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# Implementing public policies and public action for adapting to droughts in the semi-arid Northeast

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# Public policies for adapting agriculture to climate change in semi-arid Northeast Brazil

*organizers*

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## CHAPTER 1

# Implementing public policies and public action for adapting to droughts in the semi-arid Northeast<sup>1</sup>

*Eric Sabourin*

## Introduction

Several extreme climate events observed in recent years have attracted the public's attention in Latin America on the need to adapt to increasing climate variability. The theme entered the agenda of most governments in the region. In Brazil, climate policies have been influenced by the evolution of the international debate since the 1990s (RODRIGUES-FILHO et al., 2016). The clean development mechanisms and, more recently, reducing deforestation and promoting more sustainable production systems were some of the objectives of these efforts. Notably, the rural sector is among the main sources of greenhouse gas emissions in the country and the sectors most impacted by climate change. Climate projections foresee important changes in temperature and precipitation patterns for Brazilian biomes (MARENGO et al., 2017).

The semi-arid region of the Northeast represents a strategic case in the context of climate change. Although droughts are chronic events in this region, climate variability is expected to increase, generating a series of socio-economic impacts. Increasingly extreme climate events may compromise the resources and response capacity of societies. This scenario highlights the need to implement public policies that consider the increase in climate variability and promote the capacity to minimize, prepare, and recover from potential effects (BOCKEL; SMIT, 2009; CAMPOS, 2014).

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1 This chapter mobilizes results from the projects ARTIMIX (Articulating policy mixes across scales & sectors to address adaptation to climate change challenges in vulnerable tropical agricultural landscapes - ANR-17-CE03-0005), TYPOCLIM (Typology and assessment of policy instruments to promote agricultural adaptation to climate change -MUSE-ANR-16 IDEX-0006) and INCT Odisseia (Observatorio das dinâmicas socioambientais - CNPq). This text mobilize results from ATTER Project which has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101007755.

Brazil, within its National Policy on Climate Change (PNMC), also considers more specific instruments that contribute to climate change adaptation and, among other sectors, the case of agriculture (Milhorange et al., 2020).

In this context, this chapter proposes a crosscutting analysis of the different contributions in this book. The text examines various public policy instruments and public action initiatives on adaptation in agriculture given increased climate variability and, in particular, drought. It proposes a characterization of these policies and the governance arrangements of collective action and public adaptation instruments. The chapter has two parts. The first introduces the institutional context and presents the theoretical and methodological framework. The second develops the main characteristics of the adaptation actions and public policies studied based on the transversal analysis of the cases in this book.

## Climate and institutional context

### Adaptation policies

The Intergovernmental Panel on Climate Change (IPCC, 2014) defines adaptation as “any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities.”

Examples of adaptation measures in the case of agriculture include several practices: using scarce water resources more efficiently, building flood defenses and raising levee levels; developing drought-tolerant crops, choosing tree species and forestry practices less vulnerable to fire, and separating terrestrial corridors to help species migrate.

The National Plan for Adaptation to Climate Change (NPA, PNA in Portuguese), launched in Brazil in 2016, defined 11 sectoral strategies and national priorities: agriculture, biodiversity and ecosystems, cities, natural disasters, industry and mining, infrastructure, vulnerable populations, water resources, health, food security and nutrition, and coastal areas (MMA, 2016).

Milhorange et al. (2019) mention that most of the NPA/PNA’s guidelines are based on existing programs and measures to support agriculture: expansion of storage capacity, inclusive rural production, access to water through rainwater catchment and storage cisterns, and developing agroecological systems.

These authors recall that the National Policy for Food and Nutritional Security (PNSAN) incorporated the motion of universal access to water as one of its guidelines in 2010 and defined the articulation of programs and actions of various sectors that promote the human right to adequate food as a goal.

