE under Furtado's leading act as a conflict intermediary between the federal government and the regional interests, helping the Northeast to consolidate its national role.

In 1964 Brazil suffered a military coup with the deposition of president João Goulart. It was a conservative political and military movement in response to Goulart's nationalist and populist *reformas de base* (core reforms) and to the unprecedented political participation of popular sector. With the coup, SUDENE suffered a setback, losing its legitimacy by incorporating again the old practices the agency tried to end. SUDENE was incorporated into the Interior Ministry, significantly reducing its autonomy. Most appointed directors were linked to landholding families, and the agency underwent structural changes focused on expanding the agro-ranching economy through bank credit and technical infrastructure. As noted by Buckley (2017, p.214), "the years of military rule recapitulated, and perhaps intensified, the pattern that had developed over the drought agency's first half-century." The military dictatorship came with new strategies, such as enhancing rural credit and fiscal stimulus. But it did not "recapitulate" patterns, as there were no meaningful changes over the years, not even under the progressist Celso Furtado's mandate. In the end, SUDENE kept a policy that had historically privileged landowners, just as its antecessors had done.

The military governments (1964-1985) launched numerous projects to develop the Northeast and combat drought, such as Polonordeste, Projeto Sertanejo, and Programa de Irrigação do Nordeste Semi-árido. This time, however, instead of building massive dams, the strategy was centered on irrigated farming. The goal was to bring traditional agriculture into a market economy and grant the region more competitiveness (MININTER/SUDENE, 1985). Polonordeste, launched in 1974 and funded by the World Bank, had more of a social scope than the other two. It provided assistance to smallholder

farmers and landless peasants in a range of activities that went from rural credit and cooperatives to the construction of roads and small reservoirs. But, as Tavares (1989) pointed out, the program's achievements were concentrated on infrastructure. The result was a worsening in social and economic inequalities, as medium and large landowners, who had the opportunity to expand their production with SUDENE's support, benefited the most from the plan. As observed by Buckley, "in the mid-1970s, when the *sertão* population was roughly twelve million, 58 percent of northeastern land area accounted for a mere 8 percent of property holdings." (Buckley, 2017, p. 216). In fact, during this period, no substantial modification to the agrarian structure occurred (J. O. Carvalho, 1988; Oliveira, 1985).

During the same period, it is worth mentioning the creation of the Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba (São Francisco and Parnaíba Valleys Development Company, CODEVASF), in 1974. The company's goal was to promote regional development using water resources for irrigated farming, boosting more profitable crops such as export-oriented, irrigated fruit-growing. The project consisted of land expropriation to implement irrigation perimeters, followed by the parceling of land into batches to be distributed through public calls. In turn, the selected families would be subordinated to specific criteria on the use of the land, such as the type of production, the crop extension and the techniques that should be used. In many cases, the costs to keep up with the requirements led to over indebtedness and further impoverishment of these families.

As shown by Bursztyn (2008) and Diniz (2002), it was an operation characterized by authoritarianism, lack of information, and low payments for the land. Diniz summarized the irrigation perimeters strategy as an exclusionary modernization and a land counter-reform, as more families were expropriated than resettled in the irrigated

areas. Bursztyn noted that, even if the goal of settling approximately 20,000 families by 1980 had been achieved, it would represent only 2,3% of the demographic surplus for the decade of 1970. Moreover, merely 6,6% of the irrigation project was completed by the end of decade (Bursztyn, 2008, p. 84)

Therefore, not only the military dictatorship kept the historical unequal land structure in the *sertão*, but it also promoted a new group in the social and economic Northeastern organization, the “farmers,” subjected to market practices and the financial system. In this period there was a shift in the traditional DNOCS strategies of dams and private reservoirs towards a capitalist market-oriented model of production. The irrigation policy acts in two fronts. One is the enhancing of family farming under DNOCS jurisdiction. The other is the exploration of the São Francisco river valley by large companies for fruit growing and exporting under CODEVASF coordination (Bursztyn, 2008). This system was reinforced over the following decades and is one of the leading regional development strategies until the present.⁸

The Great drought of 1877-1880 was a milestone for implementing a public policy framework for the Brazilian Semi-Arid. This set of strategies started to be implemented during the imperial government. It gained proportion in the early twentieth century by creating formal institutions to combat the drought and its effects. Public action was mainly based on infrastructure strategies, such as constructing roads and railroads, dams, and irrigation channels. However, the institutional approach was slow and inefficient, with very limited results. On the one hand, there was a lack of social policies to reduce the inequalities imposed by drought. On the other hand, the government's measures over

⁸ For a broader understanding on the shift SUDENE suffered with the military coup, see Oliveira, Francisco. *Elegia para uma re(li)gião* (1985). Oliveira worked directly with Celso Furtado at SUDENE. In this book, he presents a criticism on the developmental model that guided the agency, especially after the military coup, and its impacts over the Northeast and the regional division of labor.

the decades only reinforced the benefits of wealthy landowners using public funds. This whole structure represents the paradigm of combatting drought as a strategy for water management in the Northeast.

2. The paradigm of coexistence with drought

In this chapter, I present the paradigm of coexistence with drought. This model surged as an alternative to the historical approach of combatting drought. Instead of controlling and modifying nature, it proposes learning and living with the Semi-Arid climate. The emblematic strategy for this model is the use of family unit cisterns to stock rainwater. It attempts to provide a more steady and democratic distribution of water. In the following pages, I argue that the rising of the paradigm of coexistence is a reaction to the institutionalization of combatting drought policies. It is a response to the political choices characterized by modernization ideals that forged the public institutions which proposed emergency measures to tackle the drought, focused on alleviation and not prevention. In spite of that, the paradigm of coexistence with drought have been losing importance among the public policy framework for the Semi-Arid, making space for the rise of old clientelist practices.

