

THE BRAZILIAN SEMI-ARID REGION AND MIGRATION PROCESSES

**The historical transformation
of the relationship between climate
variability and population mobility
in Brazil (1877–2022): the role
of territorial development**





This paper is part of ASA's contribution to international debates on land restoration, climate adaptation and human mobility in drylands. It presents the Brazilian experience of Living with the Semi-Arid as a territorial development strategy for strengthening resilience to climate variability.

SUMÁRIO

1. Introduction.....	7
2. Theoretical framework: the evolution of interpretations of drought, development and population mobility	12
2.1 The construction of the sertão as a national problem	14
2.2 The political economy of hunger	15
2.3 The political economy of regional development	17
2.4. Critical geography: territory, circulation and population mobility..	19
2.5 The sociology of migration: labour markets, social networks and family strategies	20
2.6 Environmental migration: vulnerability and adaptive capacities	22
2.7 Coexistence with the semi-arid: adaptive capacities and remaining in the territory	24
2.8 Synthesis of the theoretical framework and analytical model	28
3. Methodology	31
3.1 Study design	32
3.2 Sources and methodological strategy	33
3.3 Time frame	34
3.4 Analytical categories	34
3.5 Analytical Model	35
4. Results and discussion	37
4.1 Population mobility and territorial formation before the great droughts	38
4.2 The great drought of 1877-1879 and the opening of the amazonian frontier	42
4.3 The droughts of 1915 and 1932: the institutionalization of drought policy and the management of monility	45
4.4 The second world war, the rubber army and state mobilization of the labour force (1942-1945)	47
4.5 Industrialization, urbanization and the consolidation of the northeast-southeast migratory axis (1930-1980)	49
4.6 Brasília and the expansion of the agricultural frontier: new destinations of mobility (1956-2000)	51
4.7 Adaptive capacities, public policy and the transformation of	

mobility in the semi-arid (1990-2022)	54
4.8 Census evidence of the transformation of brazilian population mobility (1940-2022)	56
4.9 Interpretative synthesis of the historical trajectory	59
5. Discussion: the historical transformation of the influence of climate variability	61
5.1 Mobility as component of brazilian territorial formation	63
5.2 The historical dimension of the relationship between climate variability and mobility	65
5.3 Territorial development, adaptive capacities and state mediation ...	67
5.4 Contributions of the brazilian case to international debates on climate, development and mobility	70
6. Conclusions	73
7. References	77

Antonio Gomes Barbosa is a sociologist and coordinator of coexistence-with-the-Semi-Arid initiatives at the One Million Cisterns Programme Association (AP1MC), the executive body of the Brazilian Semi-Arid Articulation (ASA). His research addresses territorial development in semi-arid regions, with emphasis on coexistence with the Semi-Arid, public policy, climate adaptation, and the relationship between climate variability and population mobility.

ABSTRACT

Internal migration played a decisive role in the territorial formation of Brazil, yet the influence of climate variability on population mobility has changed profoundly over the course of the country's history. Although contemporary scholarship recognizes that human mobility arises from the interaction of environmental, economic, social and institutional factors, it remains poorly understood how different regimes of territorial development have historically transformed that relationship, redefining the social effects of drought over time. This article examines how successive national development projects, articulated with state action and the building of adaptive capacities, historically mediated the relationship between climate variability and population mobility in Brazil between the Great Drought of 1877–1879 and the Population Census of 2022. The study adopts a qualitative, historical-interpretive approach grounded in an interdisciplinary literature review, a reconstruction of Brazil's principal economic cycles, an analysis of territorial development policies, and an interpretation of the historical series of the Population Censuses of the Brazilian Institute of Geography and Statistics (IBGE). The findings show that droughts

intensified social vulnerabilities throughout the entire period analysed, but their conversion into forced migration, into staying put, or into other forms of mobility depended on the ways in which the State, labour markets and successive regimes of territorial development reorganized economic opportunities, institutional capacities and the conditions for adaptation. As a result, drought episodes of comparable intensity produced profoundly different patterns of mobility, culminating in the drought of 2012–2017 which, despite its high severity, did not trigger forced displacement on a scale comparable to that observed at earlier historical moments. The article's principal contribution is to demonstrate that the influence of climate variability on population mobility does not remain constant over time but is historically reconfigured by regimes of territorial development, by state action and by the building of adaptive capacities. On this basis, it proposes a historical-institutional model integrating the political economy of development, critical geography, the sociology of migration and climate adaptation studies, thereby broadening the dialogue between the Brazilian experience and international debates on human mobility in contexts of climate change.

keywords: Climate variability; population mobility; territorial development; adaptive capacities; territorial formation; political economy of development; Brazil.

1

INTRODUCTION

Few processes have contributed as much to the territorial formation of Brazil as internal migration. Since the colonial period, successive economic cycles have continuously redistributed the population, redefining productive frontiers, consolidating new urban centralities and integrating different regions into national development projects. The expansion of mining in the eighteenth century, the rubber cycles, industrialization concentrated in the Southeast, the construction of Brasília and the occupation of the agricultural frontier were decisive moments in this territorial reorganization, bringing together economic transformation, state action and the circulation of the labour force.

Within this process, the historical experience of the Brazilian Semi-Arid region occupies a singular position. The recurrence of drought turned the region into one of the principal symbols of national inequality, consolidating an image of migration as an almost inevitable response to climate crises. Literature and social essay writing, represented by authors such as Euclides da Cunha, Rachel de Queiroz and Graciliano Ramos, contributed decisively to constructing this representation. Later, Josué de Castro shifted the debate towards political economy by demonstrating that hunger, poverty and migration resulted less from drought itself than from historically unequal forms of organizing production, land tenure and access to resources. This interpretation was deepened by Celso Furtado, Francisco de Oliveira and Milton Santos, consolidating an analytical tradition that links mobility, development and the production of territory.

In recent decades, studies of environmental migration have substantially broadened this debate by showing that human mobility cannot be explained by climate factors in isolation but results from the interaction of environmental, economic, social,

political and institutional processes (Black et al., 2011; Piguet, 2010; McLeman, 2014; IPCC, 2022). As a consequence, deterministic interpretations that automatically associated drought with migration have progressively been replaced by approaches emphasizing vulnerability, adaptive capacities, social networks, labour markets and state action as constitutive elements of migratory processes.

Despite these advances, an important gap remains in the literature. Most studies concentrate on identifying the factors that condition mobility in specific contexts, devoting less attention to the way those factors are historically reorganized. Analyses capable of explaining how different regimes of territorial development have modified, over time, the mechanisms by which climate variability is converted into forced migration, into staying put, or into other forms of mobility are still scarce. This gap limits our understanding of the relationships between climate, development and mobility from a long-run perspective.

The Brazilian experience offers a privileged field for addressing this question. Between the end of the nineteenth century and the first decades of the twenty-first, droughts of comparable intensity produced profoundly different patterns of mobility. The Great Drought of 1877–1879 coincided with the expansion of the rubber economy and directed substantial population contingents towards the Amazon; the drought of 1942 was articulated with the recruitment of the Rubber Soldiers during the Second World War; the droughts of the 1950s to the 1980s occurred in a context of industrialization, the construction of Brasília and the expansion of the agricultural frontier; by contrast, the drought of 2012–2017, one of the most severe in recent history, did not trigger population displacement of comparable magnitude.

These contrasts suggest that the influence of drought depends less on its intensity than on the historical conditions that mediate its effects on mobility.

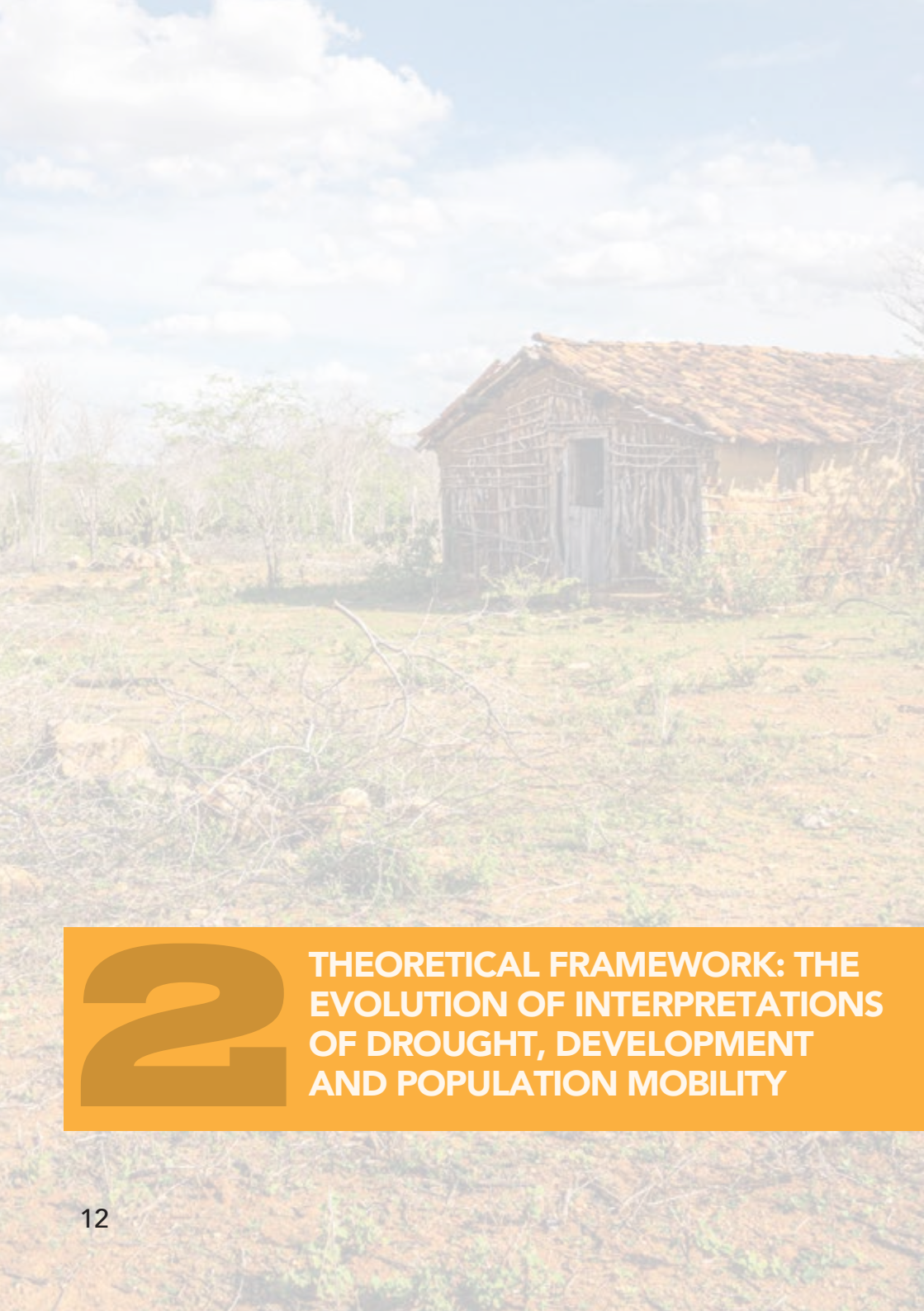
Starting from this observation, the article shifts the focus away from the traditional question — whether droughts cause migration — towards a different one: how have different regimes of territorial development historically mediated the relationship between climate variability and population mobility in Brazil between 1877 and 2022? The analytical interest therefore lies in the historical mechanisms that transformed environmental vulnerabilities into different patterns of mobility, of staying put, and of territorial redistribution of the labour force.

The central hypothesis holds that droughts historically amplified situations of social vulnerability, but their conversion into forced migration, into staying put, or into other forms of mobility depended on the mediations produced by national development projects, by state action, by labour markets and by the adaptive capacities built in each historical period. It is not only mobility that changes over time; the very influence that climate variability exerts upon it also changes. Throughout Brazil's territorial formation, that influence was continuously reconfigured by historical regimes of development, by state action and by the adaptive capacities built within territories.

To answer this question, the study adopts a qualitative, historical-interpretive approach based on an interdisciplinary literature review, an analysis of Brazil's principal economic cycles and an interpretation of the historical series of the IBGE Population Censuses. Rather than seeking linear causal relationships between climate events and migration, the study reconstructs the historical mechanisms that mediated that relationship over roughly one hundred and fifty years of Brazilian

territorial formation.

The article offers three main contributions. First, it demonstrates that the influence of climate variability on population mobility is historically transformed as regimes of territorial development change. Second, it explains that transformation through the interaction of state action, labour markets, structural vulnerabilities and adaptive capacities. Third, it proposes a historical-institutional model integrating the political economy of development, critical geography, the sociology of migration and climate adaptation studies in order to interpret mobility as part of Brazil's territorial formation.