Figure 1. Political map of the semi-arid region in Brazil



Source: National Semi Arid Institute – INSA, Campina Grande, Brazil

In the context of the Northeast region, the paradigms of *living with the semi-arid region* and *agroecology* are priorities for adapting rural populations in the region to climate change (MMA, 2016). Table 1 presents a typology of the main adaptation policies for the rural sector in the semi-arid region.

Table 1. Main instruments on adaptation in the rural sector of the semi-arid region.

Plan	Program	Instrument
ABC Plan	• ABC credit line; • Pronaf Eco	➔ Credit to transform productive systems
	• One Million Rural Cisterns Programme (P1MC); • One Land Two Waters (P1+2) • Water infrastructure state programs (ProRural, Bahia Produtiva, ProSemiárido)	➔ Decentralized water infrastructure
NAP Plan	• Desertification control program	➔ Technical assistance to restore native vegetation
	• The Harvest Guarantee Programme (over 50% of harvest failure); • The Family Farming Insurance (SEAF);	➔ Climate-related insurance
	• Regional development clusters (goat farming and bee keeping)	➔ Climate resilient productive clusters
	• Family farming credit line (Pronaf, Agroamigo)	➔ Rural credit
	• The Food Acquisition Programme (PAA); • The School Feeding Programme (PNAE)	➔ Food public procurement (commercialization)
	• The Development Programme (Programa Fomento); • The Green Grant Programme (Bolsa Verde); • The Family Grant Programme (Bolsa Família)	➔ Cash transfer (social protection)

## Theoretical and methodological background

This contribution examines the various instruments and devices developed in case studies from a classical framework of sociological analysis of public action based on the five main elements adapted from Lascoumes and Le Galès (2012): the types of instruments, actors involved, ideas or concepts mobilized based on adapting agriculture to drought, the modalities of implementation governance, and the main outcomes. Obviously, regarding *a posteriori* reading, this analysis does not have any systemic or statistical character, but it may allow for extracting lessons learned and trends at the regional scale from the contributions examined.

An instrument of public action constitutes a technical and social device that organizes specific social relations between the public power and its recipients, according to the representations and meanings it carries (LASCOUMES; LE GALÈS, 2010, p. 1). To categorize the instruments, we adopted the typology proposed by Hoods and Margetts (2007): direct intervention of the public budget (*Treasury*), institutional/governance (*Organization*), regulatory (*Authority*), and information system (*Nodality*).

These distinctions can be enriched by introducing more institutional elements regarding the role of public and private actors in the institutional arrangements. The place of institutions is indeed essential to understanding the design and governance of instruments (HOOD, 1983). Concepts mobilized in public



policies and actions can be imported from the international level and climate change adaptation negotiations (e.g., adaptation, risk, and resilience) (AYKUT; DAHAN, 2014). They can also be incorporated into national or regional proposals, such as “living with the semi-arid,” those more specific to the agricultural sector (BERTRAND; AMALRIC, 2017), or alternative paradigms, such as those linked to the concept of agroecology (ALTIERI et al., 2015).

Governance can be more horizontal (vertical) and participatory (hierarchical), with intermediate situations of a mixed nature. Governance can also be integrated, articulated, or coordinated between different instruments or policies at the intersectoral level (Sabourin, 2017). Contrarily, it can be sectoral and segmented. Milhorange et al. (2020) analyze the combinations of instruments (*policy mix*) for adapting agriculture to climate change in the semi-arid area of Bahia and Pernambuco.

Combining the literature (KOOIMAN, 1993; TCU, 2014) with the contributions of this book, we identified four dimensions of governance of public policies, all dynamic, though expressed with somewhat presence and intensity in the modalities of formulation and implementation of the public policies studied. The dimensions are decentralization (*vs.* centralization), intersectoriality (*vs.* sectoriality), participation (*vs.* hierarchy), and governance in networks. The level of implementation, considering actions and activities at the local scale, can come from executing municipal, state, federal, or territorial policies that integrate the dimension of articulation between multiple levels (SABOURIN, 2018).