Contrary to a perception widely held in the literature (C. N. D. Castro, 2021a; De Melo Branco et al., 2005; Gnadlinger, 2014; Gomes & Heller, 2016; Soares & Leitão, 2017) I demonstrate that an alternative to the infrastructural approach had been debated since the first policies started being implemented in the nineteenth century with the ideas of Guilherme Capanema. The discussion on other concepts to tackle drought is present over the entire institutionalization history of the paradigm of combatting drought, with more recent engagement of the civil society for more sustainable actions from the 1980s. A milestone for this model was the creation of the *Articulação para o Semi-Árido* (Network of the Semi-Arid, ASA) in the 1990s, a civil society organization which created the program *1 Milhão de Cisternas para o Semi-Árido Brasileiro*. The Federal Government later incorporated this project under President Lula's mandate. Although it has brought positive returns to local societies, the program is losing relevance and has

faced resource cuts in the last years. This dynamic is bringing old clientelist practices back into the water distribution for poorer families.

In the early debates, back in the nineteenth century, important names in Brazilian politics raised alternatives to the paradigm of drought combat that was starting to take shape. As briefly mentioned in the last chapter, Guilherme Capanema was one of them. The former counselor built his advice essentially on tackling drought and its effects by stocking water, fodder, and grains. He firmly refused the strategy of building dams to guarantee water during the dry season, as it would only benefit the few that lived on the dams' banks. Meanwhile, most of the population would remain without access to water. The solution of building cisterns made of lime and stones was the natural one for Capanema. It would provide the *sertanejos* with a steady water supply. Plus, it would be a closer water source, which would offer cleaner water than the usually muddy dams' water. This conception is explained in the Counselor's notes:

Não ha a menor difficuldade de se guardar a agua potavel no Ceará, mas em vez de potes de capacidade de 200 litros, façam os de pedra e cal, fechados com abobada, podendo conter 200.000 litros cada um, e d'ahi para cima. (...)
Preparam-se todos os annos, de Junho a Setembro, em que o povo não pode cuidar de plantação, alguns destes reservatorios proximos aos centros de população do interior. Não tardarão os particulares á imitar o exemplo, e na proxima secca haverá abundancia d'agua para annos. Uma dessas talhas gigantescas, com um pouco de cuidado, enquanto se enche, não é obstruida como o açude; a sua agua nunca se tornará fango saturado de infusorios como a destes. (Capanema, 1878, p. 2)

Capanema had a comprehensive understanding of the problems drought created. He was convinced that great droughts could not be avoided, and their effects could not be modified. At least, not as the “rainmakers” thought they could. Capanema did not believe in the possibility of altering the climate with the construction of huge dams. He considered that the only measure capable of minimizing the impacts of the drought was to store unused resources during prosperous years to be used in times of penury. That is, to stock water in cisterns during the rainy season, stock grains in the years of generous harvests, and use the *capim de roça*, a widespread spontaneous growing weed in the

region, to provide fodder for the cattle. Moreover, he firmly believed that the traditional knowledge of *sertanejos* should be respected, as they understood local natural phenomena with great perspicacity:

Assim, Pescadores, pela temperatura da agua que reconhecem ao tacto, vão ou deixam de ir a pesca, pois conhecem quando é inútil; predizem mudança de tempo, e um disse-me, um dia claro com nordéste rijo, que teríamos aguas ao norte por causa de ténues stratus de nuvens que apareciam no horizonte, o que se verificou no dia seguinte. (Capanema, 1878, p. 21)

The pillars of coexistence are expressed in Capanema's ideas. Coexisting with the Semi-Arid meant to stockpile – primarily water, but also grains and fodder. It was also related to managing the soil and preserving natural resources. The empirical experiences from traditional practices to develop regional strategies, such as flooded farming and using xerophytes to feed the cattle, were fundamental to conceiving solutions. Moreover, there was a need for local and integrated solutions. As Capanema explained in his report, the hydraulic solution should not be condemned. Still, it should be part of a broader system, including dams to promote irrigated farming and cisterns to guarantee access to poorer families.

In the 1940s, the paradigm of coexistence with drought acquired a more socially critical approach with Josué de Castro, a Brazilian physician, and geographer. He is the author of the seminal work *Geografia da Fome* (Geography of Hunger, 1946). The book is recognized by its innovative approach of hunger as a social matter identifying hunger as an endemic problem. His publications and advocacy for food- and water security led to an indication for the Nobel Prize in Medicine in 1954, and two for the Nobel Peace Prize in 1963 and 1970, when he was in exile due to the military dictatorship in Brazil. Josué de Castro's interdisciplinary thought gave a new approach to the problem of drought. It raised the matter of social dynamics in combination with the economic development model. In his view, drought was only one of many aspects to cause

impoverishment in the region. Regarding the living situation of *sertanejos*, he noticed that:

Mesmo que quando chove, sua produtividade é miserável, sua renda é miserável, sua renda é mínima, de maneira que ele está sujeito a viver na miséria relativa ou na miséria absoluta, segundo haja ou não inverno na região do sertão. (J. de Castro, 1959, p. 86)

For Castro, the great inequality that lay over the *sertão* was crystallized in the widespread poverty. The *sertanejo* progressive proletarianization and the poor productivity that did not allow them to have a minimum stock to endure the dry season. This condition only aggravated the structural patterns that kept the *sertanejo* trapped in misery, in a continuous circle of dependency from the state and the inefficient public policies to tackle the effects of the drought and the land and water patterns distribution in the Northeast.