2

THEORETICAL FRAMEWORK: THE EVOLUTION OF INTERPRETATIONS OF DROUGHT, DEVELOPMENT AND POPULATION MOBILITY

The relationship between drought and population mobility is one of the most persistent themes in interpretations of Brazil's territorial formation. Since the end of the nineteenth century, different analytical currents have sought to explain why the recurrent droughts of the Semi-Arid produced successive population displacements and which factors conditioned those movements over time. The answers formulated have varied considerably. Whereas the earliest interpretations emphasized drought as the principal cause of migration, later approaches came to highlight the social production of vulnerability, regional development, the organization of territory, labour markets, migratory networks and, more recently, the adaptive capacities built by public policies and territorial institutions.

This trajectory produced a progressive shift in analytical focus. Drought ceased to be understood as a sufficient explanation for mobility and came to be interpreted as a factor that interacts with broader economic, social, political and institutional processes. Yet, although these contributions have substantially expanded our understanding of migration, they remain relatively dispersed when it comes to explaining how those relationships were historically transformed over the course of Brazil's territorial formation.

This chapter reconstructs that theoretical evolution from a historical perspective. Rather than presenting a mere review of authors, it seeks to show how each current broadened understanding of the relationship between drought and mobility, incorporating new analytical dimensions without necessarily replacing earlier interpretations. These contributions are then integrated into the historical-institutional model that guides the analysis developed in this article.

2.1 THE CONSTRUCTION OF THE SERTÃO AS A NATIONAL PROBLEM

The first interpretations of the relationship between drought and migration emerged not in demography or economics but in literature and social essay writing. Between the end of the nineteenth century and the first decades of the twentieth, the recurrence of the great droughts turned the sertão — the semi-arid backlands — into one of the principal symbols of Brazilian inequality, consolidating a representation in which drought appeared as the organizing element of social life in the backlands and migration as the dramatic expression of survival in the face of hunger and scarcity.

In *Os Sertões* (1902), Euclides da Cunha gave the question of drought a national dimension by bringing together environment, society and political conflict in his interpretation of the War of Canudos. Although strongly influenced by the scientific conceptions of his time, his work made the historical specificity of the sertão visible and inaugurated a debate that would extend well beyond the strictly environmental dimension.

In the following decades, this representation was deepened by regionalist literature. In *O Quinze* (1930), Rachel de Queiroz portrayed the drought of 1915 through the everyday experience of backland families, showing how the loss of subsistence conditions drove thousands of people to leave. A few years later, in *Vidas Secas* (1938), Graciliano Ramos presented migration as part of the permanent cycle of vulnerability lived by the rural populations of the Semi-Arid, reinforcing the image of the retirante — the drought migrant forced to leave the land — as a central figure of north-eastern social identity.

These works exerted a profound influence on the way Brazilian society came to understand drought. Their principal contribution lay

in revealing the human dimension of poverty, hunger and migration, turning the sertão into a national question and lending political legitimacy to the debate on regional inequality. At the same time, they consolidated an interpretation in which drought appeared as the central element of the migratory experience, helping to associate population displacement above all with climatic adversity.

However, while fundamental to understanding the historical construction of the imagery surrounding the retirante, these interpretations did not seek to explain the economic, social and institutional mechanisms responsible for producing vulnerability. Migration was presented predominantly as a consequence of the social tragedy caused by drought, leaving in the background any analysis of economic structures, the organization of territory and state action. It was precisely this limitation that motivated the emergence of a new interpretive tradition, inaugurated by Josué de Castro, which shifted the explanation of hunger and migration from natural conditions to the social and economic organization of Brazilian society.

This interpretive tradition was later deepened by Albuquerque Júnior (2011), who demonstrated that the Northeast is not merely a geographical or climatic reality but a historical, political and cultural construction produced by discourses, institutions and social representations over the course of the twentieth century. This perspective reinforces the understanding that the centrality of drought in regional identity also results from historical processes of territorial production and collective memory, broadening our understanding of how the imagery of the retirante was incorporated into Brazilian social thought.

2.2 THE POLITICAL ECONOMY OF HUNGER

The most significant break with interpretations that attributed a predominant explanatory role to drought in accounting for poverty and migration came with the work of Josué de Castro. In *Geografia da Fome* (1946), he shifted the debate from the strictly environmental plane to the economic and social organization of Brazilian society, demonstrating that hunger is not an inevitable consequence of natural conditions but an expression of historical forms of production, distribution and access to resources.

Analysing different regions of the country, Josué de Castro showed that areas subject to the same climatic conditions displayed very different levels of food insecurity, making clear that vulnerability resulted less from scarce rainfall than from land concentration, rural poverty, low productive diversification and inequality in access to food. Drought remained a relevant element, but it ceased to be interpreted as a sufficient cause of hunger and migration, acting instead as a factor that intensified vulnerabilities already produced by economic and social structures.

This interpretation represented a profound change in Brazilian social thought. For the first time, drought-related migration came to be understood as a manifestation of structural problems of development rather than as an inevitable response to climate events. In breaking with environmental determinism, Josué de Castro inaugurated a perspective in which vulnerability constitutes a social product, historically conditioned by the ways the economy, land ownership and public policy are organized.

His contribution goes beyond the critique of climatic determinism. By demonstrating that hunger results from the social organization of production, he introduced a historical and political dimension that made it possible to understand droughts as phenomena whose impacts depend on the economic and institutional conditions existing in each territory. This perspective opened the way for the

“north-eastern question” to cease being treated exclusively as an environmental problem and to become part of the debate on national development.

This shift sought to consolidate a new research agenda within Brazilian social thought. Building on it, authors such as Celso Furtado, Caio Prado Júnior and Francisco de Oliveira began to investigate how the country’s economic formation, national development projects, state action and the regional organization of the economy conditioned the production of inequality and the territorial redistribution of the population. Migration thus ceased to be interpreted merely as a consequence of social vulnerability and became part of a broader analysis of regional development, territory and the mobility of the labour force.

2.3 THE POLITICAL ECONOMY OF REGIONAL DEVELOPMENT

The interpretations inaugurated by Josué de Castro were deepened, in the following decades, by authors who decisively shifted the understanding of regional inequality into the field of the political economy of Brazilian development. This tradition came to interpret migration not only as an expression of social vulnerability but as part of the historical processes of economic formation, territorial organization and state action in the production of regional inequality.

Among its principal proponents, Celso Furtado demonstrated that the relative backwardness of the Northeast did not stem from natural limitations but from the way the region was historically incorporated into national development. In *Formação Econômica do Brasil* (1959) and *A Operação Nordeste* (1959), he argued that land concentration, low productive diversification, limited industrial capacity and the concentration of public investment restricted the

generation of employment and income in the region. From this perspective, droughts aggravated pre-existing vulnerabilities but did not constitute their structural cause. The creation of the Superintendency for the Development of the Northeast (SUDENE) represented precisely an attempt to confront these inequalities through a regional development policy, shifting the focus from emergency responses to the transformation of economic structures.

The work of Caio Prado Júnior broadens this interpretation by analysing Brazil's economic formation as a result of a colonial insertion oriented towards external markets. In *Formação do Brasil Contemporâneo* (1942), he demonstrates that the organization of territory, production and the circulation of wealth was historically shaped by external interests, producing deep regional asymmetries that would continue to condition national development. This reading helps to show that population flows follow the very dynamics of the reorganization of the Brazilian economy, marked by a succession of different productive cycles and by the spatial redistribution of economic opportunity.

Within the same tradition, Francisco de Oliveira deepened the analysis of the relationships between regional development, the State and inequality. In *Elegia para uma Re(li)gião* (1977), he argues that the so-called "drought problem" cannot be dissociated from agrarian structure, power relations and the ways in which the State has historically intervened in the Northeast. His critique of the so-called "drought industry" showed that part of the public policy directed at the region helped to reproduce mechanisms of political and economic dependency, reinforcing the need to interpret droughts within the broader context of Brazilian social formation.

Taken together, these contributions consolidated a historical-structural interpretation of migration. Population displacement came to be understood as part of the reorganization

of the economy, of territory and of state action, while drought came to be interpreted as a factor that intensifies vulnerabilities rather than as a sufficient cause of mobility.

This analytical shift opened the way for critical geography, which incorporated the social production of territory as a central element in understanding population mobility.

2.4 CRITICAL GEOGRAPHY: TERRITORY, CIRCULATION AND POPULATION MOBILITY

Critical geography broadened the interpretations of the political economy of development by incorporating territory as a central category for understanding regional inequality and population mobility. From this perspective, migratory flows do not result solely from differences in income or employment between regions but from the way the State, infrastructure, productive systems and circulation networks historically organize space.

Among its principal proponents, Milton Santos understands territory as the outcome of the interaction between technology, labour, information, infrastructure and power. In works such as *A Natureza do Espaço* (1996) and *Por uma Outra Globalização* (2000), he demonstrates that public investment, transport systems, urban networks and economic circuits continuously reorganize the distribution of opportunity and, consequently, of population. Mobility ceases to be interpreted merely as the displacement of people and becomes part of the processes of production and reorganization of territory itself.

In the study of the Northeast, Manuel Correia de Andrade contributed to understanding how the occupation of regional space was historically conditioned by land tenure structures, forms of

economic exploitation and state action. His analyses show that territorial inequalities are not a simple expression of natural conditions but result from historical processes of occupation, land use and the distribution of public investment.

These contributions reinforce the understanding that mobility accompanies the territorial reorganization of the Brazilian economy. The expansion of mining, rubber, industrialization, the construction of Brasília and the agricultural frontier not only generated new labour markets but reorganized transport networks, infrastructure, cities and productive activities, successively redefining the principal destinations of population circulation.

By incorporating the territorial dimension into interpretations of development, critical geography demonstrated that migration is part of the social production of space. This perspective brings the study of mobility closer to processes of territorial formation and provides the basis for the sociology and demography of migration to analyse, more specifically, how labour markets, social networks, family strategies and economic change condition the continuity of those flows.

2.5 THE SOCIOLOGY OF MIGRATION: LABOUR MARKETS, SOCIAL NETWORKS AND FAMILY STRATEGIES

From the 1970s onwards, studies of internal migration began to shift focus away from explanations centred exclusively on regional inequality towards the mechanisms that structure population mobility. Without abandoning the importance of economic development and the organization of territory, this literature came to analyse how labour markets, social networks, family strategies and demographic change condition the intensity, direction and continuity of migratory flows.

In Brazil, Paul Singer was among the first authors to interpret migration as part of the process of industrialization and urbanization. In *Economia Política da Urbanização* (1973), he demonstrated that population displacement accompanies the expansion of the urban labour market and the concentration of economic activity, constituting a structural component of Brazilian capitalist development.

This interpretation was extended by José de Souza Martins, who highlighted the socially contradictory character of agricultural modernization. The expansion of capitalism in the countryside simultaneously produced rising productivity, land concentration and the expulsion of rural workers, helping to intensify migratory flows towards cities and new economic frontiers.

Brazilian demography added further dimensions to this debate. Studies by George Martine, Fausto Brito, José Marcos Pinto da Cunha, Ricardo Ojima and Alisson Barbieri show that migration responds to multiple factors, among them employment opportunities, the expansion of urban networks, family strategies of social reproduction, regional income differentials and the dynamics of migratory networks themselves. This perspective helped to overcome linear interpretations, showing that the decision to migrate results from a combination of economic, social and territorial determinants.

A further advance of this literature was to demonstrate that migration has a cumulative dynamic. Family and community networks reduce the costs of displacement and favour the continuity of flows between places of origin and destination.

Taken together, these contributions consolidated an understanding of migration as a multifactorial phenomenon resulting from the interaction of labour markets, social networks, family strategies and

territorial transformation. This understanding opened the way for studies of environmental migration, which came to incorporate climate variability as one of the factors conditioning human mobility.

2.6 ENVIRONMENTAL MIGRATION: VULNERABILITY AND ADAPTIVE CAPACITIES

Studies of environmental migration broadened our understanding of mobility by incorporating climate variability as one of the factors influencing population displacement. In opposition to deterministic interpretations, this literature demonstrates that extreme events such as droughts, floods and storms do not produce migration automatically. Their effects depend on interaction with economic, social, institutional and territorial vulnerabilities (Richard Black; Étienne Piguet; Graeme Hugo).