## Cross-cutting analysis of some tools for adaptation of agriculture to drought

This book integrates 11 contributions. Ten public action instruments or devices for adapting agriculture to droughts are considered, some treated in several chapters.

These public actions and policies, developed from local state or federal levels, are : Adapta Araripe, National Family Farming Support Program (PRONAF) and Agroamigo credit for family farming, harvest insurance Garantia-Safra; Water productive cisterns 2a Água, Local Seed Programs in Ceará, agroecology extension by Federal University of Pernambuco, State Policy on Agroecology and Organic Production (PEAPO) in the state of Sergipe, Pró-Semiárido in Bahia, and the National Territorial Development Program, in the State of Paraíba .

Table 2 at the end of this section summarizes their main characteristics based on the proposed analysis grid.

## The instruments

### *Direct intervention by the public budget (Treasury)*

We can distinguish three major subcategories of direct intervention instruments or measures. The first comprises subsidies (e.g., for equipment such as cisterns, dams, or small irrigation *kits*). The second comprises loans in the form of rural credit, following the example of the PRONAF (particularly Semi-Arid, Women, Youth, and Agroecology) and Agroamigo (Aquino et al.). The third compensatory modality of the Crop Guarantee and other crop guarantee policies (Bolsa Estiagem, Seguro Agricultura Familiar) offers partial payment of the losses to the most vulnerable producers given prolonged droughts.

### *Regulatory instruments (Authority)*

We observed a few main regulatory cases. Generally, they are regulatory instruments or measures within a more global public policy: An example includes the requirement of the Access Document to PRONAF (DAP), which allows access to the different modalities of family farming policy, in addition to credit from the PRONAF, analyzed by Aquino et al.

### *Institutional instruments (Organization)*

The rural territorial development policy of the former Ministry of Agrarian Development (MDA) (CANIELLO; VALENCIA) and the policies of public purchases of food from family farmers, mentioned in several chapters, fall into this category.

It is also the case of the Ecoforte program, developed by the National Policy for Agroecology and Organic Production (PNAPO), to support the structuring of organizational networks and strengthen agroecological knowledge management. It is mentioned in the chapters by Canaviesi et al., Milhomens et al., and Monteiro et al.

The organizational dimension (e.g., of the Productive Cisterns program, the Seed Banks in Ceará, or the Pasture Funds in Bahia articulated by Articulação Semiárido Brasileiro [ASA]) also refers to this category of instrument.

### *Information communication tools (Nodality)*

All rural extension instruments or university extension courses, as in the Mandacaru Settlement of Petrolina-PE, mentioned by Freitas et al. in this book, promote information, capacity-building, and organizational actions that correspond to this type.

The Productive Cisterns Program is based on inclusive small investments associated with training and extension. It is also the case with the Agroecology

policy (PEAPO) in the state of Sergipe or the network of Community Seed Houses in Ceará (LOPES; SCHMITT).

### *Instrument mix*

Finally, the local state agroecology and organic production policies analyzed by Canaviesi et al., Monteiro et al., and Milhomens et al. constitute combinations of several policy tools or the *policy mix* associating various instruments that converge toward the same objectives through coordination. It is also the case of the rural territorial development policy in the State of Paraíba analyzed by Caniedo and Valencia Perafán in this book.

## The actors

All policies analyzed address the activities of a public institution regarding family farmers. Today, however, in most cases addressed in this book, various other actors are also active, ranging from farmers' organizations, civil society NGOs, universities, banks, rural extension entities, or even federated state or municipal secretariats.

The configurations are diverse, but the classic policy executed entirely by a single public institution (ministry, state secretariat, federal, or state public enterprise) is increasingly rare. Even instruments of public-rural extension today involve calls open to private or civil society institutions, as in the case of the former MDA and PRONAF or the Ministry of Social Development (MDS) with productive cisterns or public food purchases.