In this period, a critical voice for the paradigm of combatting drought was José Guimarães Duque, an engineer for the former IFOCS, and then DNOCS. His works discussed ecological strategies for farming in the Semi-Arid and focused on technical aspects. He emphasized the limitations of hydraulic solutions to tackle drought and its effects, explaining that:

Muitos erros foram cometidos em nome da aridez generalizada. E entre eles está a adoção da solução hidráulica geral, que não deu os frutos esperados, porque a água não é o fator mais importante no progresso da região. Às vezes, o é, mas, em outro ano, não o é. (Duque, 1964, p. 39)

It is interesting to note how Duque's ideas related to the water problem. His thoughts on development were not limited to water distribution and believed that droughts were overused as an excuse for the slow advances towards a less unequal society. He argued that, for the steady economic growth and development of the *sertão*, it was essential to benefit from natural regional advantages, such as the under-used xerophytes cultivation, in a logic of accommodation to the semi-aridic climate. Moreover, he

advocated for local solutions, rather than generalized models, and for ecological education with popular participation. Many of Duque's proposals would later be identified in the policies for the coexistence with drought.

Finally, Celso Furtado is another central author to understand the paradigm of coexistence with drought. Although he did not achieve deep institutional changes, he foresaw an inclusive development in the Northeast. Furtado was responsible for the creation of Operação Nordeste in 1959, led by the Grupo de Trabalho para o Desenvolvimento do Nordeste (Work Group for the Northeast Development, GTDN). The GTDN report on the 1959 drought provided a fresh look at the Semi-Arid reality, with an action plan to adopt new regional development strategies. Chief among them were the call to rethink and adapt the hydraulic solution to the local reality; investing in irrigation rather than dams; and a rearrangement of the regional economy, with a focus on food production and the expansion of the new agricultural frontier towards the west (Grupo de Trabalho do Desenvolvimento do Nordeste, 1959). This document indicates a movement towards a more resilient development model by recognizing that droughts were a recurrent phenomenon in the *sertão*. Thus, the agrarian structure should be rearranged, reinforcing family farming and increasing food production.

2.1. The reaction to structural patterns

But it was only thirty year later that the first institutional approach on coexistence with the drought would appear. In 1982, the Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Agency, EMBRAPA), presented a proposal to implement new farming systems in the Semi-Arid called *Convivência do Homem com a Seca*. It was one of the first official documents institutionalizing a new model for tackling drought based on coexisting with it. EMBRAPA is a research state company linked to the

Brazilian Ministry of Agriculture, founded in 1973. It has been devoted to applied research to develop solutions and innovations for sustainable agriculture focused on the Brazilian reality. The document stated that EMPBRAPA was offering an alternative to the emergency measures historically adopted in the region, a method that would bring profound implications not only to smallholders, but also to governmental efficiency. The main goal was to

Concorrer para a estabilização e/ou aumento da produtividade, da produção e renda do agricultor beneficiário, de ordem a melhorar suas condições de vida e da sua família, sem agressão ao meio ambiente. (Embrapa Semiárido, 1982, p. 6)

In sum, the agency proposed a new water distribution system for lands of no more than 100 ha., taking into account the desired goals, water sources, and available technology, as shown in table 1. Meanwhile, areas without access to irrigation would benefit from activities more resistant to droughts, such as drought-resistant crops and goat farming. To take advantage of this policy, the farmer would have to meet a series of conditions that would guarantee the social character of the project, such as farming being their main economic activity and living with the family on the benefited land.

The document incorporated the logic of coexistence with drought, proposing more permanent actions with long-lasting results and not only emergency reliefs. The principle was to create an infrastructure for water harvesting and stockpiling for different situations, with due attention to regional and specific conditions. The self-proclaimed “orientação governmental inovadora” (p.1) proposed by EMBRAPA was, thus, small-scale hydraulic works in the land of smallholders or sized to serve a reduced group of farmers, as exposed in table 1.

The drought of 1990-1993 was a milestone for the paradigm of coexistence with drought. It was considered the worst drought to affect the Semi-Arid in the twentieth century. The social impact was devastating. There were reports on families that were

eating *mandacaru* and *palma*⁹ to survive. In some regions, being admitted to the hospital was the only way to get food and water (Almeida, 1993).

Table 1: Water harvesting, source, and technology

Destination	Water source/Technology
Human consumption	Cistern and water well
Animal consumption	Waterhole, water well, small reservoir
Vegetal consumption	Dry farming: <i>In situ</i> water harvesting
	Flooded farming: Riverbed, temporary reservoir
	Irrigated farming: Water well, dam, reservoir, river

Source: Embrapa Semiárido, 1982.

The tolling effects of this drought led to the occupation of SUDENE in March 1993. The occupiers comprised the Confederação Nacional dos Trabalhadores na Agricultura (National Confederation of Workers in Agriculture, CONTAG), other civil society organizations, and members of the National Conference of Brazilian Bishops such as Dom Helder Camara, and other public figures. It was a reaction to the federal government's negligence. But it was also an appeal to public opinion, an attempt to bring the suffering of the *sertanejos* to light. Until this point, civil society's role in shaping public policies for water management in the Northeast had been small. But with the movement for democratization in Brazil in the 1980s, after two long decades of military dictatorship, Brazilian society was eager to participate more actively in defining national political directions.

⁹ Two types of xerophytes that serve as food for cattle.

The occupation outcome was positive, as the movement negotiated with the government an action plan for the Semi-Arid with permanent measures to be elaborated by civil society. The document was then created at the Fórum Nordeste in May 1993, coordinated by members of CONTAG, pastoral commissions, farmers' associations, and NGOs with more than 150 representations (Jalfim, 2011). The document, entitled *Ações Permanentes para o Desenvolvimento do Nordeste Semi-Árido Brasileiro: propostas da sociedade civil*, presented strategies to improve the life of smallholder farmers, to eradicate hunger and poverty, and to promote the decentralization of hydraulic resources. It stated that coexistence with the semi-arid was possible as long as adequate agrarian policies, technics, and public management were secured (Fórum Nordeste, 1993).