This perspective was consolidated by studies that came to understand mobility as one among several strategies of adaptation to environmental change. The decision to migrate depends on conditions of access to income, infrastructure, social protection, labour markets, social networks and natural resources, rendering interpretations based on direct causal relationships between climate and migration inadequate (Black et al., 2011; Piguet, 2010; McLeman, 2014).

The reports of the Intergovernmental Panel on Climate Change and of the United Nations Convention to Combat Desertification reinforce this interpretation by recognizing that droughts, land degradation and climate change amplify pre-existing vulnerabilities, but that their effects on mobility are mediated by the adaptive capacities built within each territory. Infrastructure, public policies, social protection, access to water, institutions and livelihoods influence both the decision to migrate and the possibilities for

populations exposed to climate events to remain where they are.

This literature has also come to recognize that Indigenous Peoples, quilombola communities and other traditional communities constitute important references for building adaptive capacities in contexts of climate variability. Their ecological knowledge, collective forms of organization and modes of managing natural resources are the result of long processes of interaction with their territories and contribute to strengthening the socio-ecological resilience of local populations. From this perspective, territorial rights and the recognition of such knowledge cease to represent merely an agenda of social recognition and become part of the conditions that favour climate adaptation and enable populations to remain in their living spaces.

These experiences demonstrate that climate adaptation depends not only on the expansion of state capacities but also on the existence of socially protected territories, on the continuity of ways of life and on the recognition of knowledge produced by the populations themselves.

This change of perspective brings the environmental debate closer to the interpretations previously developed by the political economy of development, critical geography and the sociology of migration. Climate variability remains relevant but comes to be understood as an element that interacts with broader historical processes producing vulnerabilities and territorial opportunities.

In this context, the Brazilian experience offers a particularly relevant contribution. From the 1990s and 2000s onwards, the consolidation of the coexistence-with-the-Semi-Arid paradigm came to demonstrate that public policies, social technologies and territorial institutions can modify conditions of vulnerability and, consequently, transform the relationship between drought and population

mobility. This perspective is the subject of the following section.

2.7 COEXISTENCE WITH THE SEMI-ARID: ADAPTIVE CAPACITIES AND REMAINING IN THE TERRITORY

From the 1990s onwards, a new interpretation of the relationship between drought, development and mobility took shape in the Brazilian Semi-Arid. In contrast to the paradigm of fighting drought, centred on hydraulic works and emergency measures, the perspective of coexistence with the Semi-Arid came to understand climate variability as a permanent characteristic of the region and to advocate strengthening the adaptive capacities of rural populations through public policy, social technologies and territorial development.

The construction of this paradigm speaks directly to the understanding that adaptation to drought depends on a combination of public policy, the strengthening of local capacities and the recognition of the territorial forms of social organization discussed in the previous section.

This approach was built by civil society organizations, social movements, research institutions and public bodies, with the Brazilian Semi-Arid Articulation (ASA) as one of its principal organizers. Authors such as Roberto Malvezzi, Eric Sabourin, Joacir Rufino de Aquino and Geraldo Duque have contributed to demonstrating that confronting drought depends less on controlling natural conditions than on expanding the social, economic and institutional capacities of territories.

From this perspective, policies for access to water, the strengthening of family farming, social protection, technical assistance, contextualized education and the recognition of local knowledge cease to be understood as emergency responses and

become part of a permanent strategy of adaptation to the Semi-Arid. Families remaining in rural areas becomes a result of the expansion of their conditions for social reproduction, reducing dependence on migration as a recurrent survival strategy.

Studies of the Cisterns Programme and other territorial development policies record consistent advances in water security, food security, the autonomy of rural families and their capacity to withstand drought. This evidence reinforces the understanding that the relationship between drought and mobility can be transformed by public policies capable of reducing structural vulnerabilities and expanding the adaptive capacities of territories.

By incorporating climate adaptation into the debate on regional development, coexistence with the Semi-Arid extends the interpretations discussed in the previous sections. Mobility ceases to be analysed solely as a response to vulnerability and comes to be understood alongside staying put, return migration and other strategies of social reproduction. This perspective provides the empirical and conceptual basis for integrating, in the following section, the various currents discussed throughout this chapter into a historical-institutional model of the relationship between climate variability, development and population mobility.

Table 1 – Evolution of the principal interpretations of drought, development and population mobility

INTERPRETIVE CURRENT	PRINCIPAL AUTHORS	HOW IT INTERPRETS THE RELATIONSHIP BETWEEN DROUGHT AND MOBILITY	PRINCIPAL CONTRIBUTION TO THE EVOLUTION OF THE DEBATE
Construction of the sertão as a national problem	Euclides da Cunha; Rachel de Queiroz; Graciliano Ramos	Drought appears as social tragedy and migration as forced departure.	Nationalizes the question of drought and consolidates the historical imagery of the retirante.

Political economy of hunger	Josué de Castro	Hunger and migration result from the social production of vulnerability; drought intensifies these processes.	Breaks with climatic determinism and shifts the analysis towards the social and economic organization of vulnerability.
Political economy of regional development	Celso Furtado; Caio Prado Júnior; Francisco de Oliveira	Mobility follows the inequalities produced by development processes and by state action.	Introduces economic formation, regional development and state action as central elements of mobility.
Critical geography	Milton Santos; Manuel Correia de Andrade	Mobility follows the production of territory, infrastructure and circulation networks.	Incorporates the territorial dimension into the understanding of migration and the formation of space.
Sociology and demography of migration	Paul Singer; José de Souza Martins; George Martine; Fausto Brito; Ricardo Ojima; Alisson Barbieri	Migration results from the interaction of labour markets, social networks, family strategies and territorial transformation.	Explains the social mechanisms that structure, direct and reproduce migratory flows.
Environmental migration	Richard Black; Étienne Piguet; Graeme Hugo; IPCC	Climate variability influences mobility through vulnerabilities and adaptive capacities.	Integrates environmental factors into multifactorial approaches to human mobility and highlights the role of adaptive capacities.
Coexistence with the Semi-Arid	ASA; Roberto Malvezzi; Eric Sabourin; Geraldo Duque; agroecology literature	Public policy, social technologies and institutional strengthening expand the conditions for remaining in the territory.	Demonstrates that adaptive capacities and territorial development can historically transform the relationship between drought and mobility.
Historical-institutional model (this article)	The author	Mobility results from the historical interaction between climate variability, structural vulnerabilities, regimes of territorial development, state action and adaptive capacities.	Integrates the different traditions into a historical-institutional interpretation of the transformation of the influence of climate variability on population mobility over the course of Brazil's territorial formation.

Source: Synthesis prepared by the author from the literature reviewed.

Table 1 summarizes the evolution of the principal interpretations of the relationship between drought, development and mobility in Brazil. The earliest readings, produced by literature and social essay writing, gave visibility to the experience of the retirantes and established drought as a central element of the national imagination. Josué de Castro then shifted the explanatory focus towards the social production of hunger, while the political economy of development, represented by Celso Furtado, Caio Prado Júnior and Francisco de Oliveira, showed that migration results from structural inequality, the historical formation of territory and state action. Critical geography, especially with Milton Santos and Manuel Correia de Andrade, incorporated the territorial dimension by demonstrating that the circulation of the labour force follows the historical production of space and infrastructure.

Subsequently, the sociology of migration explained the persistence and diversification of flows through the dynamics of labour markets, social networks and family strategies. More recently, studies of environmental migration came to understand mobility as the result of interaction between climate change, socio-economic vulnerabilities and adaptive capacities, while the perspective of coexistence with the Semi-Arid demonstrated that public policies, social technologies and participatory forms of governance can transform the historically established relationship between climate and mobility.

Where Furtado demonstrates that development produces territorial inequality, the IPCC shows that adaptive capacities condition the effects of climate change. The Brazilian case makes clear that these two dimensions form part of the same historical process.

Building on this articulation, the article proposes to understand the relationship between climate variability and population mobility as a

process historically mediated by regimes of territorial development, by state action and by the building of adaptive capacities. From this perspective, drought does not by itself produce migration; its effects depend on the economic opportunities, institutions and social capacities built in each historical period.

2.8 SYNTHESIS OF THE THEORETICAL FRAMEWORK AND ANALYTICAL MODEL

The evolution of interpretations presented in this chapter reveals a progressive shift in understanding the relationship between drought and population mobility. The earliest readings emphasized drought as the central element of social experience in the sertão and of migration. Subsequently, the political economy of hunger shifted the analysis towards the social production of vulnerability; the political economy of regional development incorporated structural inequality and state action; critical geography introduced the territorial dimension; sociology and demography explained the social mechanisms of mobility; studies of environmental migration came to understand climate variability as a factor mediated by vulnerabilities and adaptive capacities; and the coexistence-with-the-Semi-Arid paradigm demonstrated that public policies and territorial institutions can transform that relationship.

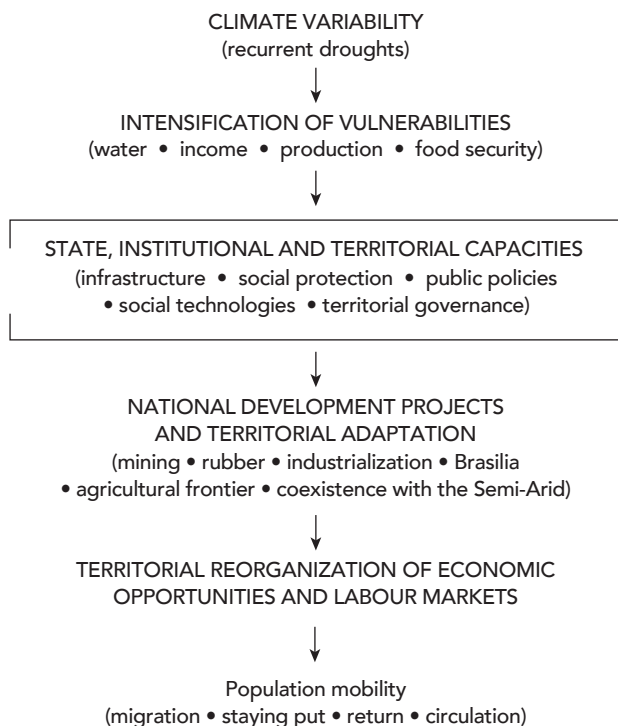
More than competing interpretations, these currents represent different levels of understanding of the same phenomenon. Each added new analytical dimensions, progressively extending the explanation of population mobility beyond interpretations centred exclusively on climate variability.

Building on this theoretical trajectory, the article adopts a historical-institutional model that understands population mobility

as the result of interaction between five dimensions: (i) climate variability, (ii) structural vulnerabilities, (iii) state, institutional and territorial capacities, (iv) national development projects and the territorial reorganization of the economy, and (v) strategies of mobility, staying put and return built by populations over time. From this perspective, droughts do not produce displacement automatically. Their effects depend on how these different dimensions come together in each historical context.

The figure below summarizes this interpretive model and guides the historical analysis presented in the following chapter.

Figure 1 – Historical-institutional model of the relationship between climate variability, development and population mobility (1877–2022)





HISTORICAL TRANSFORMATION OF THE RELATIONSHIP BETWEEN DROUGHT AND MOBILITY (1877-2022)

Source: Prepared by the author.

The model summarized in Figure 1 operationalizes the theoretical framework developed in this chapter and guides the historical analysis presented in the following sections. Climate variability is understood as a factor that intensifies social vulnerabilities, whose effects are mediated by state, institutional and territorial capacities. These capacities influence the way national development projects reorganize territory, distribute economic opportunity and condition different patterns of mobility, of staying put and of return.

In sum, the theoretical framework converges on the understanding that population mobility results from the interaction of environmental, economic, social and institutional factors. This article advances that debate by proposing that the very influence of climate variability on mobility does not remain constant over time but is historically mediated by regimes of territorial development, by state action and by the building of adaptive capacities. This proposition guides the historical analysis developed in the following sections.

3

METHODOLOGY



This chapter presents the methodological design adopted to analyse the historical transformation of the relationship between climate variability, territorial development and population mobility in Brazil between 1877 and 2022. It describes the study design, the sources used, the time frame, the analytical categories and the interpretive model that guides the analysis developed in this article.

As this is a historical-interpretive study, the methodology privileges the reconstruction of long-run processes and mechanisms, bringing together different bodies of evidence in order to understand how the interaction between climate variability, state capacities, territorial development and mobility produced distinct patterns of mobility over the course of Brazil's territorial formation.

3.1 STUDY DESIGN

The study adopts a qualitative, historical-interpretive approach grounded in historical sociology and the political economy of development (Mahoney & Rueschemeyer, 2003). The objective is not to estimate statistically the effects of drought on migration but to understand how the relationship between climate variability, development, state action and population mobility was historically transformed over the course of Brazil's territorial formation.

