THE TRANSFORMATIVE POTENTIAL OF AGROECOLOGY: INTEGRATING POLICIES, PRACTICES, POWER, AND PHILOSOPHIES FOR LIVING WELL

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Abstract

The dominant industrial agri-food system is a key contributor to global socioecological crises, including climate, biodiversity, and public health crises. In response, social movements, researchers, and decision-makers have increasingly called for transforming food systems through agroecology. Commonly defined as a science, practice, and social movement, agroecology provides a holistic alternative paradigm for (re)designing agri-food systems that are based on ecological principles and social justice.

Given its status as an agricultural powerhouse and its reputation for advancing agroecological innovations through state and civil society institutions, this thesis uses Brazil as a case study to assess agroecological approaches to food systems transformation at multiple scales. First, through a literature and policy review, I take a historical-relational-interactive approach to describe how the interplay between social movements, the state, and the agribusiness sector has shaped agroecological policy in Brazil, assessing the degree to which its institutionalization was successful. I then use municipal-level agricultural census data to identify how agroecological indicators are spatially distributed across Brazil in order to identify municipalities with relatively high and low agroecological performance. I suggest that stronger agroecological performance is influenced by grassroots organizations, local cultures and traditions, and access to public policies and markets. Third, I analyze farm management plans and interview data to assess the relationship between farm size and agroecological practice use among farmers in an agroecology network in southern Brazil, and suggest that the lack of a relationship may be explained by the role of social movements in promoting a shared vision for territorial autonomy. Finally, given the central role of social movements and networks in advancing agroecology, I take an ethnographic

approach to investigate how actors involved in Brazil's agroecology movement describe and define agroecology from their own perspectives, and find that they explain agroecology as a philosophy for living well.

Collectively, these findings provide additional evidence for the crucial role that social movements play in scaling out agroecological policies, practices, and principles. Therefore, increased support and investment should be directed to territorially embedded networks and organizations that are already successfully implementing agroecological approaches on the ground.

Lay Summary

The industrial agri-food system is a key contributor to climate, biodiversity, and public health crises. In response, social movements, researchers, and decision-makers have increasingly called for transforming food systems to be based on agroecology. Commonly defined as a science, practice, and social movement, agroecology provides a holistic and alternative approach for (re)designing agri-food systems that align with ecological and social justice principles. Using Brazil as a case study, this thesis provides an integrated, mixed-methods analysis of the ways in which an agroecological approach can be implemented at multiple scales through creating innovative policies; promoting agroecological practices across diverse farm types; building collective power via social movements; and cultivating new values and relationships in the pursuit of well-being. Collectively, the findings provide additional evidence for the crucial role that social movements play in scaling out agroecological policies, practices, and principles.

Preface

This dissertation is my original work; I led the research design, data collection, analysis and interpretation, writing, and editing of all chapters contained in the thesis. I benefitted from the guidance of Drs. Hannah Wittman, Navin Ramankutty, and Jennifer Blesh, who provided input and feedback on conceptualization, research design, and analysis in their roles as committee members. An earlier version of Chapter 2 received comments from Natal João Magnanti, Ademir Antônio Cazella, and Evan Bowness. Chapter 3 benefitted from the input of Christian Levers on research design and methods. Natal João Magnanti, Ademir Antônio Cazella, and Cristiano Motter contributed data and input for Chapter 4 and Jeff Liebert offered statistical guidance and feedback. I collaborated with master's student Rebecca Wolff to develop the conceptual framework that informed the structure of Chapter 5. Fieldwork was supported by the Brazilian NGOs CEPAGRO and Centro Vianei, which hosted me in Brazil and connected me to farmers and organizers as part of our shared commitment to community-based research. Research conducted for this project was approved by UBC's Behavioral Research Ethics Board (UBC BREB number: H15-00600).

All chapters in this thesis are unpublished and have been written as independent manuscripts, and I intend to submit chapters 3, 4, and 5 to academic journals. Thus, the chapters share some repetition, in particular related to outlining the state of agri-food system (un)sustainability, introducing the paradigm of agroecology, and describing the Brazilian context.

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List of Abbreviations

ATER	Assistência Técnica e Extensão Rural (Technical Assistance and Rural Extension)
CEPAGRO	Centre for the Study and Promotion of Collective Agriculture
CONSEA	Conselho Nacional de Segurança Alimentar e Nutricional (National Council on Food and Nutritional Security)
CONTAG	Confederação Nacional dos Trabalhadores na Agricultura (National Confederation of Agricultural Workers)
CSA	Community Supported Agriculture
Embrapa	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)
FAO	Food and Agricultural Organization of the United Nations
FNDE	Fundo Nacional de Desenvolvimento da Educação (National Fund for the Development of Education)
FSN	Food Security and Nutrition
FUNAI	Fundação Nacional do Índio (National Foundation for Indigenous Peoples)
HHP	Highly Hazardous Pesticides
HRI	Historical-Relational-Interactive
INCRA	Instituto Nacional de Colonização e Reforma Agrária (National Institute for Colonization and Agrarian Reform)
MAB	Movimento dos Atingidos por Barragens (Movement of People Affected by Dams)
MAPA	Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Livestock, and Food Supply)