Even the extension project of the Federal University of São Francisco Valley (UNIVASF) in the Mandacaru Settlement promotes the construction and operation of a socio-technical network that integrates public (research, extension, funding, teaching), private (commerce), and producer institutions and organizations (FREITAS ET AL.).

Over 15 years ago, federal or state rural territorial development policies began mainly based on family farmers' participation through their organizations, as Caniedo and Valencia Perafán note in this book. This participatory governance has been extended to Social Development policies, particularly in the cistern construction programs, in coordination with Articulação Semiárido, ASA Brazil, which federates 3,000 grassroots producer and civil society organizations.

It is very significant that strategies for adapting agriculture to climate change, in particular to droughts, involve the mobilization of different categories of diversified actors to provide a service and decision-making as close as possible to reality and identity of the beneficiaries, territories, and local conditions.

# Concepts mobilized in public action on adaptation to drought

## *Global concepts*

Agroecosystems: this concept defines the specific ecosystem of an agricultural production unit in two reference universes: sustainable agriculture (CONWAY, 1985) for Embrapa's research and agroecology, which refers to a more radical alternative paradigm, presented in the chapters by Monteiro et al. and Milhomens et al. An agroecosystem is an ecosystem with, at least, an agricultural population (HART, 1980). Therefore, it can be understood as a unity of work in the case of agricultural systems, differing fundamentally from natural ecosystems by being regulated by human intervention for a particular purpose (MARTEN, 1988).

In the Adapta Araripe project, the notion of agro-ecosystem is associated with the proposal of consortia and crops or agroforestry systems. Moreover, "to achieve sustainability, the proposal of agro-ecosystems is based on the limited use of energy and external resources, seeking to re-establish food chains, keeping biogeochemical cycles closed as much as possible [and], hence, [keeping] the interest in integrated systems through crop consortia" (ANGELOTTI et al.).

For agroecology promoters, the agroecosystem is defined as a cultivated, socially managed ecosystem; "it is the material anchorage of the processes of matter and energy exchange between the natural and the social sphere" (PETERSEN et al., 2017).

The concepts of vulnerability and resilience are typical of notions originating in the global agenda and associated with the idea of adaptation to climate change (BOCKEL; TINLOT, 2009; PELLING, 2011). Milhomens et al. talk about "climate resilience" and associate it with resistance and resilience of agroecosystems in agroecological transition.

## *Water security*

According to the United Nations (UN/d), ensuring water security means "ensuring sustainable access to quality water in adequate quantity to sustain livelihoods, human well-being, and socio-economic development; ensuring protection from water pollution and water-related disasters; [and] preserving ecosystems in a climate of peace and political stability."

This concept is mobilized for access to domestic water and productive water, particularly regarding the productive cisterns program, One land and Two Waters program, or the Water for All plan (NOGUEIRA; SAITO). Thus, contributing to water security by decentralizing sources and small reservoirs comprises the

adaptation strategies of agriculture to reduce the impact of drought on the poorest people of the semi-arid region (NOGUEIRA, 2017).

The concepts of social technologies and resilience are mentioned in only one case. The notion of social technology for the productive cisterns corresponds to a technical and social adaptation dimension of the self-construction component of these tanks. Following the Institute of Social Technology, Brazil (ITS, 2004), it represents “a set of techniques and transformative methodologies developed [and] applied in interaction with and appropriation by the population, representing solutions for social inclusion and improvement of living conditions.”

### *Local/Regional concepts*

Among the concepts of regional origin, “Coexistence with the semi-arid” “Convivência com o semárido” (CSA) is the most referenced in this book through a *mix of agroecology policy instruments and public action by civil society organizations.*

CSA is typical of a concept based on adapting (of people, communities, agricultural production, and resource management) to the reality of a biome characterized by drought. “Learning to live with the semi-arid region, instead of fighting droughts, means reinterpreting how people deal with their natural environment and reviewing the mechanisms and instruments of public intervention. Instead of seeking to transform the region into what it is not, coexistence implies seeking technological alternatives that allow for [valorizing] potentialities and vocations compatible with its real natural conditions and its social context” (BURSZTYN, 2016).