The document was submitted to the federal government at the end of the conference. It is difficult to assess whether it has had any direct impact on future projects, but the fact is that in 1994 the program *ÁRIDAS: Uma estratégia de desenvolvimento sustentável para o Nordeste* was launched. The program had the goal achieve sustainable development in the Brazilian Northeast. It presented an innovative character by incorporating many of the goals that later would become the SDGs, such as the right to water access. It also contemplated climatic changes concerns, highlighting the rise in the global temperature. The project proposed a long-term perspective, decentralized actions, and the participation of civil society. The strategies proposed to develop the region looked very similar to those proposed in 1959 by the GTDN to rearrange the Semi-Arid space and economy. The document stated that:

A questão do desenvolvimento do Semi-Árido da Região Nordeste passa, necessariamente, pela apreciação dos usos dos recursos naturais, da intensidade das pressões exercidas sobre os mesmos e, sobretudo, das causas da referida insustentabilidade. (Brasil, 1994, p. 1)

The document pointed out that the main obstacles to achieving a sustainable economy in the region were the traditional agricultural practices, irrigated farming, and mining. It concluded that the primary degradation vector was subsistence agriculture due to the lack of smallholders' technical knowledge. It recognized climatic restrictions and the poor trade system as elements for the regional production depreciation. Regarding mining and irrigated farming, the document suggested those practices could reduce their impacts with better quality techniques. However, irrigated farming was pointed out as a beneficial technique and a solution to overcome climatic constraints if applied with proper methodologies (Brasil, 1994, p. 80).

In short, the report offered a general diagnosis for the region's underdevelopment but did not bring substantial or innovative solutions. Just like the GTDN report, this one focused on strategies to provide jobs and income through industrialization and agriculture modernization in conjunction with the displacement of landless and poorer peasants to the western frontier. Although the document title carried the concept of sustainable development, in the end, it reproduces old logics that were insufficient to tackle drought effects and persistent regional inequalities.

Another outcome of the SUDENE occupation, and with a much more significant impact, was the creation of Articulação Semiárido Brasileiro (Brazilian Semi-Arid Coordination, ASA) in 1999, formed by 61 organizations. During the United Nations Conference of Parties, COP3, in Pernambuco, ASA launched the Declaração do Semi-Árido, a document with propositions for the coexistence with drought and combat desertification, urging for an adequate policy framework for the region. Breaking with the dominant vision up to that point, which focused on hydraulic solutions, ASA proposed that living in the Semi-Arid was possible without huge hydraulic works. Instead, living with drought would be possible with democratic water distribution, technical assistance,

and credit. They sought a more comprehensive policy framework that did not put on hydraulic works the sole responsibility for the region's development:

Sabemos agora que não há como simplificar, reduzindo as respostas a chavões como “irrigação”, “açudagem” ou “adutoras”. Além do mais, os megaprojetos de transposição de bacias, em particular a do São Francisco, são soluções de altíssimo risco ambiental e social. Vale lembrar que este ano, em Petrolina, durante a Nona Conferência Internacional de Sistemas de Captação de Água de Chuva, especialistas do mundo inteiro concluíram, na base da sua experiência internacional, que a captação da água de chuva no Semi-Árido Brasileiro seria uma fonte hídrica suficiente para as necessidades produtivas e sociais da região. (ASA Brasil, 1999, p. 3)

For ASA, the Semi-Arid was a complex space with different needs. While lack of water was a particular problem inherent to the region, the organization brought to the public debate the notion of universal. In other words, ASA addressed the problem of the Semi-Arid as a more complex and diversified than lack of water exclusively. Moreover, they looked for extrapolating the idea of the poor *sertanejo* as the only affected by the disparities in the region by proposing a that inequality was formed by a myriad of social identities:

Encontraremos, ainda, agricultores familiares que plantam no sequeiro, colonos e grandes empresas de agricultura irrigada, famílias sem terra, famílias assentadas, muita gente com pouca terra, pouca gente com muita terra, assalariados, parceiros, meeiros, extrativistas, comunidades indígenas, remanescentes de quilombos, comerciantes, funcionários públicos, professores, agentes de saúde... (ASA Brasil, 1999, p. 4)

Moreover, they criticized solutions based on the displacement of *sertanejos*, as they would only worsen an already existing problem of disordered urbanization in medium-sized cities. Emergency measures such as water tank trucks and food parcels were still necessary, but they should not be seen as a development policy, given that they would keep the families ever more dependent on anti-economical strategies. To have an idea, the budget for combatting the drought effects of 1998 was 2 billion Reais. If the all the affected families had received one cistern, the public expenditure would be of around

500 million Reais, a quarter of what was spent in mitigating drought effects. Most of this was spent on hiring *sertanejos* for emergency drought works at very low wages, following the centuries-old practice, and to pay for food parcels (ASA Brasil, 1999).

One of the solutions presented in this document that became the symbol for the paradigm of coexistence with drought was to equip low-income families with concrete cisterns. The document showed that with one-fourth of the emergency budget for the drought of 1998, it would be possible to guarantee drinking water for more than 6 million people (ASA Brasil, 1999, p. 8). Therefore, in 2000, ASA launched the program 1 Million Cisterns (P1MC).

The scope was to decentralize and democratize water access for peasant families in the rural area of *sertão*. Instead of the huge dams that benefited a few landowners, the 16.000 liters cisterns would supply families of up four members with rainwater during the dry season (see figure 1). The criteria for selecting participants were also an innovation: the family should live in a rural area, not have access to piped water and fit in the condition of extreme poverty. Female-headed families with children under six years old would have priority. Described as a project from the society to the society, it presented a methodology that embraced active community participation. First, members of the benefited families should attend educational activities on managing hydric resources, citizenship, and coexistence with the Semi-Arid. Second, they should participate in the cistern's construction (ASA Brasil, n.d.). This strategy was a pioneer by proposing people's participation in public policies, which overcame the structure of the traditional institutions until then. In this sense, we can observe that the benefited families were also meant to be active actors in the project's implementation.