MDA	Ministério do Desenvolvimento Agrário (Ministry of Agrarian Development)
MDS	Ministério do Desenvolvimento Social (Ministry of Social Development and the Fight against Hunger)
MG	Minas Gerais
MP	Medida Provisória (Provisional Measure)
MST	Movimento dos Trabalhadores Rurais Sem Terra (Landless Rural Workers' Movement)
NGO	Non-governmental Organization
PAA	Programa de Aquisição de Alimentos (Food Acquisition Program)
PGS	Participatory Guarantee Systems
PNAE	Programa Nacional de Alimentação Escolar (National School Feeding Program)
PNAPO	Política Nacional de Agroecologia e Produção Orgânica (National Policy on Agroecology and Organic Production)
PR	Paraná
PRONAF	Programa Nacional de Fortalecimento da Agricultura Familiar (National Program for the Strengthening of Family Farming)
PT	Partido dos Trabalhadores (Workers' Party)
PTB	Partido Trabalhista Brasileiro (Brazilian Labor Party)
RS	Rio Grande do Sul
SC	Santa Catarina
SP	São Paulo
TAPE	Tool for Agroecology Performance Evaluation

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To the farmers, workers, community organizers, activists, and decision-makers working on the frontlines every day to advance agroecology and create new possible worlds. A luta continua.

Chapter 1: Introduction

1.1 Background

Globally, the industrial agri-food system is a driver of ecological crises, contributing to deforestation, biodiversity loss, climate change, and land and water pollution and degradation (Campbell et al. 2017; Foley et al. 2011; Power 2010). Additionally, the social and public health costs associated with the industrial food system are high: two billion people are moderately or severely food insecure and healthy diets are unaffordable for at least three billion people (FAO et al. 2020). A tragic irony is that many of these same people are farmers or food and agricultural workers who are struggling to make ends meet and are subject to a wide range of occupational hazards and exploitative conditions (FAO et al. 2020; IPES-Food 2017). These negative outcomes have led to renewed calls for transformation toward food systems that provide affordable, accessible, nourishing, and culturally appropriate food for all, while improving social equity, respecting environmental boundaries, and enhancing local-to-global ecosystem services (Anderson 2019; Anderson et al. 2019; Caron et al. 2018; FAO, UNDP, and UNEP 2021; IPES-Food and ETC Group 2021).

In response, scholars (e.g., Anderson et al. 2019; Bezner Kerr 2020), civil society actors (e.g., HLPE 2019; IPES-Food 2016), social movements (e.g., La Via Campesina 2019), governments (e.g., Gonzalez, Thomas, and Chang 2018; Red Políticas Publicas en América 2017) and intergovernmental organizations (e.g., FAO 2018b, 2018a) have increasingly highlighted the transformative potential of agroecology as an alternative to the industrial agrifood paradigm: "Rather than tweaking the practices of unsustainable agricultural systems, agroecology seeks to

transform food and agricultural systems, addressing the root causes of problems in an integrated way and providing holistic and long-term solutions" (FAO 2018b, p. 2). Agroecology is commonly described as a science, a practice, and a social movement (Wezel et al. 2009). As a science and practice, agroecology entails applying traditional, experiential, and/or scientific socioecological knowledge to agrifood systems in order to produce food, maintain or enhance ecosystem functions, and contribute ecosystem services (beyond food production) to people (Méndez, Bacon, and Cohen 2013; Vandermeer and Perfecto 2013; Wezel et al. 2009). As a social movement, agroecology is linked to the calls of transnational agrarian organizations to rectify power imbalances within the global agrifood system, which benefit corporate actors at the expense of human and environmental health and well-being (Patel 2009; Wittman 2011).

While there has been an increasing tendency to frame the term agroecology as confusing or unclear due to its tripartite definition as a science, a diverse set of practices, and a social movement (Wezel et al. 2009), agroecologists argue that this framing obscures advances in agroecological scholarship and practice that explicitly incorporate social dimensions of agroecology. For example, Méndez et al. (2013) state,

> [W]e argue that a persistent depiction of agroecology as unclear explicitly ignores important aspects of its evolution as a field of knowledge [with roots in ecology and agronomy, and having expanded to include social science analyses of broader food system issues]. In addition, presenting the agroecological approach as confusing justifies the application of narrow definitions that may be better suited for particular perspectives.

In particular, Méndez et al. and others note that it is important to avoid "narrow definitions" that neglect the social dimensions of agriculture by instead focusing only on the technical aspects of agroecology (e.g., using certain practices to increase efficiency without challenging unequal social relations (Alonso-Fradejas et al. 2020)) or limited, productivist outcomes (e.g., only yield and profit at the expense of a broader suite of social, cultural, economic, and environmental metrics (Anderson and Maughan 2021)). Challenging these narrow definitions is viewed as crucial to prevent corporate and technocratic institutional actors from potentially co-opting agroecology, which agroecologists repeatedly describe as a systems-change-oriented approach to transforming the political economy of the food system (Gliessman and Montenegro de Wit 2021; Méndez et al. 2013; Sevilla Guzmán and Woodgate 2013). In particular, agroecology scholars and advocates clearly articulate that the social movement component of agroecology is just as essential as the scientific and practice components, and that

> attempts to define agroecology as an applied science without a social context, without problematizing capitalist relations of production or allying itself with agrarian social movements, will significantly limit its ability to contribute to more sustainable systems of food production, distribution and consumption (Sevilla Guzmán and Woodgate 2013, p. 33).