Two chapters mention local crop consortia that refer to the more global notion of agroforestry systems. Agroforestry systems are “productive systems that can be based on ecological succession, analogous to natural ecosystems, in which exotic or native trees are intercropped with agricultural crops, vines, forage crops, [and] shrubs, according to a pre-established spatial and temporal arrangement, with [a] high diversity of species and interactions among them” (EMBRAPA, undated). They are mobilized through environmental recovery strategies and adaptation to climate change (SCHEMBERGUE et al., 2017).

### *Alternative paradigms*

The concept of agroecology, as an ecological practice, science, and social movement (ALTIERI et al., 2015), is also proposed as an alternative paradigm to traditional agriculture, particularly irrigated agribusiness in the PEAPO study in the State of Sergipe, Monteiro et al.’s study in the semi-arid region of Bahia, and Milhomens et al.’s study. For these proposals for public action, agroecology seeks to radically transform agricultural and food systems. It opposes the conventional

export-oriented model, considering that this transformation is necessary to address environmental and social challenges.

Agroecology advocates greater autonomy for producers regarding input markets and oligopolies selling raw materials and promotes the priority use of production unit resources (SABOURIN et al., 2018). Milhomens et al. present agroecology “as an adaptation strategy to reduce vulnerability and increase the resilience of agriculture in the semi-arid region.”

Milhorance et al. and Milhomens et al. remind us that the adoption of the agroecological approach is among the initiatives of the sectoral strategy for agriculture in the PNA; however, it belongs to a minority and marginal coalition in the face of agribusiness coalitions that justify the “climatization” of its proposals. These authors state that “without changes in the dominant forms of agricultural policy and production, the agroecological approach will hardly surpass the current stage of isolated and socially invisible experiences” (MILHOMENS et al.).

## Modalities of governance of adaptation policies

### *Centralization/decentralization*

Although decentralization (e.g., of state policies [ARRETCHE, 1999]) has progressed significantly in Brazil, particularly in social policies over the last 20 years, it is not a process established in a natural and generalized manner. In addition to the adoption of new practices and rules, the main problem lies in the transfer of resources (financial and human) and decentralized norms, including structural ones. The former MDA has experienced tensions between instruments of the Secretariat of Family Agriculture and those of the Secretariat of Territorial Development. It can be verified in the implementation norms of PRONAF (Aquino et al.). Another example is mentioned in the chapters for the National agroecological technical assistance and rural extension policy (ATER agroecology) methodology, which was considered too bureaucratic and centralized. Certain policies can be decentralized to the municipalities, as with the Garantia-Safra, and maintain hierarchical governance (Aquino et al.).

The most notable decentralization efforts for the climate change adaptation strategy were those of social policies (various categories of grants) noted by Matos et al. and water policies, particularly the MDS programs for the construction of cisterns and underground dams, as evidenced by Cavalcante et al. and Nogueira and Saito.

The policy of recognition and support of grassland communities (*Fundo de pasto*) in Bahia is a successful decentralization and deconcentration of agrarian or land reform, even in its implementation through producer associations (Monteiro

et al.). The same can be observed in the case of community seed banks (LOPEZ; SCHMITT). The application of the notion of multi-level governance completes the decentralization and deconcentration of the State insofar as the articulation between the different levels is planned, anticipated, regulated, and coordinated. It was the case of the territorial development policy, even creating a new level of state action and territory while functioning and supporting autonomous organizational processes of family farmers, as in the case reported by Caniello and Perafán in Paraíba.

### *Intersectoral governance*

Without a doubt, another merit of the former MDA's territorial policy was the attempt to introduce an intersectoral dimension to rural development actions, opening a dialog with the education, health, social development, tourism, and infrastructure sectors.