Figure 3: Concrete Cistern of 16,000 liters



Source: (MDR, 2013a)

In 2003, during President Lula's first mandate (2003-2006), the P1MC was institutionalized under the then newly created Ministério Extraordinário de Segurança Alimentar (Special Ministry of Food Security, MESA), funded by resources from the Fome Zero program.¹⁰ It is especially symbolic that P1MC had gained such a central role with Lula's election. The president raised the fight against hunger to one of the most important actions of his government. In Lula's inaugural speech in 2003, he stated that priority clearly:

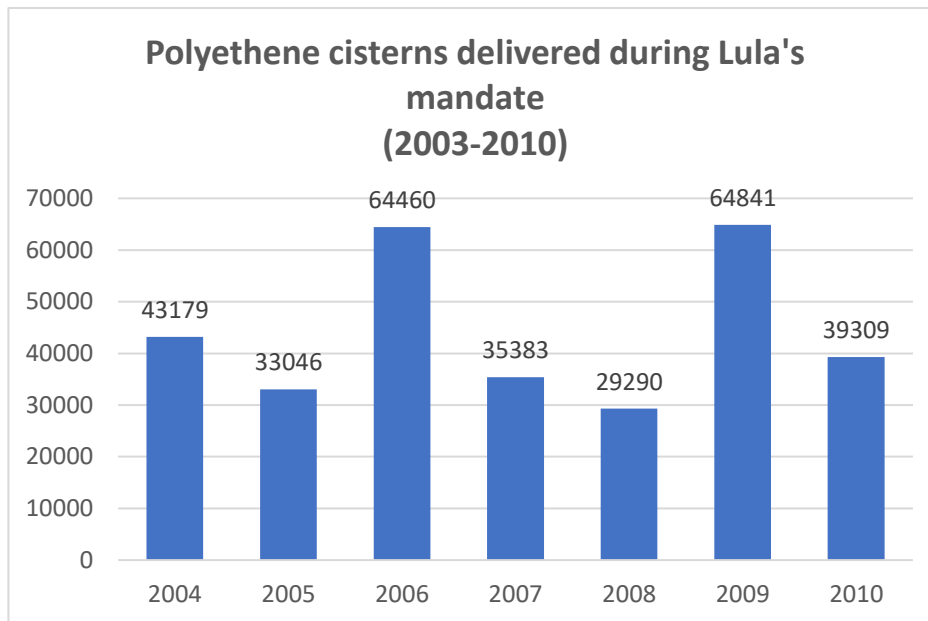
Por isso, defini entre as prioridades de meu Governo um programa de segurança alimentar que leva o nome de Fome Zero. Como disse em meu primeiro pronunciamento após a eleição, se, ao final do meu mandato, todos os brasileiros tiverem a possibilidade de tomar café da manhã, almoçar e jantar, terei cumprido a missão da minha vida. É por isso que hoje conclamo: vamos acabar com a fome em nosso país. Transformemos o fim da fome em uma grande causa nacional, como foram no passado a criação da Petrobrás e a memorável luta pela redemocratização do país. Essa é uma causa que pode e deve ser de todos, sem distinção de classe, partido, ideologia. (Lula da Silva, 2003)

¹⁰ In 2004, P1MC became part of the Ministério para o Desenvolvimento Social e Combate à Fome (Ministry for Social Development and Action Against Hunger, MDS)

Lula's commitment to tackling poverty and hunger opened the doors for innovative projects that, until then, had been out of the institutionalized public sphere. In this vein, the partnership contract between ASA and MESA gave a greater dimension to the small-scale project ASA had already been implementing since 2000. Not only were ASA's strategies incorporated into the government's actions, but the association would play a key role in developing further dimensions of the program, including the formalization of a work plan with purposes, goals, results, and performance indicators. ASA would receive and manage the funds according to the original program's criteria, which were incorporated in full by MESA (ASA, 2011a). That way, the project would still have the civil society as its leading actor, thus safeguarding its autonomy from old political and clientelist practices. As Andrade e Cordeiro (2016) noted, the idea of a successful experience in an initiative articulated by civil society and public power was historically almost inconceivable in the Semi-Arid. Local *mandonismo*¹¹ and the entrenched paradigm of combatting drought were a persistent obstacle to implementing synergistic actions. As shown in Chart 1, during Lula's two mandates – between 2004 and 2010 – more than 300,000 cisterns were provided for families in the Semi-Arid (Brasil, n.d.).

Chart 1: Number of cisterns delivered during Lula's mandates

¹¹ '*Mandonismo local*' refers to oligarchic and personalized power structures. In the Northeast, it is usually the arbitrary exercise of power over people at a local scale due to the ownership of land and resources (J. M. de Carvalho, 1997).



Source: Prepared by the author based on data from the Ministério da Cidadania for family cisterns units (Brasil, n.d.)

2.2. Counterreaction and the resolution of the conflict

In 2010, a new chapter was opened with Dilma Rousseff winning the presidential election. She was Lula's chosen successor, also from the Workers' Party (Partido dos Trabalhadores, PT). Much of Dilma's narrative when she assumed her mandate also felt on promoting social equity, just like its predecessor. However, she begins her mandate with austerity measures and heavy stimulus for infrastructure works. In 2011, Dilma launched an ambitious social program, Brasil sem Miséria (Brazil without extreme poverty), meant to eradicate extreme poverty by 2014. One of this program's branches was the project Água para Todos (Water for All), with the scope of guaranteeing universal access to water in the rural areas of the Semi-Arid. In 2013, it was regulated by Decree 8,038 and started to be called Programa Cisternas. The program did not differ from the previous P1MC in that it also relied on the distribution of cisterns. The goal was to assist 750,000 families with precarious or no access to water in the Semi-Arid by 2014 (MDR,

2011). To do so, it would be necessary to double the number of cisterns distributed during Lula's mandates.