The methodological design was constructed to analyse historically the mediations between climate variability, territorial development, state action and population mobility, taking as its unit of analysis the processes of territorial reorganization of the Brazilian population.

The unit of analysis is not the individual migrant but the historical processes of territorial reorganization of the Brazilian population between the Great Drought of 1877–1879 and the Population Census of 2022. From this perspective, mobility is interpreted as a component of territorial formation and of the transformations of national development.

3.2 SOURCES AND METHODOLOGICAL STRATEGY

The study is based on the triangulation of four bodies of evidence.

The first is an interdisciplinary literature review covering drought, regional development, territorial formation, political economy, critical geography, the sociology of migration, climate adaptation and coexistence with the Semi-Arid. This review made it possible to reconstruct the evolution of the principal interpretations of the relationship between climate variability, development and population mobility.

The second consists of a historical reconstruction of the principal economic cycles and national development projects that reorganized the territorial distribution of the Brazilian population, including mining, the rubber cycles, industrialization, the construction of Brasília, the expansion of the agricultural frontier and the consolidation of coexistence-with-the-Semi-Arid policies.

The third comprises an analysis of the historical series produced by the Population Censuses of the Brazilian Institute of Geography and Statistics (IBGE), complemented by specialized literature in demography and regional development. These data were used to identify changes in the spatial distribution of the population, in patterns of urbanization and in migratory trends over the period analysed.

Finally, public policies relating to access to water, social protection, the strengthening of family farming and territorial development in the Brazilian Semi-Arid were examined. These policies were analysed as mechanisms for expanding adaptive capacities and transforming the relationship between climate variability and population mobility.

Integrating these different sources made it possible to cross-check historical, territorial and demographic evidence, strengthening the interpretive consistency of the study without seeking to establish causal relationships of a statistical nature.

3.3 TIME FRAME

The period analysed spans roughly a century and a half, from the Great Drought of 1877–1879 to the publication of the results of the 2022 Population Census.

The choice of this interval rests on three grounds. First, the drought of 1877–1879 represents the first widely documented drought episode associated with population displacement on a national scale, coinciding with the expansion of the First Rubber Cycle. Second, the period covers the principal development projects that reorganized the Brazilian economy and territory, making it possible to analyse changes in patterns of mobility over time. Third, the 2022 Population Census makes it possible to assess the most recent configuration of population mobility following the consolidation of public policies oriented towards coexistence with the Semi-Arid.

A long-run perspective makes it possible to analyse continuities and changes in the relationship between climate variability, development and mobility, privileging the identification of historical mechanisms rather than the interpretation of isolated events.

3.4 ANALYTICAL CATEGORIES

The analysis was structured around five interdependent analytical categories.

The first is climate variability, understood as the occurrence of droughts capable of intensifying situations of social vulnerability.

The second refers to structural vulnerabilities, understood as the result of the interaction between regional inequality, land concentration, access to water, infrastructure, rural poverty and public policy.

The third is state, institutional and territorial capacities, understood as the set of institutions, public policies, social technologies and forms of organization capable of expanding populations' capacity to adapt to climate variability.

The fourth category comprises national development projects, understood as historical strategies for reorganizing the economy and territory implemented through state action, public investment, infrastructure and the expansion of labour markets.

The fifth category is population mobility, analysed in its different forms — migration, staying put, return and circulation — as an expression of the transformations of Brazilian territorial organization over the period studied.

3.5 ANALYTICAL MODEL

The analytical model summarized in Figure 1 operationalizes the central hypothesis of the study and guides the interpretation developed in this article. Grounded in the political economy of development, critical geography, the sociology of migration and climate adaptation studies, the model interprets population mobility as the result of interaction between five dimensions: climate variability, structural vulnerabilities, state, institutional and territorial capacities, national development projects, and population mobility

itself.

The model organizes analytically the relationships between these five dimensions, making it possible to reconstruct how different historical configurations produced distinct patterns of population mobility over the period analysed.



4

RESULTS AND DISCUSSION

This section analyses how the relationship between climate variability and population mobility was transformed between the Great Drought of 1877–1879 and the Population Census of 2022. It argues that, although climate variability remained recurrent, migratory patterns responded to changes in development processes, in state action and in the territorial organization of the economy.

4.1 POPULATION MOBILITY AND TERRITORIAL FORMATION BEFORE THE GREAT DROUGHTS

Classic interpretations of Brazilian internal migration attributed a central role to the droughts of the Northeast in explaining population mobility. Contemporary scholarship, however, demonstrates that human displacement results from the interaction of environmental, economic, institutional and social factors. From this perspective, although droughts have historically amplified vulnerabilities, Brazil's territorial formation was marked from the colonial period onwards by successive population movements associated with the expansion of economic frontiers, state strategies for occupying territory and the reorganization of labour markets. Long before the Great Drought of 1877–1879, the spatial distribution of the population was already being continuously redefined by the economic cycles that structured the colonial and imperial economy.

During the sixteenth and seventeenth centuries, the principal population flows accompanied the consolidation of the sugar economy on the north-eastern coast. Colonial occupation mobilized European settlers, drove the forced displacement of Indigenous populations and incorporated millions of enslaved Africans, structuring a form of occupation subordinated to Portuguese mercantile logic. Oriented towards the production of export

commodities and the strategic control of the Atlantic coast, this dynamic brought together economic expansion, territorial occupation and the circulation of the labour force, establishing the foundations of the colony's spatial organization (Prado Júnior, 1942).

The discovery of gold and diamonds at the end of the seventeenth century triggered the first major demographic reorganization of Brazilian territory. Migration towards what are now Minas Gerais, Goiás and Mato Grosso pushed colonial occupation inland, stimulated the formation of new urban centres, expanded the overland circulation network and strengthened economic integration between different regions. Between the end of the seventeenth century and the beginning of the nineteenth, the colony's population rose from roughly 300,000 to more than 3 million inhabitants, growth driven both by mining and by the intensification of the transatlantic trade in enslaved Africans. For the first time, mobility took on a national dimension, simultaneously reorganizing the economy, the territory and colonial administration.

These processes show that mobility predates the great droughts documented in the nineteenth century. From the colonial period onwards, economic cycles and territorial occupation strategies drove successive redistributions of the population, demonstrating that the circulation of the labour force was a structuring element of Brazil's territorial formation. Droughts came to act upon a spatial organization already marked by intense mobility and deep regional inequality.

Over the course of the nineteenth century, the decline of mining, the expansion of coffee growing, the incorporation of new agricultural areas and the strengthening of the domestic market once again redefined the poles attracting population. It is in this context that the Great Drought of 1877–1879 acquires its historical significance. More than inaugurating new displacements, it made visible how

development projects, rendering explicit the articulation between vulnerability, state action, economic opportunity and mobility.

The different theoretical traditions discussed in this article converge on this interpretation. The political economy of development demonstrates that the spatial distribution of economic opportunity results from successive national development projects (Furtado, 1959; Oliveira, 1993); critical geography shows that the production of territory depends on the interaction between the State, infrastructure and markets (Santos, 2006; Becker, 2005); and contemporary migration studies show that mobility responds simultaneously to environmental, institutional, economic and social factors, ruling out explanations based on single causes (Black et al., 2011; McLeman, 2014; Ojima, 2014).

On this basis, the analysis is organized into distinct historical periods in which forms of development, state action and the territorial organization of the economy changed. This periodization does not represent rigid ruptures but identifies changes in the conditions that shaped population mobility over the course of Brazil’s territorial formation. Table 2 summarizes this analytical trajectory and guides the development of the following sections.

Table 2 – Analytical periodization of the relationship between drought, development and population mobility in Brazil (sixteenth to twenty-first centuries)

Historical period	Predominant economic cycle	Principal droughts	Predominant migration destination	Papel do Estado	Principal territorial effects	Principal argument
Sixteenth–seventeenth centuries	Sugar economy and colonial occupation	Scattered records	North-eastern coast	Establishment of the hereditary captaincies, the governorate-general and the consolidation of Portuguese colonization	Consolidation of coastal occupation, expansion of sugar production and of enslaved labour	Mobility accompanies colonial occupation and predates the great droughts.

Late seventeenth–eighteenth centuries	Mining	Drought of 1783	Minas Gerais, Goiás and Mato Grosso	Colonial administration, opening of overland routes and strengthening of fiscal control	Inland expansion of occupation, formation of new urban centres and integration of the interior	Economic cycles reorganize the population on a national scale.
1877–1912	First Rubber Cycle	Great Drought of 1877–1879	Amazon	Incentives for extractivism and integration of the Amazonian economy into the international	Expansion of the rubber estates, growth of Manaus and Belém and redistribution of the north-eastern labour force	Drought amplifies vulnerabilities; the rubber economy redefines the principal migratory destination.
1915–1932	Transition of the agro-export economy	Droughts of 1915 and 1932	North-eastern state capitals, Amazon and Southeast	Emergency work fronts, hydraulic works and concentration	Expansion of state intervention over mobility	The State begins to manage population displacement directly.
1942–1945	Second Rubber Cycle	Drought of 1942	Amazon	Washington Accords, recruitment of the Rubber Soldiers and international financing	Strategic mobilization of the labour force during the Second World War	State mobilization turns migration into an instrument of development and geopolitical strategy.
1930–1980	Industrialization and urbanization	Recurrent droughts	Southeast, especially São Paulo and Rio de Janeiro	Industrialization, labour legislation, investment in infrastructure and urban expansion	Consolidation of the Northeast–Southeast migratory axis and accelerated urbanization	Urban labour markets become the principal pole of migratory attraction.
1957–1960	Construction of Brasília	–	Federal District	State planning and construction of the new capital	Inland expansion of public administration and integration of the Central-West	State planning reorganizes territorial occupation.
1970–2000	Expansion of the agricultural	Droughts of 1979–1983	Central-West and Amazon	Directed colonization, rural credit, opening of highways and tax incentives	Expansion of agriculture and livestock and occupation of new frontiers	New development projects redirect migratory flows.

2003– presente	Regional development, social inclusion and climate adaptation	Drought of 2012–2017	Return migration, medium-siz ed cities and regional mobility	Cisterns Programme, social protection, strengthening of family farming and territorial development	Reduction of forced migration and strengthening of adaptive capacities	Adaptive capacities historically transform the relationship between drought and mobility.
-------------------	---	-------------------------	--	--	--	---

Source: Prepared by the authors on the basis of IBGE; Prado Júnior (1942); Furtado (1959); Santos (2006); Becker (2005); Martins (1997); Villa (2000) and the literature on migration, regional development and the Semi-Arid.

Note: The periods presented are not mutually exclusive. Some represent long-run economic cycles, while others correspond to specific development projects that produced significant changes in population mobility.

Table 2 summarizes the analytical periodization adopted in this study. Over almost five centuries, population displacement accompanied successive transformations of the economy and of the organization of territory. Droughts appear recurrently as factors intensifying vulnerability, while the direction and intensity of flows varied according to the economic opportunities and institutional capacities built in each historical period.

This periodization guides the analysis presented in the following sections, making it possible to examine how different development processes historically modified the interaction between climate variability, vulnerability, state action and population mobility. Rather than assigning drought an isolated explanatory role, the analysis reconstructs the historical mechanisms that conditioned different patterns of mobility over the course of Brazil’s territorial formation.

4.2 THE GREAT DROUGHT OF 1877–1879 AND THE OPENING OF THE AMAZONIAN FRONTIER

The Great Drought of 1877–1879 marks a turning point in Brazilian social history because it made visible, on a national scale, the

interaction between climate variability, social vulnerability and the reorganization of population mobility.

Between 1877 and 1879, the drought struck extensive areas of the provinces of Ceará, Rio Grande do Norte, Paraíba, Pernambuco and Piauí. Successive crop failures, livestock mortality, the collapse of food supply and the spread of epidemics produced one of the gravest humanitarian crises of the imperial period (Marco Antonio Villa, 2000). The demographic dimension of this episode remains a matter of debate owing to the scarcity and heterogeneity of the historical records. Estimates range between 400,000 and 500,000 deaths and point to tens of thousands of displacements, including approximately 120,000 migrants towards the Amazon (Villa, 2000; Dean, 1987; Weinstein, 1983). These figures are treated here as historical estimates rather than as census records.

At the same time, the rubber economy in the Amazon was undergoing a period of rapid expansion. Driven by growing international demand for natural rubber, associated with industrialization, telegraph networks, electrification and, later, the tyre industry, the region became one of the country's principal economic poles (Weinstein, 1983; Dean, 1987). Until the consolidation of Asian plantations in the first decades of the twentieth century, the wide availability of native rubber trees gave Brazil a strategic position in that market.