Embrapa's intervention in Serra do Araripe is in the actions of the Araripe Plaster Industry Hub, a Local Productive Arrangement that associates 16 municipalities in Pernambuco and brings together various public and private actors (ANGELOTTI et al.).

Milhorance et al. analyze the forms of interaction between policies that contribute to climate change adaptation in the states of Bahia and Pernambuco, illustrating how a minimum of coordination and articulation is essential for the success of adaptive strategies. They find that the PNA juxtaposes prior policies without integration. They mention only one case of articulation in the MDS productive cisterns program with ASA member organizations and one space for coordination by discussing state policy actions in Bahia and Pernambuco in the reminiscent territorial council (collegia) of the São Francisco river valley.

### *Participation vs. hierarchization*

Another characteristic of the articulated or territorial policies is that they are participatory and rely on consultation with local organizations and authorities or municipal rural development and environment councils and territorial collegiate bodies. The MDS cisterns program and the former MDA with PRONAF have also transferred resources to municipalities, NGOs, and producer organizations to implement the policy, similar to the management units of the Cisterns Program.

The state policies on agroecology and organic production in Bahia and Sergipe, which supported the *Fundos de Pasto* (community managed collective pasture) in Bahia or the community seed banks in Ceará, were also built and governed by participatory commissions or committees, bringing together public institutions and representatives of civil society or users.

The descriptions of the processes in the different cases in this book show different participation degrees. In the Mandacaru Settlement, this interlocution was long reserved for a single charismatic leader, and the UNIVASF university aimed to train new leaders (Freitas et al.).

In the Adapta Araripe project, farmers' participation is indispensable for experiments in real environments. However, the level of choice or decision on the design or experimentation content can be differentiated per farmers' capacities and resources.

In this book, Nogueira and Saito propose a gender-specific analysis of participation in the case of the productive cisterns program. The fact that the policy of promoting cisterns has been directly based on women has guaranteed productive results insofar as they are responsible for fruit and vegetable gardens in the backyards around their homes. This gender dimension has also been verified in the Mandacaru Settlement (Freitas et al.), Borborema territory in Paraíba (CANIELLO; PERA-FÁN), and the Middle São Francisco (Monteiro et al.).

### *Network governance*

The reports of attempts at network governance in various chapters (Freitas et al.; Monteiro et al.; CANIAVESI et al.; MILHOMENS et al.; CANIELLO and PERAFÁN; LOPES and SCHMITT) also show the great diversity of composition, size, and density of the networks.

In some cases, such as PEAPO in Sergipe or PRONAT in Borborema, the network of local actors pre-exists the policy formulation and promotes its construction, contributing to its implementation. In other cases, the construction or strengthening of a socio-technical network (e.g., around water management, grasslands, or agroecology) is an objective of the intervention. Regarding the seed houses in Ceará, instruments and policies, that favor and others that hinder the dynamics of the network are identified.

## Effects and implications

Public actions and policies in this book show four main categories of results regarding adaptation to drought and climate change.

### *Technical implications*

First, there are elements such as positive technical results on species adaptation, cultivated varieties, breeds of small ruminants that are drought-tolerant, more ecological cultivation techniques such as agroecology, organic production and crop consortia or agroforestry systems, and management of the dry forest called *caatinga*. These results are generally associated with rain-dependent agricultural



production or only supported by occasional small irrigation of vegetables, fruits, and forage crops.

Second, there are technical alternatives for local and decentralized water collection and storage, particularly productive cisterns and underground dams. Third, programs such as Prosemi-arido in Bahia, ProRural in Pernambuco,

Seed Banks in Ceará, PRONAT in Paraíba, Water for All, and Agrarian Reform in Petrolina have allowed for constructing collective infrastructure for processing, storage, and commercialization of agricultural raw materials, food, fibers, and handicrafts. However, above all, they have managed to train local human resources to manage and maintain them.