To meet this higher and faster target, a questionable decision was made: instead of concrete cisterns, the program would distribute polyethylene ones. The Ministério do Desenvolvimento Regional (Ministry of Regional Development, MDR) justified this decision by arguing that polyethylene cisterns were faster to install, had high durability, and had better performance:

Além de conservar melhor a água, as cisternas de polietileno possuem qualidade e durabilidade comprovadas por seu uso no Brasil e em outros países com regiões de clima desértico, como Austrália, México, China, Peru e Índia. Nessas localidades, o tempo de vida útil das cisternas foi calculado em mais de 35 anos (MDR, 2013b).

This strategy presented numerous backdrops. First, the use of polyethylene cisterns was not supported by ASA. They immediately launched the campaign "Cisterna de Plástico/PVC - Somos Contra!" (ASA, n.d.) to warn the people and state governments about the disadvantages of polyethylene cisterns. ASA understood that this technology would jeopardize the entire logic of coexistence with drought:

Parece-nos, no entanto, estranho e inaceitável que, neste contexto, as cisternas de plástico/PVC surjam como alternativa para o semiárido, uma vez que excluem a população local, não permitindo a sua participação no processo de reaplicação da técnica, criando dependência das empresas. Efetivamente, o sucesso da ação da ASA através do Programa Um Milhão de Cisternas está na participação das famílias como protagonistas de sua história. No fazer e ser parte do processo. (ASA, 2011b)

Their main argument was that polyethylene cisterns would reinforce the paradigm of combatting drought. In ASA view, this was a logic of resource concentration, not a strategy adapted to the region, neither to promote the ongoing educational and mobilization actions for living with the Semi-Arid. The concrete cisterns had active and intense participation of the beneficiary, as the families took part in the construction (see figure 4). In addition, the technology of concrete cisterns reinforced the local economy as all the construction materials were acquired in local shops. ASA estimated that, for

every 10,000 concrete cisterns built, more than 20 million reais were injected into the local markets by acquiring material, services, and taxes (ASA, 2011b).

Figure 4. Community building a concrete cistern



Source: (MDR, 2013a)

Meanwhile, polyethylene cisterns arrived ready to install, in a process completely centralized in the contracted company. As such, public resources were concentrated in the hands of a few corporations – which were, as a rule, based outside the region. Moreover, the argument of faster installation and high durability was not verified in practice. For example, installing a polyethylene cistern should only take three hours. However, there are numerous reports of families who had to wait several months between digging the ditch to fit the cisterns and setting them up (Nogueira, 2015). Furthermore, after being installed, many polyethylene cisterns have collapsed and bent after a few months of use because of heavy rains, extreme heat, and direct sun exposure (see figures 5 and 6).

Figure 5: Collapsed polyethylene cisterna



Source: (AS-PTA, 2013)

Figure 6: Bent polyethylene cistern



Source: (UOL, 2012)

Another questionable topic is the cost of a single polyethylene cistern. In 2013, a concrete cistern had an estimated cost of 3,000 reais on average. In the same year, a polyethylene one cost on average 6,000 reais. The coordinator of Projeto Caritás, one of the civil society associations that form ASA, noted that:

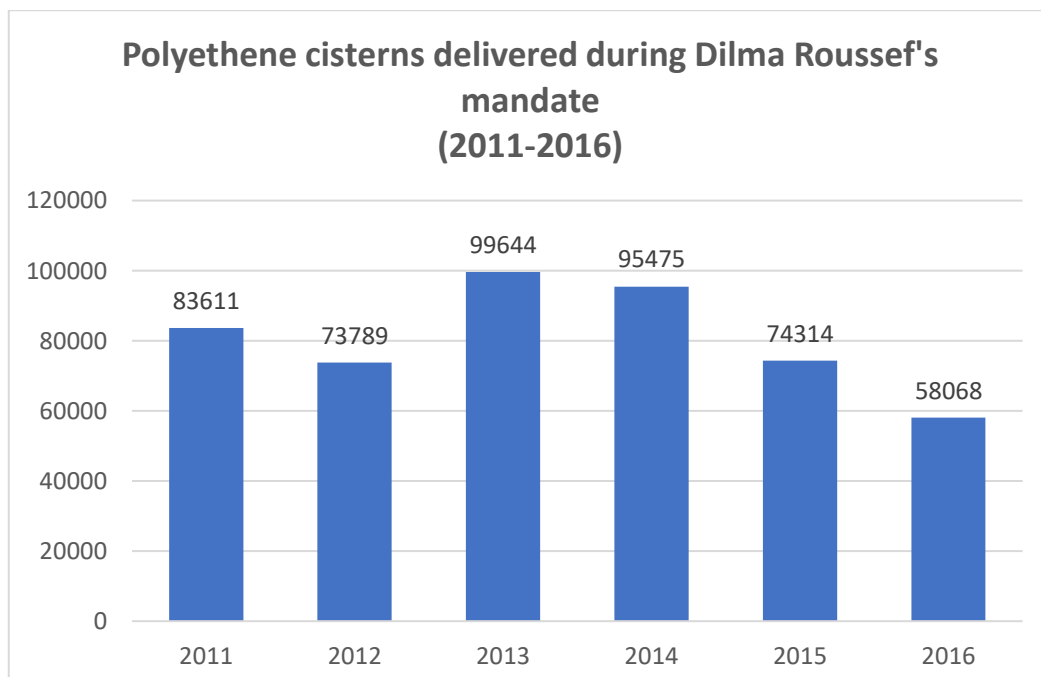
Com R\$ 2,5 mil, a gente consegue construir a cisterna de placas com o processo de formação junto. Já a cisterna de polietileno custa cerca de R\$ 6 mil, além do custo do transporte para levá-las às comunidades, e não gera renda local. Uma empresa é contratada, chega e instala. Não tem o processo de formação, mas sim de entrega. Isso quebra toda a lógica de mobilização social que a gente tem feito nos últimos anos. Volta toda aquela história da indústria da seca. (Nogueira, 2015)