In this context, drought expanded the contingent of workers in situations of vulnerability, while the expansion of the rubber estates generated demand for labour. The convergence of these processes helps to explain the intensity of displacement towards the valleys of the Amazonas, Madeira, Purus, Juruá and Acre rivers, which consolidated themselves as new frontiers of economic occupation.

Migration occurred through different mechanisms. Some workers

moved on their own initiative, motivated by the prospect of work in the Amazon. Others were recruited by merchants and intermediaries linked to the *aviamento* system, which structured the financing of the rubber economy. Under this system, transport, tools, food and merchandise were supplied on credit, producing relationships of indebtedness that restricted the autonomy of rubber tappers and their capacity to leave the estates (Dean, 1987; Weinstein, 1983).

Although estimates vary across sources, there is consensus that north-eastern migration played a decisive role in the expansion of the rubber economy and in the occupation of extensive areas of the Amazon during the late nineteenth century (Dean, 1987; Weinstein, 1983). More than precisely quantifying this displacement, what matters is understanding the mechanisms that made it possible.

In this episode, drought amplified the conditions of vulnerability of rural populations, while the expansion of the rubber economy created employment opportunities capable of attracting and absorbing part of those contingents. Mobility resulted from the interaction of these processes, not from any single isolated factor. This interpretation converges with contemporary scholarship on mobility in contexts of environmental change, which understands displacement as the result of interaction between environmental, economic, institutional and social factors (Black et al., 2011; Piguet, 2010; McLeman, 2014; IPCC, 2022).

The experience of 1877–1879 also anticipates a pattern that would recur throughout Brazilian history: populations affected by environmental crises came to be incorporated into economic expansion projects located in other regions of the country. This dynamic would reappear in the recruitment of the Rubber Soldiers during the Second World War, in the industrialization of the Southeast, in the construction of Brasília and in the occupation of the

Central-West agricultural frontier, all examined in the following sections.

4.3 THE DROUGHTS OF 1915 AND 1932: THE INSTITUTIONALIZATION OF DROUGHT POLICY AND THE MANAGEMENT OF MOBILITY

After the Great Drought of 1877–1879, the question of drought progressively gained greater prominence on the national political agenda. The magnitude of the crisis revealed the limitations of the emergency responses adopted by the imperial State and prompted the creation of permanent institutions dedicated to the Semi-Arid. Over the first decades of the twentieth century, drought ceased to be treated merely as a climatic recurrence and became part of policies on infrastructure, territorial administration and assistance to affected populations (Villa, 2000; Furtado, 1959).

It was in this context that the Inspectorate of Works Against Drought (IOCS) was created in 1909, later transformed into the Federal Inspectorate of Works Against Drought (IFOCS) and, from 1945, into the National Department of Works Against Drought (DNOCS). The work of these bodies consolidated the paradigm of fighting drought, based principally on the construction of reservoirs, dams and other hydraulic works, which would remain predominant for much of the twentieth century (Furtado, 1959; Villa, 2000).

The drought of 1915 occurred during this process of institutionalization. It caused agricultural losses, livestock mortality and worsening food insecurity, prompting the displacement of thousands of families to Fortaleza and other north-eastern cities. The rapid concentration of retirantes in urban centres came to worry political and public health authorities, who associated these movements with urban disorder, the spread of disease and rising

poverty (Neves, 2001).

The government response combined work fronts, emergency assistance and mechanisms designed to control the circulation of the retirantes. The Alagadiço camp, set up in Fortaleza, became one of the principal symbols of this strategy. Although officially presented as a reception facility, its operation combined assistance, surveillance and the restriction of mobility, inaugurating a more systematic form of state intervention over population displacement (Neves, 2001).

This model was expanded during the drought of 1932, by then under the provisional government of Getúlio Vargas. In a context of strengthening federal institutions and greater administrative centralization, concentration camps — internment facilities for drought migrants — were set up in Fortaleza, Senador Pompeu, Quixeramobim, Cariús, Crato and Ipu, with the aim of preventing affected populations from moving to the main urban centres (Villa, 2000; Neves, 2001).

Administrative records indicate that 73,918 people were confined in these camps at the height of the drought. Later studies estimate that, taking the experiences of 1915 and 1932 together, more than 150,000 retirantes passed through these facilities. Although the figures vary across sources, the literature converges in characterizing these spaces as instruments for controlling mobility, marked by precarious living conditions and restrictions on freedom of movement (Neves, 2001; Villa, 2000).

While they expanded the State's capacity to respond to drought, these policies did little to alter structural factors such as access to land, access to water and productive diversification (Furtado, 1959; Oliveira, 1993).

The experience of the concentration camps makes clear that state

action on mobility has taken different forms throughout history. At some moments, public policies encouraged displacement towards new economic frontiers; at others, they sought to restrict people's circulation and their presence in urban centres. Migratory flows thus came to be conditioned not only by environmental conditions but also by the institutional instruments used to administer them.

The droughts of 1915 and 1932 further helped to consolidate a lasting representation of the Semi-Arid as a space of permanent emergency, legitimizing policies predominantly guided by the paradigm of fighting drought. This interpretation remained influential for much of the twentieth century, until it began to be questioned by the emergence of new approaches oriented towards coexistence with the Semi-Arid, discussed below.

4.4 THE SECOND WORLD WAR, THE RUBBER ARMY AND STATE MOBILIZATION OF THE LABOUR FORCE (1942–1945)

Brazil's participation in the Second World War marked a new stage in the relationship between drought, population mobility and national development. Unlike the Great Drought of 1877–1879, when displacement towards the Amazon accompanied the expansion of the rubber economy, the mobilization of the 1940s was organized through a state policy articulated with the geopolitical interests of the Allied powers (Garfield, 2013).

The Japanese occupation of Malaya, Indonesia and other natural rubber-producing territories between 1941 and 1942 compromised much of the world supply available to the Allies. Rubber was a strategic input for the production of tyres, military vehicles, aircraft, vessels, medical equipment and communication systems. Against this backdrop, the Amazon once again acquired international importance as the principal area of natural rubber production

available to the war effort (Garfield, 2013).

In March 1942, Brazil and the United States signed the Washington Accords, establishing cooperation mechanisms aimed at restoring Amazonian production. United States funds financed infrastructure, transport, public health and worker recruitment, while the Brazilian government created specific institutions to coordinate this mobilization, among them the Special Service for the Mobilization of Workers for the Amazon (SEMTA), the Special Public Health Service (SESP) and the Administrative Commission for the Dispatch of Workers to the Amazon (CAETA) (Garfield, 2013).

The implementation of this programme coincided with a new drought in the Northeast. Although less severe than that of 1877–1879, the drought of 1942 aggravated rural unemployment, reduced agricultural production and increased the vulnerability of backland populations, enlarging the pool of workers available for recruitment.

Official propaganda played an important role in this process. The workers came to be identified as “Rubber Soldiers”, in reference to the members of the Brazilian Expeditionary Force. Posters, radio campaigns and official speeches promised high wages, medical care, transport, food, a return journey to the Northeast and rights similar to those granted to the combatants sent to Europe (Garfield, 2013).

It is estimated that approximately 60,000 workers, the majority of them north-easterners, were recruited between 1943 and 1945 (Garfield, 2013). Despite the new institutional apparatus, the labour regime remained based on the *aviamento* system. Tools, food and merchandise continued to be supplied on credit, producing permanent relationships of indebtedness. The isolation of the rubber estates and the high incidence of malaria, hepatitis, leishmaniasis and other tropical diseases worsened working

conditions and made it difficult for thousands of workers to return to the Northeast (Dean, 1987; Weinstein, 1983).

The so-called Battle for Rubber partially restored Amazonian production between 1942 and 1945, although the results remained below the targets set by the Washington Accords. The low productivity of native rubber stands, logistical limitations and sanitary conditions constrained the expansion of production, but the programme secured the supply of natural rubber during a strategic period of the war and reaffirmed the geopolitical importance of the Amazon (Garfield, 2013).

The episode illustrates the growing capacity of the State to organize the mobility of the labour force in pursuit of economic and geopolitical objectives. Drought enlarged the pool of available workers, while the Washington Accords and international demand for rubber determined the predominant direction of that displacement.

After the end of the war, most of the promises made to the workers went unfulfilled. Thousands remained in the Amazon without the means to return to the Northeast, contributing to the formation of communities that preserve this historical memory. Recognition of their rights came only decades later, following intense social mobilization and successive legislative initiatives (Garfield, 2013).

4.5 INDUSTRIALIZATION, URBANIZATION AND THE CONSOLIDATION OF THE NORTHEAST–SOUTHEAST MIGRATORY AXIS (1930–1980)

From the 1930s onwards, Brazil's principal internal migratory flows underwent profound reconfiguration. Whereas until then the rubber economy had been the principal pole attracting north-eastern migration,

industrialization progressively shifted that role to the Southeast, especially to São Paulo and Rio de Janeiro. This change accompanied the reorganization of the Brazilian economy initiated after the Revolution of 1930 (Cano, 1977; Fausto, 1995).

Under the governments of Getúlio Vargas, the State assumed a central role in promoting industrialization, expanding transport infrastructure, establishing labour legislation and integrating the domestic market. Import substitution policy, the creation of state-owned enterprises and public investment concentrated productive activity in the Southeast, consolidating the region as Brazil's principal industrial centre (Cano, 1977; Furtado, 2007). The expansion of the automotive, steel, textile, construction and service sectors rapidly increased demand for urban workers.

It was in this context that the Northeast–Southeast migratory axis took shape. Between the 1940s and the 1980s, millions of north-easterners migrated to cities such as São Paulo, Rio de Janeiro, Belo Horizonte, Campinas, Santo André, São Bernardo do Campo and São Caetano do Sul, following the expansion of industry and of the metropolitan regions. The Population Censuses record this process through the country's rapid urbanization and the intense displacement of the rural population, especially workers from the Northeast, constituting the largest movement of population redistribution in Brazilian history (IBGE; Martine, 1994; Brito, 2009; Baeninger, 2012).

Net migration balances followed this spatial reorganization. While the Northeast recorded successive population losses, the Southeast concentrated the largest positive balances in the country. Estimates from the IBGE and from demographic studies indicate that between 10 and 12 million north-easterners migrated to other regions between 1950 and 1980, predominantly to the Southeast (Martine, 1994; Brito, 2009; Baeninger, 2012).

Droughts remained recurrent throughout this period. Episodes such as those of 1951, 1958, 1970 and, above all, 1979–1983 aggravated the vulnerability of rural populations. Displacement, however, followed principally the concentration of industrial employment, public investment and urban infrastructure in the Southeast (Furtado, 2007; Cano, 1977).

Over the decades, north-eastern communities consolidated themselves on the peripheries of the main metropolitan areas, strengthening family and community networks that facilitated further displacement and contributed to the continuity of migratory flows (Brito, 2009; Baeninger, 2012).

These movements produced profound economic, social and cultural transformations. North-eastern workers took part in the expansion of industry, construction, services and commerce, sectors fundamental to the urban and industrial growth of the developmentalist period. At the same time, they contributed to the constitution of new metropolitan identities, bringing cultural, religious, musical and culinary practices that became part of Brazilian urban life (Santos, 2008).

By the end of the 1970s, the Northeast–Southeast axis remained predominant, but the construction of Brasília, the inland expansion of federal administration and the expansion of the agricultural frontier were already redefining part of Brazil’s internal migratory flows — a process examined in the following section.

4.6 BRASÍLIA AND THE EXPANSION OF THE AGRICULTURAL FRONTIER: NEW DESTINATIONS OF MOBILITY (1956–2000)

The transfer of the federal capital to Brasília and the expansion of the agricultural frontier in the Cerrado inaugurated a new stage in the territorial reorganization of the Brazilian population. If

industrialization had concentrated the principal migratory flows towards the Southeast (Cano, 1977; Martine, 1994; Brito, 2009), the inland expansion promoted by the State and the growth of modern agriculture progressively shifted part of that mobility towards the Central-West, diversifying the principal destinations of internal migration.

The construction of Brasília, begun in 1956 under the government of Juscelino Kubitschek, formed part of the Target Plan and gave concrete form to a strategy of taking development inland. Besides housing the new capital, the project sought to strengthen the presence of the State in the interior, expand territorial integration and stimulate the economic occupation of regions until then only weakly connected to the national market (Fausto, 1995).

Building the city mobilized tens of thousands of workers, mainly from the Northeast, Minas Gerais and Goiás. The so-called *candangos* took part in the construction of the capital under conditions frequently marked by intense labour exploitation, high turnover and precarious housing. Many remained in the region after Brasília was inaugurated, contributing to the rapid demographic growth of the Federal District and its metropolitan area (Fausto, 1995).