However, the most significant factor in adaptation impacts was the capacity to widely disseminate the technical elements or social technologies as cisterns, fodder palm, fodder silage, or the valorization of *caatinga* resources.

### *Social effects*

One can distinguish social effects in compensation and transfer and social outcomes in population organization. In their contribution, Mattos et al. compare climate data from three drought periods: 1980–1983, 1990–1993, and 2012–2016 and their social impacts. Despite being more prolonged (lasting until 2018 in several areas), the last period did not have severe agricultural and socio-economic consequences. The authors attribute this difference to the greater organization and resilience of farmers to social public policies (*Bolsa Família*, Rural retirement, Bolsa Estiagem, Garantia-Safra) and instruments for adapting agriculture to drought. Regarding the latter, they highlight those brought together in the proposal for living with the semi-arid, water decentralization, networked Technical Assistance and Rural Extension, and agroecological practices. They consider it a “combination of policies of permanent action, social, environmental, [and] infrastructure [...] that made the drought of 2012–2016 seem much milder than its predecessors.”

Table 1. Characteristics of the adaptation instruments analyzed

<b>Instrument</b>	<b>Type</b>	<b>Concepts</b>	<b>Actors</b>	<b>Governance</b>	<b>Effects</b>
PNA + Cred	Policy mix	CSA	Multiple	Mixed, poorly integrated	Relevance and coherence of C with semi-arid
Adapta Araripe	Information	Sustainable Agri AESS	Embrapa+ IPA, ITEP	Participatory Experimental	Adapts crop and livestock farming techniques
PRONAF -Agroamigo	Treasure	Family farming	Audience,	Hierarchical decentralized	Consolidation of cattle ranching and drought- tolerant agriculture
Garantia-Safra	Treasure	Risks	Family farming	Hierarchical decentralized	Support consumption and purchase inputs
Cisterns 2nd water MDS	Treasure + Information	Social technology/ water security	Multiple	Participatory + NGO + gender	Women productive autonomy
PNBI Bioinsumes	Regulation Authority	Sustainable Agri	Public	Sectoral	Not yet
ATER ext Univ Mandacaru	Information	TAE and AE	Multiple	Participatory , networks	Capacity- building, leadership training
PEAPO Sergipe	Information and organization	AE and PO	Multiple	Participative Networks	Institutionalization of the EA by the actors
PSA Bahia	Information and Regulation	AE, AESS resilience	Multiple	Participation + NGO, Org. prod.	Autonomy, endogenous income, recovery of the caatinga
Territorial Development	Organization and treasure	AE, CSA	Multiple	Intersectoral participatory	Collective infrastructures, capacities in favor AE
Ceará Seeds	Organization and information	CSA	Civil society, O. P.	Participatory , networked	Org. and gender reinforcement, backyard revitalization
AE NSA	Organization and information	AE, CSA, AESS, Resilience	Multiple	Participatory and networked	TAE support, Strengthening socio-technical networks and resilience AF

Legends: AE: Agroecology; FA: Family farming; AESS: Agroecosystems; CSA: Convivência com o semárido; PO: Organic production; TAE: Agroecological transition.

Source: Authors, from the chapters of this book.

Several chapters indicate the role of social or conditional transfer policies in adapting rural populations to the last prolonged droughts. Even the crop insurance *Seguro-Safra* ended up being institutionalized by the drought permanence into an almost perennial instrument, enabling it at the level of beneficiaries as a social and food security policy and not just a productive support to buy new inputs.

Strengthening the organizational and representative capacities of family farmers, particularly women and youth, has been essential for drought adaptation as it has delivered three complementary types of results:

- i) The access to public policies and services (non-access remains but is reduced);
- ii) The capacity to manage inputs and equipment accessible through rural credit or collective infrastructures obtained from public subsidies;
- iii) The capacity for building local organization and territorial or regional articulation in larger organizations or networks.