The increase in the cistern cost significantly impacted the program's budget, but it did not achieve better results, at least in the same plane of the expected result of guaranteeing water access. On the contrary, the acquisition of large batches of cisterns from a few companies only concentrated even more public resources distributions. However, it becomes evident that the number of cisterns delivered during Dilma's mandate was considerably high, reaching a total of 484,901 (see chart 2). what connects the different elements of ASA's position is, in the framework of this dissertation, the

perception that polyethylene cisterns represented a fallback to the paradigm of combatting drought

Compared to Lula's period, Dilma distributed cisterns to families in the Semi-Arid at double the yearly rate, leading to an overall average of 80,000 per year. Nonetheless, the goal of installing 750,000 cisterns was not achieved. The Controladoria Geral da União (Office of the Comptroller General, CGU), an entity responsible for supervision and control over public accounts, identified irregularities in bidding processes, evidence of overbilling payments, and faulty cisterns (CGU, 2014). The inspection verified that 87,3% of the beneficiary had their cisterns installed and loaded. Despite the infringement of some eligibility criteria, CGU concluded that the program reached its goal of water supply, successfully meeting its target public.

Chart 2. Cisterns delivered during Dilma's mandate

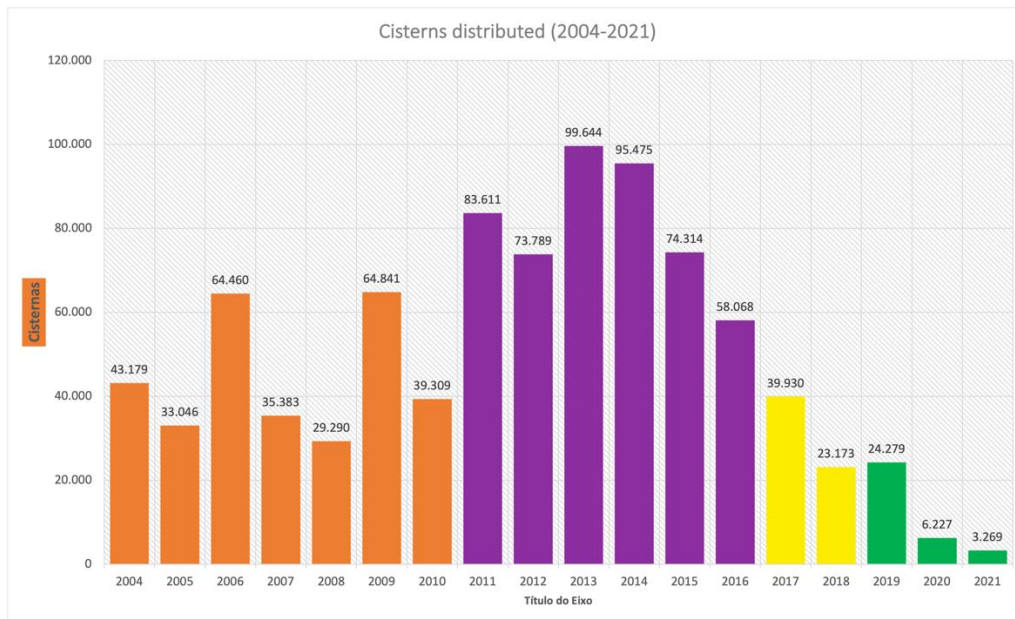


Source: Prepared by the author based on data from the Ministério da Cidadania for family cisterns units. (Brasil, n.d.)

In 2020, with the election of Jair Bolsonaro, the program suffered another backdrop with severe budget cuts. As a result, the number of distributed cisterns decreased to an annual average of 10,000 cisterns (see chart 3). Accusations over corruption schemes evolving cisterns distribution were widespread. The claims were that, without the government funds, politicians were using Parliament's amendments to buy hundreds of cisterns to be distributed to their voting fidders in exchange for political support (Carta Capital, 2021; Folha de São Paulo, 2021a, 2021b). In an article, the newspaper Folha de São Paulo reported on this strategy's *modus operandis* last year. From discrimination on the distribution to accumulation of cisterns in the same Family, the industry of drought was back in the Semi-Arid:

Moradores relatam discriminação política na distribuição dos reservatórios pela prefeitura. Segundo eles, aqueles que nas eleições a vereador de 2020 declararam apoio à campanha do atual secretário de Agricultura do município, Gilberto de Sá Melo, foram contemplados com as cisternas. Há casos, inclusive, de pessoas que receberam uma segunda cisterna de polietileno, apesar de já possuírem os reservatórios de alvenaria, em razão de terem feito campanha pela candidatura de Gilberto, dizem os sertanejos.

Chart 3. Comparison between Lula's and Dilma's cistern distribution



Source: Prepared by the author based on data from the Ministério da Cidadania for family cisterns units (Brasil, n.d.)

When looking back at the trajectory of the program Água para Todos, it becomes clear that a conflict was raised between the two paradigms for water management in the Semi-Arid. However, the choice for polyethylene cisterns in Dilma's mandate, followed by the program's dismantling in Bolsonaro's government, reinforced the practices of combatting drought instead of coexisting with it. Coexistence with the drought is not only about stocking water. It is also about implementing new social mobilization practices and enhancing civil society's role. The original form of P1MC was elaborated on a local self-reinforcement logic. That is, the beneficiaries would actively participate in the cistern's construction while the public funds would be spent within the community, which dominated the technology. The current face of Programa Cisternas shows an entirely different side of this practice, summed in the concept of accumulation instead of democratization. This case explicit the mechanisms of institutional self-reinforcement of a hegemonic strategy and the resistance to reverse or to change initial choices.