The move of the capital inland was accompanied by a broad cycle of investment in transport, energy and communications infrastructure. The expansion of the road network, with corridors such as the BR-040, BR-153 and BR-364 highways, increased territorial integration, reduced circulation costs and favoured the economic incorporation of the Central-West (Becker, 2005).

From the 1970s onwards, this process was intensified by the modernization of Brazilian agriculture. The development of technologies adapted to the Cerrado, particularly in soil correction,

plant breeding and agricultural mechanization, combined with the expansion of rural credit, tax incentives and federal colonization programmes, made it possible to incorporate extensive areas into the national productive system (Martins, 1997; Becker, 2005).

Programmes such as POLOCENTRO and PRODECER drove the occupation of Goiás, Mato Grosso, Mato Grosso do Sul and western Bahia. The rapid expansion of soybean, maize, cotton and livestock production turned the Central-West into one of the world's principal agricultural frontiers, creating new poles of attraction for the labour force (Becker, 2005; Sawyer, 1984).

These transformations once again altered Brazilian migratory patterns. North-eastern workers began to move not only to the industrial metropolises of the Southeast but also to the new agricultural areas of the Cerrado, following colonization projects, the opening of rural properties and opportunities generated by the expansion of agribusiness, construction and services. Farmers from southern Brazil, especially from Paraná, Rio Grande do Sul and Santa Catarina, migrated to the Central-West, introducing new productive systems and accelerating the modernization of regional agriculture (Sawyer, 1984; Schmink & Wood, 1992).

The Population Censuses record this process through the high population growth of the Central-West between 1970 and 2000, driven principally by interstate migration and by the expansion of agricultural and urban activity.

Throughout this period, droughts remained recurrent in the north-eastern Semi-Arid, including the prolonged drought of 1979–1983, which aggravated the vulnerability of rural populations. The principal migration destinations, however, came to follow the redistribution of public investment, infrastructure and the new economic opportunities opened up by the occupation of the

Central-West.

Another important component of this process was the consolidation of new migratory networks. As had previously occurred between the Northeast and the Southeast, the first migrants established family, community and professional ties that facilitated further displacement and contributed to the formation of north-eastern communities in cities such as Goiânia, Brasília, Cuiabá, Campo Grande, Palmas, Rondonópolis, Sinop and Luís Eduardo Magalhães (Brito, 2009; Baeninger, 2012).

By the end of the twentieth century, the Brazilian migratory configuration had become more diversified. The Northeast–Southeast axis remained significant but coexisted with flows towards the Central-West, the Legal Amazon and medium-sized cities in the interior, reflecting the expansion of new economic frontiers and the territorial redistribution of productive activity.

4.7 ADAPTIVE CAPACITIES, PUBLIC POLICY AND THE TRANSFORMATION OF MOBILITY IN THE SEMI-ARID (1990–2022)

The first decades of the twenty-first century represent the principal change observed in the relationship between drought and mobility across the historical trajectory analysed in this study. Unlike the episodes examined in the previous sections, the major droughts did not produce population displacement on a scale comparable to that recorded between the end of the nineteenth century and the second half of the twentieth. This transformation occurred in a context in which climate variability persisted but public policies, territorial institutions and the living conditions of rural populations

had changed profoundly.

Between 2012 and 2017, the Brazilian Semi-Arid faced one of the longest and most severe droughts since the beginning of systematic meteorological measurement. The drought affected thousands of municipalities, lowered reservoir levels, compromised agricultural and livestock production and caused significant economic losses.

This change coincides with the consolidation, from the 1990s onwards, of a new paradigm of territorial development based on coexistence with the Semi-Arid. In contrast to traditional drought-fighting policies, centred principally on large hydraulic works and emergency measures, this approach came to prioritize strengthening local capacities for adapting to climate variability (Malvezzi, 2007; ASA, 2024).

Within this process, the Brazilian Semi-Arid Articulation (ASA) played a central role by bringing together community organizations, rural trade unions, social movements, churches, non-governmental organizations and research institutions around the democratization of access to water, the recognition of local knowledge and the dissemination of social technologies.

The One Million Cisterns Programme (P1MC), later expanded through the Cisterns Programme, became the principal expression of this strategy. The installation of more than one million rainwater harvesting social technologies expanded access to water for human consumption and food production; studies record positive impacts on water security, food security, child health, school attendance, women's autonomy and families' capacity to remain in rural areas (ASA, 2024; Luna, 2011; Diniz, 2022).

In parallel, the expansion of the Bolsa Família cash transfer programme, rural pensions, PRONAF (the National Programme for Strengthening Family Farming), rural electrification, basic education,

federal universities and institutes, together with the diversification of local economies, reduced vulnerabilities historically associated with drought and broadened rural families' strategies of social reproduction.

This interpretation is supported by recent evidence. In a study published in 2026, Costa et al., drawing on the 100 Million Brazilians Cohort, demonstrate that the combination of the Cisterns Programme, Bolsa Família and other social protection policies strengthened water security and the conditions for social reproduction among rural families, expanding their capacity to withstand extreme drought events. The authors conclude that remaining in the Semi-Arid came to reflect the expansion of adaptive capacities produced by the interaction between water infrastructure, social protection and territorial development.

These transformations significantly altered patterns of mobility in the Semi-Arid. Forced migration associated with drought lost its centrality, while more diversified mobility strategies gained importance, such as remaining in the territory, temporary migration, return movements and displacement related to education, professional qualification and entry into more specialized labour markets.

Taken together, these transformations indicate that mobility in the Semi-Arid came to respond less to climate crises and more to changes in the conditions of social reproduction, produced by the expansion of adaptive capacities and the strengthening of territorial institutions.

4.8 CENSUS EVIDENCE OF THE TRANSFORMATION OF BRAZILIAN POPULATION MOBILITY (1940–2022)

The historical trajectory reconstructed in the previous sections can be set against the series of Population Censuses of the Brazilian

Institute of Geography and Statistics (IBGE), which constitute the principal empirical basis for tracking transformations in the spatial distribution of the Brazilian population between 1940 and 2022. Although there are methodological differences between the various census editions, especially in the definitions of urban population, rural population and migration, the historical series reveal consistent trends of urbanization, territorial redistribution of the population and diversification of migratory flows. Taken together, this evidence provides empirical support for the interpretation developed in this article by demonstrating that internal mobility followed changes in the territorial organization of the economy, in state action and in national development projects (IBGE, 2023; Martine, 1994; Brito, 2009).

The first of these transformations concerns the intense process of urbanization. In 1940, approximately 31 per cent of the Brazilian population lived in urban areas and around 69 per cent in rural areas. By 2022, the urban share had reached roughly 87 per cent. Between these extremes, the censuses recorded continuous growth in urbanization: 36 per cent in 1950, 45 per cent in 1960, 56 per cent in 1970, 67 per cent in 1980, 75 per cent in 1991, 81 per cent in 2000 and 84 per cent in 2010 (IBGE, 1950; 1956; 1967; 1973; 1983; 1994; 2003; 2012; 2023). In little more than eight decades, Brazil was transformed from a predominantly rural society into one of the most urbanized in Latin America.

This transformation was accompanied by an intense process of internal mobility. Between 1950 and 2010, more than 50 million Brazilians left rural areas, with the 1970s concentrating the largest volumes of displacement, in line with industrial, urban and national infrastructure expansion (Martine, 1994; Brito, 2009; Santos, 2008).

The most recent results of the 2022 Population Census demonstrate the enduring historical importance of north-eastern migration.

According to the IBGE, 19.2 million people were living in a region other than the one in which they were born. Of that total, 10.4 million were natives of the Northeast Region, representing approximately 54 per cent of Brazil's interregional migrants. Among these migrants, some 6.8 million were living in the Southeast Region, reflecting the persistence of the migratory axis consolidated during industrialization (IBGE, 2023).

At the same time, the data reveal important changes in the recent configuration of mobility. Although the accumulated stock of migrants remains high, contemporary flows show greater territorial diversification, growth of migration towards the Central-West, the strengthening of medium-sized cities and the expansion of return movements to the Northeast (Baeninger, 2012; Brito, 2009).

Studies based on the Population Censuses of 1991, 2000, 2010 and 2022 identify consistent growth in return migration, associated with economic deconcentration, the ageing of the first generations of migrants, the strengthening of family networks and changes in regional development conditions (Baeninger, 2012; Ojima, 2014). These processes have helped to reduce the concentration of flows along the traditional Northeast–Southeast axis and to expand circulation between different regions of the country.

The 2022 Census also shows the consolidation of new poles of population attraction. States such as Goiás, Mato Grosso and Santa Catarina began to record substantial positive migration balances, associated with the expansion of agribusiness, industrial deconcentration and the growth of medium-sized cities. In parallel, São Paulo ceased to exercise the absolute migratory centrality observed for much of the twentieth century, indicating a more diversified territorial configuration of internal flows (IBGE, 2023).

Considered together, this quantitative evidence makes it possible to identify three long-term structural transformations. The first is the

intense urbanization and territorial redistribution of the Brazilian population. The second is the central role played by north-eastern migration in the formation of labour markets during the cycles of industrialization, the construction of Brasília and the expansion of the agricultural frontier. The third is that, in the first decades of the twenty-first century, patterns of mobility became more diversified, combining return movements, the strengthening of medium-sized cities and a greater plurality of migratory destinations.

Taken together, the census series confirm the transformation of mobility patterns observed throughout this chapter. Although climate variability remains recurrent, the intensity and direction of migratory flows followed changes in the territorial organization of the economy, in state action and in the adaptive capacities built in different historical periods.

4.9 INTERPRETIVE SYNTHESIS OF THE HISTORICAL TRAJECTORY

The historical reconstruction presented in this chapter shows that the relationship between climate variability and population mobility changed over the course of Brazil's territorial formation. Although droughts remained recurrent in the Semi-Arid, their effects on mobility varied as the organization of the economy, state action and the social and institutional conditions present in each historical period were transformed.

The different development cycles analysed show that the principal migratory flows followed successive changes in the territorial distribution of economic opportunity. The expansion of the rubber economy, industrialization, the construction of Brasília, the occupation of the agricultural frontier and, more recently, the expansion of coexistence-with-the-Semi-Arid policies corresponded

to distinct historical contexts in which the predominant destinations of Brazilian internal mobility were redefined.

State action also changed along this trajectory. Responses initially concentrated on emergency measures and on controlling population displacement were gradually complemented by policies aimed at expanding adaptive capacities, helping to alter the conditions under which droughts are faced and the strategies of social reproduction available to rural populations.

The historical reconstruction demonstrates that the recurrence of drought does not by itself explain the evolution of Brazilian migratory patterns. Over roughly one hundred and fifty years, the influence of climate variability on mobility changed as regimes of territorial development, state action and the adaptive capacities built in each historical period were transformed. This finding constitutes the principal empirical result of the study and guides the discussion presented in the following chapter.



5

DISCUSSION: THE HISTORICAL TRANSFORMATION OF THE INFLUENCE OF CLIMATE VARIABILITY ON MOBILITY

The results presented in the previous chapter make it possible to answer directly the question that guided this study and to make explicit its principal contribution to the literature. The historical reconstruction demonstrates that the influence of climate variability on population mobility did not remain constant over the course of Brazil's territorial formation. Although droughts remained a recurrent feature of the Semi-Arid between the Great Drought of 1877–1879 and the beginning of the twenty-first century, their effects on mobility were continuously reconfigured by regimes of territorial development, by state action and by the adaptive capacities built in different historical periods.

This interpretation engages with the advances of contemporary scholarship on environmental migration, which understands human mobility as the result of interaction between environmental, economic, social and institutional factors (Black et al., 2011; Piguet, 2010; McLeman, 2014; IPCC, 2022). The Brazilian case confirms this understanding by demonstrating that climate variability, although it intensifies vulnerabilities, does not on its own explain the patterns of mobility observed throughout history.

The results presented here, however, make it possible to go beyond that interpretation. More than identifying the factors that condition mobility in a given context, the analysis shows that the relative importance of those factors is itself historically transformed. It is not only mobility that changes over time; the influence that climate variability exerts upon it also changes. Between 1877 and 2022, that influence was continuously reconfigured by changes in regimes of territorial development, in state action and in the adaptive capacities built within territories. As a result, droughts of comparable intensity produced profoundly different patterns of mobility because the historical conditions mediating their social effects had changed.