### *Political and institutional effects*

Regarding ideas and political resources, the success and consolidation of the paradigm of “living with the semi-arid” for family farming in the Northeast of Brazil is a step forward for an increasingly broad coalition of actors originating came from the social movement and state articulations.

Regarding agricultural and rural development strategy, this proposal, associated with water decentralization and agroecological transition (including bio-inputs, organic production, crop consortia, agroforestry systems, management of the *caatinga*, and local seeds), is based on labor intensification as an alternative to capital intensification.

Part of public policies at the federal level that contributes to adapting agriculture to climate change has suffered a major dismantling since the Temer government (2016 for family farming policy and territorial development) or from the Bolsonaro government (2019 for federal councils, environmental, and agroecology policies) (SABOURIN et al., 2020). However, several federated state rural development programs in the Northeast, such as Pró-Semiárido, the Dom Helder Camara Project, or São José Project, linked to loans from international organizations (e.g., World Bank and IFAD), are threatened with closure by the opposition of the federal government’s guarantee.

In this context of reduced federal resources, there was an attempt to progressively institutionalize state agroecology policies and food public purchases of family farming products, following the states of Bahia, Sergipe, Ceará, and Maranhão (SABOURIN et al., 2019). However, the processes remain fragile and dependent on ministerial orders and relatively “weak” institutional instruments.

## Final considerations

The above results show the attempts to consolidate a strategy of adaptation of agricultural production to climate change given the characteristics and specificities of the resources of the *caatinga* biome. The idea of climate adaptation comes stems from an international agenda but has existed at the territorial level, particularly in the semi-arid Northeast, as per a previous in-depth reflection and experience.

The technological and socio-technical content results from an accumulation of experimentation by research and extension centers and management and horizontal dissemination of adaptive practices of local populations. Rural social movements with academic centers, civil society organizations, and international funding have promoted this strategy. In certain cases, they have integrated more articulated and sufficiently strong coalitions to construct municipal, state, and even federal public policies on family farming, seeds, cisterns, traditional peoples and communities, and agroecology.

Despite the current unfavorable federal political and administrative context, this strategy constitutes a framework and a programmatic basis. It represents a series of advances that seem difficult to be completely broken or dismantled, even in the current context of dismantling federal policies. Several components of the adaptation strategy are not easily reversed such that its implementation does not depend solely on resources linked to federal public policies.

Moreover, most contributions in this book do not always show a critical reading of the policies studied, particularly of innovation or implementation limits or challenges (HOWLETT, 2014). In some cases, these policies are very recent, such as the Agroecology policy in Sergipe. Further, given that there are no results yet, it was only possible to identify the challenges or mechanisms in their construction.

Some chapters describe alternative technical proposals or analyze socio-economic data at the scale of the production units and focus on the progress achieved relative to prior practices or situations. It may also represent the expression of a certain technological, methodological or militant bias in favor of the object of study. However, two chapters do not spare criticism to the policies analyzed: The chapter by Aquino et al. on the limits of content and implementation of PRONAF and *Garantia-Safra* crop insurance, and that where Mesquita et al. show the great lack of articulation and coordination between the different adaptation instruments, particularly through dialog spaces as the municipal and territorial councils.

Most of the chapters present a series of specific recommendations for the maintenance, expansion, or evolution of instruments of adaptation policy

studied. Nevertheless, the first recommendation is coordination or integration between various sectoral policies and the different implementation scales.

Given the intersectoral nature of the climate challenge, more integrated approaches are key to reducing vulnerability to these events (AHMAD, 2009). Indeed, integration is a political process, not just an administrative one. It depends on the coordination of actors, confrontation of ideas, and sometimes mediation (Mesquita et al.).

Different systems have different sensitivities to disturbances and an unequal potential to resist and adapt to these changes. In this context, regionalized analyses of climate policy formulation and implementation are needed, including the different instruments combinations that materialize in each territory, interactions between actors at different levels, and mobilizing distinct adaptation visions and discourses.

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