Conclusion

This dissertation explored the two different paradigms for water distribution in the Brazilian Semi-Arid, looking at singular crucial moments from the Great Drought of 1877 to present days. Each of the two paradigms is the lens that frames the reality in particular ways and proposes different solutions for tackling the drought effects. It was possible to identify connections and different conceptions for regional development within the two models and throughout the distinctive studied periods.

As shown in this study, the paradigm of combatting drought is essentially anchored in old practices. It represents a fragmented and technicist conception of development. The idea of controlling nature is part of the modernization ideology that molded this paradigm's trajectory. This anthropocentric aspect is encompassed in the current economic model based on exploiting natural resources but also the most vulnerable. In this sense, the cause for the "Northeast problem" is the drought, not the social inequalities perpetuated by discriminatory public policies. The poverty in the Semi-Arid can, thus, be explained by the climate, concealing the structural factors responsible for it: land and water concentration and the absence of public power. It generates a regional dynamic of worker exploitation, the exhaustion of natural resources, and the reinforcement of excluding market-oriented practices.

In contrast, the coexistence with drought is based on a holist view, putting the human action in conciliation with nature. Even in its initial sparkles, in the nineteenth century, this alternative was already presented, considering the complex and rich relationship between nature and the local realities and practices. More recently, this paradigm acquired a broader notion of sustainable development. It means that a comprehensive public policy for water distribution must take into consideration human development. Although its most significant feature are the cisterns, this paradigm is

looking at solutions able to modify production and consumption patterns and use natural resources best fitted to current needs in the face of climate changes and global economic crises.

The use of the path-dependence framework to conduct this study outlined how development trajectories are social constructions and not a sequence of spontaneous and interconnected events. The drought of 1877 represented the critical juncture that determined the future public policy for tackling the drought in the Brazilian Semi-Arid. Contrary to what is broadly diffused in the literature, different views were under dispute on what should be the best approach. The decision to undertake hydraulic works and emergence measures, acting more in a logic of contention than prevention, was a choice.

This choice led to the formation of institutions that have self-reinforcement attributes. According to Mahoney, the key actors' choices in critical junctures “set in motion more deterministic causal processes that drive processes of political development” (2001, p.112). In the case presented here, the institution can be understood both as DNOCS (and its variants) and the paradigm itself. In this framework, once the processes have been established, reversal costs are very high. Pierson (2011) noted that “there will be other choice points, but the entrenchments of certain institutional arrangements obstruct an easy reversal of the initial choice” (p.20). The author calls this “inertia.” That is, if at the early stages of institutional reproduction, small events can play a role in changing the course of the development path, at later stages, large events will not have great consequences due to the acquired equilibrium and the capacity to resist changes.

The attempt to institutionalize a policy for coexistence with drought in the last decades is an example of the effects of this resistance mechanism. With the democratization process after the military dictatorship in Brazil, the organized civil

society gained a voice to react to structural power patterns that could no longer answer the demands of the society. The P1MC and Programa Cisternas short flight showed that it is possible to create different realities, where not only alternatives can emerge but also can coexist with other solutions.

Assuming that the patterns of water distribution are not merely material practices, but also political and social actions, identifying and contrasting the power relations and social dynamics related to these two diverse distribution models is essential to understanding the conflicts, disputes, and outcomes that arise from this relationship.

In this sense, there are three pairs of analytical categories identified in that analysis to explain the paradigms. The first is the management of the water, which can be **centralized** or **decentralized**. For example, in the paradigm of combatting drought, the choice for hydraulic works resulted in water accumulation in large dams. It required vast sums of public funds and many years to build this type of construction. As a result, the water distribution is concentrated and targeted to landowners. This analytical set cannot be dissociated from the second pair of analyses, the **accumulation/stock** category.

More recently, the development of irrigated farming requires more intensively this resource. Water is redirected to fruit-growing farms, concentrated in private companies in the São Francisco River valley. They cultivate melon and watermelon, crops with high water demand, benefitted from irrigated farming with intense use of pesticides. An emblematic example is Agrícola Formosa, the largest fruit export company in the region. They count with 21 deep wells (400m to 800m) and 582 wells with less than 400 meters deep (Agrícola Formosa, n.d.). These wells are supplied with water from dams and the São Francisco River that reach the property through water pipelines.

In contrast, the paradigm of coexistence with drought is based on water stocking in cisterns. The water distribution is decentralized and directed toward the widespread

sertanejo's communities without access to drinking water. The containers are built next to the family house, facilitating access to water. The 16,000 liters cisterns capture the rainwater from gutters installed on the house's roof. This technology allows a family of five members to have water for up to eight months. Compared to melon growing, which requires up to four million liters per hectare, it is possible to have the dimension of the inequalities in water distribution in the Semi-Arid.

The third pair is **public power/civil society**, embedded in the socio-political dimension of water distribution. In the paradigm of combatting drought, the processes are controlled by a few governmental actors, the private sector, and elite members. During the institutionalization of this paradigm, democratic citizen participation in patterns for water distribution is not observed. It is noticeable that landowners and farming companies' lobby provided guidance to public policies in the Semi-Arid, securing benefits for the agribusiness. On the other hand, water distribution under the paradigm of coexistence entails a shared operation between public power and civil society. The public policies that arise from this paradigm tend to have a commitment to the environment while seeking sustainable alternatives to enhance the quality of life of the *sertanejos*. The PIMC is a successful example of the application of coexistence beliefs. Not only is the program decentralized, but it is flexible, incorporating several organizations in different locations, which guarantees its adaptative characteristic. Although the program had failed to solve the challenges of unequal water distribution due to its limitations, its contributions are undeniably toward a better quality of life for the *sertanejos* and the decentralization of water access.

This dissertation demonstrates that different water distribution models create different social, political, and economic realities. They generate power and distribute land and wealth but also produce structural inequalities. Moreover, these two paradigms are

connected to different development conceptions for the Semi-Arid. Thus, the two paradigms presented here are also objects of dispute in many spheres, as they can reinforce or unleash old practices.

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