From this perspective, the principal contribution of this article does not lie in demonstrating that human mobility is multifactorial in nature — a point now widely established in the literature. Its contribution lies in showing that the relationship between climate variability and mobility constitutes a historical process whose meaning is transformed as forms of development, institutions, economic opportunities and adaptive capacities are reorganized. This perspective shifts the analytical focus away from the search for isolated causes of migration and towards an understanding of the historical mechanisms that alter the influence of climate variability on human mobility.

On the basis of this interpretation, this chapter discusses four central implications of the study. The first demonstrates that mobility is an active component of Brazil's territorial formation. The second analyses the historical dimension of the relationship between climate variability and mobility. The third examines how territorial development, state action and adaptive capacities work together to transform that relationship. Finally, the fourth discusses the contributions of the Brazilian case to international debates on climate, territorial development and human mobility.

5.1 MOBILITY AS A COMPONENT OF BRAZILIAN TERRITORIAL FORMATION

The historical transformation of the influence of climate variability on mobility can only be fully understood once population displacement ceases to be interpreted as a simple response to environmental adversity or economic inequality and comes to be analysed as a constitutive component of Brazil's territorial formation itself. This change of perspective represents the first theoretical implication of

the results presented in this study.

Much of the Brazilian literature has interpreted internal migration as a consequence of regional inequality, the expansion of labour markets, industrialization or vulnerabilities aggravated by drought. These interpretations were decisive in overcoming environmentally deterministic explanations and in demonstrating that population displacement is bound up with processes of economic development and state action (Castro, 1946; Furtado, 1959; Singer, 1973; Martine, 1994; Brito, 2009). The results of this study engage with that tradition but suggest a further analytical shift. More than resulting from development, mobility was one of the mechanisms through which successive national projects reorganized Brazilian territory.

Across the different periods analysed, the circulation of the labour force accompanied the expansion of mining, the rubber economy, industrialization, the construction of Brasília, the occupation of the Cerrado and, more recently, the transformations associated with territorial development in the Semi-Arid. At each of these moments, population displacement redistributed people, labour and economic activity between different regions of the country, helping to consolidate new productive frontiers, strengthen urban centres and successively redefine the spatial organization of the national territory.

This interpretation is close to the contributions of critical geography, especially the formulations of Milton Santos and Manuel Correia de Andrade, for whom territory is the historical outcome of interaction between infrastructure, circulation, economy and power. From this perspective, mobility ceases to represent merely a reaction to territorial transformation and comes to participate actively in the production of new spatial configurations. Migratory flows link places of origin and destination, redistribute economic opportunity and accompany the very construction of the successive geographies of

Brazilian development.

Understanding mobility as a component of territorial formation also makes it possible to reinterpret the role of climate variability. Droughts remained recurrent throughout the entire period analysed, but their effects depended on the ways in which each development project reorganized economic opportunity, infrastructure and labour markets. The influence of climate variability on mobility changed precisely because development processes continuously altered the country's territorial organization. Migration thus ceases to be interpreted as a direct consequence of climate events and becomes part of the historical mechanisms through which territorial development and climate variability interact in producing human mobility.

5.2 THE HISTORICAL DIMENSION OF THE RELATIONSHIP BETWEEN CLIMATE VARIABILITY AND MOBILITY

The second contribution of this study is to demonstrate that the relationship between climate variability and population mobility must be understood as a historical process in permanent transformation. Although contemporary scholarship has consolidated the understanding of human mobility as a multifactorial phenomenon, relatively little attention has been paid to the way the relative importance of the factors conditioning mobility changes over time. The historical reconstruction developed in this article helps to fill that gap by showing that it is not only migratory patterns that are transformed, but also the very influence that climate variability exerts upon them.

The international literature on environmental migration represented a decisive advance in overcoming deterministic interpretations that attributed to climate events a direct causal role in population

displacement. Studies by Black et al. (2011), Piguet (2010), McLeman (2014) and the reports of the IPCC (2022) demonstrate that mobility results from interaction between environmental, economic, social, political and institutional factors. This perspective showed that droughts, floods and other extreme events produce distinct impacts depending on the vulnerabilities, livelihoods, institutional capacities and adaptive strategies present in each context.

The results of this study engage directly with that interpretation but add a temporal dimension that remains relatively underdeveloped in that literature. More than recognizing that different factors condition mobility, the historical analysis demonstrates that the relative importance of those factors is also transformed. The influence of climate variability on mobility did not remain constant between 1877 and 2022 but was successively reconfigured by changes in regimes of territorial development, in state action and in the adaptive capacities built over the course of Brazil's territorial formation.

Comparison between different drought episodes makes this transformation clear. The Great Drought of 1877–1879 occurred in a context marked by limited state capacity, high social vulnerability and the expansion of the rubber economy, and was converted into intense population displacement towards the Amazon. By contrast, the drought of 2012–2017, despite its high intensity and long duration, unfolded in a context characterized by expanded access to water, the consolidation of social protection policies, the strengthening of family farming and the expansion of territorial adaptive capacities. Although climatic conditions remained severe, the social effects of the drought on mobility became substantially different.

This difference does not stem from a change in the nature of climate events but from historical transformations in the conditions that

mediated their effects. Over roughly one hundred and fifty years, successive development projects reorganized economic opportunity, redefined labour markets, expanded state capacities and produced new ways of confronting climate variability. As a consequence, the explanatory weight of drought in producing population mobility progressively changed.

This perspective broadens our understanding of mobility in contexts of climate variability by explicitly incorporating the historical dimension of the mediations between environment and society. Rather than asking only why populations migrate in the face of extreme events, the interpretive model developed in this article makes it possible to understand why the influence of those events on mobility changes over time. The Brazilian case demonstrates that this transformation accompanies changes in regimes of territorial development, offering a contribution that complements studies focused predominantly on contemporary contexts and broadening the dialogue between the political economy of development, climate adaptation and human mobility studies.

5.3 TERRITORIAL DEVELOPMENT, ADAPTIVE CAPACITIES AND STATE MEDIATION

The third contribution of this study is to demonstrate that the historical transformation of the influence of climate variability on mobility results from the interaction between territorial development, state action and the building of adaptive capacities. These three processes are not independent dimensions but historically articulated mechanisms that redefine the conditions under which climate events produce — or cease to produce — population displacement.

The literature on the political economy of development, particularly

following the contributions of Celso Furtado, demonstrated that Brazilian regional inequalities are produced by different patterns of economic organization of territory. Development does not distribute opportunity evenly; on the contrary, it concentrates investment, infrastructure, employment and services in particular regions, continuously reorganizing the location of economic activity and labour markets. The results presented in this study confirm that interpretation by showing that the principal migratory flows followed successive changes in national development projects, from the expansion of the rubber economy through industrialization, the construction of Brasília, the occupation of the Cerrado and, more recently, territorial development policies directed at the Semi-Arid.

The historical analysis, however, makes it possible to go beyond that interpretation by demonstrating that development projects do not reorganize economic opportunity alone. They also transform the institutional and social conditions that mediate the effects of climate variability. By modifying infrastructure, the presence of the State, social protection systems, access to water, productive organization and the conditions of social reproduction of rural families, different development regimes progressively alter the way drought influences population mobility.

This interpretation brings the political economy of development closer to contemporary scholarship on climate adaptation. The IPCC (2022) assigns adaptive capacities a central role in reducing the vulnerabilities associated with extreme climate events. Such capacities are generally understood as the set of material resources, institutions, knowledge and infrastructure that expand populations' capacity to respond to environmental change. The Brazilian case makes it possible to add a historical dimension to this approach by demonstrating that such capacities are not static attributes of territories but the outcome of cumulative development processes.

Along the trajectory reconstructed in this study, the expansion of water infrastructure, social protection policies, the strengthening of family farming, social technologies for access to water and civil society organizations progressively expanded the adaptive capacities of rural populations. The fact that families remained in place during the drought of 2012–2017 cannot be attributed to any single public policy or specific institution. It expresses the historical accumulation of investment, institutional learning and territorial development processes that reduced the vulnerabilities previously responsible for the recurrent conversion of droughts into forced migration.

Where Furtado demonstrates that development produces territorial inequality, the IPCC shows that adaptive capacities condition the social effects of climate change. The Brazilian case shows that these two dimensions form part of the same historical process. Regimes of territorial development produce, simultaneously, economic opportunities, institutional capacities and adaptive conditions that redefine the influence of climate variability on mobility. Territorial development and climate adaptation thus cease to constitute parallel agendas and come to be understood as mutually constitutive processes.

This interpretation makes it possible to understand that state action should be analysed not only through the implementation of specific policies but through the capacity to reorganize historically the conditions under which societies live with climate variability. The principal contribution of this study is to demonstrate that adaptive capacities represent a dimension of territorial development itself. By structurally modifying vulnerabilities, economic opportunities and institutional capacities, they also transform the intensity and the meaning of the influence exerted by climate variability on human mobility.

5.4 CONTRIBUTIONS OF THE BRAZILIAN CASE TO INTERNATIONAL DEBATES ON CLIMATE, DEVELOPMENT AND MOBILITY

The fourth contribution of this study is to broaden the dialogue between the Brazilian historical experience and international debates on human mobility in contexts of climate variability. In recent decades, the international literature has advanced significantly by demonstrating that population displacement results from the interaction of environmental, economic, social, political and institutional factors, moving beyond interpretations that attributed to climate change a direct causal role in migration (Black et al., 2011; Piguet, 2010; McLeman, 2014; IPCC, 2022). Much of that work, however, remains concentrated on identifying the factors that condition mobility in specific contexts, devoting less attention to the historical processes that transform the relationship between climate and mobility over time.

The Brazilian case helps to broaden this analytical horizon by showing that the influence of climate variability on mobility is a historically dynamic relationship. Over roughly one hundred and fifty years, successive regimes of territorial development reorganized economic opportunity, expanded or reduced vulnerabilities, modified the presence of the State and accumulated adaptive capacities that progressively altered the social effects of drought. The recurrence of climate variability remained relatively constant; what changed were the historical conditions responsible for converting — or not converting — those events into population displacement.

This interpretation makes it possible to understand adaptive capacities as long-run historical processes rather than merely as attributes present at a given moment. Water infrastructure, social

protection, the strengthening of family farming, education, social technologies, community organization and public institutions are dimensions that accumulate historically and modify the range of responses available to populations facing extreme climate events. Climate adaptation thus ceases to be understood exclusively as a technical response to environmental impacts and becomes part of territorial development processes themselves.

From this perspective, the experience of the Brazilian Semi-Arid offers a contribution that speaks simultaneously to the political economy of development and to climate adaptation studies. While the former shows how different development projects reorganize territory and distribute economic opportunity unevenly, the latter demonstrates that adaptive capacities condition the social impacts of climate change. The analysis developed in this article integrates these two traditions by demonstrating that regimes of territorial development are the historical processes through which such capacities are produced and continuously transformed.

This proposition also broadens our understanding of human mobility. Rather than treating it exclusively as a consequence of environmental risk or economic inequality, the study demonstrates that population displacement participates in the reorganization of territories themselves and that its relationship with climate variability depends on the ways in which each society historically organizes its development process. The analytical focus thus shifts from the search for direct causal relationships between climate and migration towards the investigation of the historical mediations that transform the influence of climate events on mobility.

The evidence presented does not seek to establish a universal model for explaining mobility in contexts of climate variability, since each region has its own institutional, economic and environmental trajectories. Nevertheless, the historical-institutional model

developed in this study offers an analytical framework potentially applicable to comparative studies in other semi-arid regions, making it possible to investigate how different regimes of territorial development modify, over time, the relationship between climate variability, vulnerability and mobility.

In sum, the principal contribution of this article does not lie in demonstrating that human mobility is multifactorial in nature, a point widely established in contemporary scholarship. Its contribution lies in showing that the very influence of climate variability on mobility is a historically variable phenomenon. Over the course of Brazil's territorial formation, successive development regimes redefined vulnerabilities, reorganized economic opportunity and expanded adaptive capacities, continuously transforming the social effects of drought. This perspective integrates economic history, the political economy of development, critical geography and climate adaptation studies within a single interpretive model, opening new possibilities for understanding human mobility in a context of intensifying global climate change.



6

CONCLUSIONS

This study sought to understand how different regimes of territorial development historically mediated the relationship between climate variability and population mobility in Brazil between the Great Drought of 1877–1879 and the Population Census of 2022. The results confirm the hypothesis proposed by demonstrating that the influence of climate variability on mobility did not remain constant over that period. Although droughts remained a recurrent feature of the Brazilian Semi-Arid, their effects on population displacement were continuously reconfigured by the territorial reorganization of the economy, by state action and by the historical construction of adaptive capacities.

The historical reconstruction showed that population mobility followed successive regimes of territorial development that reorganized the distribution of economic opportunity, of population and of the labour force across the country. More than a consequence of the vulnerabilities produced by drought, mobility proved to be a constitutive component of Brazil's territorial formation, taking part in the expansion of new economic frontiers, the consolidation of urban centres and the spatial reorganization of national development. This perspective makes it possible to understand population displacement not only as a response to economic and environmental transformation but as part of the historical processes of producing territory.

The principal contribution of this study does not lie in demonstrating that human mobility is multifactorial in nature; its contribution lies in showing that the very influence of climate variability on mobility is a historically variable process. Over the course of Brazil's territorial formation, that influence was continuously reconfigured by development regimes, by state action and by the adaptive capacities built within territories. It is not only mobility that changes over time; the explanatory weight that climate variability carries in

relation to it also changes.

This interpretation also broadens our understanding of adaptive capacities. The results indicate that they should be understood not merely as mechanisms for responding to extreme climate events but as historical constructions produced by territorial development processes themselves. Water infrastructure, social protection, the strengthening of family farming, education, community organization, social technologies and public policies progressively modified the conditions of social reproduction of rural populations, reducing vulnerabilities and transforming the historically established relationship between drought and mobility in the Brazilian Semi-Arid.

The study further contributes to bringing together analytical traditions frequently developed independently of one another. By integrating the political economy of development, critical geography, the sociology of migration and climate adaptation studies, it proposes a historical-institutional model that articulates climate variability, structural vulnerabilities, state action, territorial development and adaptive capacities within a single interpretive framework. This integration makes it possible to move beyond readings that treat development, climate adaptation and mobility as parallel analytical agendas, demonstrating that they constitute historically interdependent processes.

The implications of this interpretation extend beyond the Brazilian case. Although the historical and institutional specificities of the Semi-Arid do not permit direct generalization, the results suggest that the relationship between climate and mobility should be analysed as a historical process whose configuration depends on the ways in which different societies organize their development, produce adaptive capacities and confront environmental vulnerabilities. The historical-institutional model developed in this

study thus offers an analytical framework for comparative studies in other semi-arid regions, helping to broaden the dialogue between studies of human mobility, climate adaptation, desertification and territorial development.

Like any historical-interpretive study, this one also has limitations. The analysis privileged long-run processes and did not seek to measure quantitatively the relative weight of each factor in the individual decision to migrate. Future research could deepen this agenda through comparative studies of different semi-arid regions, subnational-scale analyses and longitudinal studies capable of examining how distinct trajectories of territorial development modify, over time, the influence of climate variability on population mobility.

More than explaining why populations migrate in the face of drought, this study demonstrates why the very influence of climate variability on mobility is transformed over the course of history. By showing that this relationship is historically mediated by regimes of territorial development, by state action and by the building of adaptive capacities, the article offers a new perspective for understanding human mobility in contexts of climate change and broadens the dialogue between economic history, territorial development and climate adaptation.

7. REFERENCES

- ALBUQUERQUE JÚNIOR, Durval Muniz de. A invenção do Nordeste e outras artes. 5. ed. São Paulo: Cortez, 2011.
- ANDRADE, Manuel Correia de. A terra e o homem no Nordeste. 8. ed. São Paulo: Cortez, 2005.
- ARTICULAÇÃO SEMIÁRIDO BRASILEIRO (ASA). Programa Um Milhão de Cisternas (P1MC). Recife: ASA, 2024.
- BAENINGER, Rosana. Migrações internas no Brasil no século XXI: entre o local e o global. In: ENCONTRO NACIONAL DE ESTUDOS POPULACIONAIS, 18., 2012, Águas de Lindoia. Anais [...]. Campinas: ABEP, 2012.
- BECKER, Bertha K. Geopolítica da Amazônia. Estudos Avançados, São Paulo, v. 19, n. 53, p. 71–86, 2005.
- BLACK, Richard. Environmental refugees: myth or reality? Geneva: UNHCR, 2001. (Working Paper, n. 34).
- BLACK, Richard; ADGER, W. Neil; ARNELL, Nigel W.; DERCON, Stefan; GEDDES, Andrew; THOMAS, David. The effect of environmental change on human migration. Global Environmental Change, v. 21, suppl. 1, p. S3–S11, 2011.
- BRITO, Fausto. As migrações internas no Brasil: um ensaio sobre os desafios teóricos recentes. Belo Horizonte: UFMG/Cedeplar, 2009. (Texto para Discussão, n. 366).
- CANO, Wilson. Raízes da concentração industrial em São Paulo. São Paulo: Difel, 1977.
- CASTRO, Josué de. Geografia da fome: o dilema brasileiro: pão ou aço. 10. ed. Rio de Janeiro: Civilização Brasileira, 2008.
- COSTA, P. V. M. et al. Raízes fortalecidas: imobilidade sertaneja e proteção social no Semiárido Setentrional. Revista Brasileira de Estudos de População, v. 43, p. 1–25, 2026.
- CUNHA, Euclides da. Os sertões. São Paulo: Ateliê Editorial, 2001.
- DEAN, Warren. Brazil and the struggle for rubber: a study in

environmental history. Cambridge: Cambridge University Press, 1987.

DINIZ, P. C. O.; SANTOS, C. F.; ROZENDO, C. Acesso à água para consumo humano no Semiárido brasileiro: desafios, tensões e perspectivas do Programa Um Milhão de Cisternas. *Contemporânea*, v. 12, n. 1, p. 96–119, 2022.

FAUSTO, Boris. *História do Brasil*. São Paulo: Edusp, 1995.

FURTADO, Celso. *A operação Nordeste*. Rio de Janeiro: Instituto Superior de Estudos Brasileiros, 1959.

FURTADO, Celso. *Formação econômica do Brasil*. 34. ed. São Paulo: Companhia das Letras, 2007.

GARFIELD, Seth. *In search of the Amazon: Brazil, the United States, and the nature of a region*. Durham: Duke University Press, 2013.

HUGO, Graeme. Environmental concerns and international migration. *International Migration Review*, v. 30, n. 1, p. 105–131, 1996.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1940*. Rio de Janeiro: IBGE, 1950.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1950*. Rio de Janeiro: IBGE, 1956.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1960*. Rio de Janeiro: IBGE, 1967.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1970*. Rio de Janeiro: IBGE, 1973.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1980*. Rio de Janeiro: IBGE, 1983.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 1991*. Rio de Janeiro: IBGE, 1994.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 2000*. Rio de Janeiro: IBGE, 2003.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). *Censo Demográfico 2010*. Rio de Janeiro: IBGE, 2012.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). Censo Demográfico 2022: população e domicílios: primeiros resultados. Rio de Janeiro: IBGE, 2023.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge: Cambridge University Press, 2022.

LUNA, Carlos Freire et al. Impact of rainwater cisterns on the occurrence of diarrhoea in children living in the Brazilian semi-arid region. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, v. 105, n. 11, p. 626–631, 2011.

MAHONEY, James; RUESCHEMEYER, Dietrich (eds.). *Comparative Historical Analysis in the Social Sciences*. Cambridge: Cambridge University Press, 2003.

MALVEZZI, Roberto. *Semiárido: uma visão holística*. Brasília: Confea, 2007.

MARTINE, George. A redistribuição espacial da população brasileira durante a década de 80. Brasília: IPEA, 1994. (Texto para Discussão, n. 329).

MARTINS, José de Souza. *Fronteira: a degradação do outro nos confins do humano*. São Paulo: Contexto, 1997.

McLEMAN, Robert. *Climate and Human Migration: Past Experiences, Future Challenges*. Cambridge: Cambridge University Press, 2014.

OJIMA, Ricardo. As dimensões demográficas das mudanças climáticas: cenários de mudança do clima e as tendências do crescimento populacional. *Revista Brasileira de Estudos de População*, v. 28, n. 2, p. 389–403, 2011.

OJIMA, Ricardo. A emigração recente no Semiárido Setentrional, políticas sociais e meio ambiente. *REMHU: Revista Interdisciplinar da Mobilidade Humana*, Brasília, v. 22, n. 43, p. 197–214, 2014.

OLIVEIRA, Francisco de. *Elegia para uma re(li)gião: Sudene, Nordeste, planejamento e conflito de classes*. 6. ed. Rio de Janeiro:

Paz e Terra, 1993.

PIGUET, Etienne. Linking climate change, environmental degradation, and migration: a methodological overview. *Wiley Interdisciplinary Reviews: Climate Change*, v. 1, n. 4, p. 517–524, 2010.

PRADO JÚNIOR, Caio. *Formação do Brasil contemporâneo*. São Paulo: Brasiliense, 1994.

QUEIROZ, Rachel de. *O Quinze*. Rio de Janeiro: José Olympio, 2004.

RAMOS, Graciliano. *Vidas secas*. 127. ed. Rio de Janeiro: Record, 2018.

SABOURIN, Eric et al. (eds.). *A ação pública de adaptação da agricultura à mudança climática no Nordeste semiárido brasileiro*. Brasília: Embrapa, CIRAD, INCT-Odisseia, 2021.

SANTOS, Milton. *A natureza do espaço: técnica e tempo, razão e emoção*. 4. ed. São Paulo: Edusp, 2006.

SANTOS, Milton. *A urbanização brasileira*. 5. ed. São Paulo: Edusp, 2008.

SAWYER, Donald R. Frontier expansion and retraction in Brazil. In: SCHMINK, Marianne; WOOD, Charles H. (eds.). *Frontier Expansion in Amazonia*. Gainesville: University of Florida Press, 1984. p. 180–203.

SCHMINK, Marianne; WOOD, Charles H. *Contested Frontiers in Amazonia*. New York: Columbia University Press, 1992.

SINGER, Paul. *Economia política da urbanização*. 14. ed. São Paulo: Contexto, 2002.

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD). *Global Land Outlook 2: Land Restoration for Recovery and Resilience*. Bonn: UNCCD, 2022.

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD); INTERNATIONAL ORGANIZATION FOR MIGRATION (IOM). *Addressing the Land*

- Degradation–Migration Nexus: The Role of the United Nations Convention to Combat Desertification. Bonn: UNCCD; Geneva: IOM, 2019.
- VILLA, Marco Antonio. Vida e morte no sertão: história das secas no Nordeste nos séculos XIX e XX. São Paulo: Ática, 2000.
- WEINSTEIN, Barbara. The Amazon Rubber Boom, 1850–1920. Stanford: Stanford University Press, 1983.
- Paz e Terra, 1993.
- PIGUET, Etienne. Linking climate change, environmental degradation, and migration: a methodological overview. Wiley Interdisciplinary Reviews: Climate Change, v. 1, n. 4, p. 517–524, 2010.
- PRADO JÚNIOR, Caio. Formação do Brasil contemporâneo. São Paulo: Brasiliense, 1994.
- QUEIROZ, Rachel de. O Quinze. Rio de Janeiro: José Olympio, 2004.
- RAMOS, Graciliano. Vidas secas. 127. ed. Rio de Janeiro: Record, 2018.
- SABOURIN, Eric et al. (org.). A ação pública de adaptação da agricultura à mudança climática no Nordeste semiárido brasileiro. Brasília: Embrapa, CIRAD, INCT-Odisseia, 2021.
- SANTOS, Milton. A natureza do espaço: técnica e tempo, razão e emoção. 4. ed. São Paulo: Edusp, 2006.
- SANTOS, Milton. A urbanização brasileira. 5. ed. São Paulo: Edusp, 2008.
- SAWYER, Donald R. Frontier expansion and retraction in Brazil. In: SCHMINK, Marianne; WOOD, Charles H. (org.). Frontier Expansion in Amazonia. Gainesville: University of Florida Press, 1984. p. 180–203.
- SCHMINK, Marianne; WOOD, Charles H. Contested Frontiers in Amazonia. New York: Columbia University Press, 1992.
- SINGER, Paul. Economia política da urbanização. 14. ed. São Paulo: Contexto, 2002.

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD). Global Land Outlook 2: Land Restoration for Recovery and Resilience. Bonn: UNCCD, 2022.

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD); INTERNATIONAL ORGANIZATION FOR MIGRATION (IOM). Addressing the Land Degradation–Migration Nexus: The Role of the United Nations Convention to Combat Desertification. Bonn: UNCCD; Geneva: IOM, 2019.

VILLA, Marco Antonio. Vida e morte no sertão: história das secas no Nordeste nos séculos XIX e XX. São Paulo: Ática, 2000.

WEINSTEIN, Barbara. The Amazon Rubber Boom, 1850–1920. Stanford: Stanford University Press, 1983