Therefore, while it is possible to focus on any one of these dimensions of agroecology – science, practice, or movement – insights on any one of these components shouldn't be conflated with the overall concept of agroecology, as there are other equally important dimensions to consider. Transformative approaches to agroecology require the holistic integration of all three of these

dimensions (Méndez et al. 2015, 2013; Wezel et al. 2020), and the foregrounding of conversations around equity, justice, and social change (Chappell and Schneider 2016).

Despite the promise of agroecological approaches for transforming the food system toward greater environmental sustainability and social equity (HLPE 2019), the question remains: How can agroecological approaches be "scaled out"[1] to support more just and sustainable food systems? Using an interdisciplinary, mixed methods, and multi-scalar approach, this dissertation explores how the interplay of policies, practices, and social movements contributes to advancing agroecology as an alternative model of "development" in Brazil – a country where political innovations and agrarian social movement activity provide fertile ground to explore agroecological approaches.

1.2 Theoretical Framework

Fundamentally, this dissertation interrogates approaches to rural or agricultural "development." The idea of development is contested, raising questions like: What is development – is it economic growth or quality of life, and according to whom? Who gets to decide what development looks like? Whose knowledge and experience counts, and whose is made marginal? For the purposes of this dissertation, two competing approaches to agricultural development play a major role in shaping rural livelihoods and landscapes in Brazil, making it a good case study: Top-down, technocratic approaches aligned with the Green Revolution, and bottom-up,

[1] Following Moore, Riddell, and Vocisano (2015), "scaling out" refers to expanding an initiative or activity to involve more people and communities.

participatory approaches rooted in agroecology (Schneider, Shiki, and Belik 2010). These are elaborated below.

1.2.1 Top-down Agricultural "Development"

One of the most dominant theories about how development unfolds is modernization theory, elaborated in Rostow's model of economic growth (Rostow 1959). Rostow suggested that "progress" toward "modernity" is linear; therefore, pre-industrial or "traditional" societies will all "develop" according to the same trajectory, ultimately becoming high-consumption, industrialized societies. Given that traditional societies are often agrarian or land-based, and that (according to this theory) development occurs precisely according to these stages and in a linear fashion, modernization theory has contributed to a pervasive tendency among development practitioners and governments to create "one-size-fits-all" policy approaches to agricultural development to "modernize" peasants, who are perceived as in a state of under-development or "backwardness" (Pimbert 2015; van der Ploeg 2017; Sevilla Guzmán and Woodgate 2015). The assumption embedded in this theory is that agricultural technologies, innovations, or policies created in one context (in particular, in high-income countries in the Global North) should be easily transferrable and applicable to others (in particular, low- and middle-income countries in the Global South) (Sevilla Guzmán and Woodgate 2013).

Pro-modernization approaches to agriculture took off globally during the 1960s, corresponding to the "Green Revolution" period. This period saw new technologies emerge that aimed to support increased yields, including a package of inputs such as new high-yielding staple crop varieties, synthetic fertilizers, and promotion of other agricultural inputs such as lime to

transform acidic soils, alongside new innovations in mechanization and infrastructure (Holt-Giménez and Shattuck 2011; Pingali 2012). However, many of these innovations were only accessible to more capitalized farmers – who were incorporated into increasingly concentrated value chains – while creating new forms of dispossession and exclusion that often pushed peasant farmers, who were viewed as economically inefficient, off of the land (Holt-Giménez and Altieri 2013; Patel 2013; Veltmeyer 2009). As a result, many small and family farmers struggled to stay in the countryside; if they weren't able to modernize, they often relied on finding additional positions as rural wage laborers, or out-migrated to urban areas in search of work (Holt-Giménez and Shattuck 2011; Veltmeyer 2009, 2020; Wolford 2004).

Subsequently, the 1980s–1990s saw high-income countries, intergovernmental and financial institutions like the World Bank, and transnational corporations push for neoliberal policies that promoted liberalized trade, deregulation, and privatization in the name of "development," viewed narrowly as economic growth (Martínez-Torres and Rosset 2010; McMichael 2005). These policies, institutionalized through mechanisms like the World Trade Organization's Agreement on Agriculture (Murphy 2021), further undercut the livelihood options for farmers, particularly in the Global South, as they were now forced to compete in the global market – punctuated by crises of overproduction – with reduced access to state subsidies and protections (Holt-Giménez and Shattuck 2011; McMichael 2014). Overall, these forces led to a reduction in autonomy – both for peasants, whose livelihoods were eroded, as well as for "modernized" farmers, who became increasingly dependent on external inputs and globalized markets (van der Ploeg 2008).

In Brazil, the state and corporations have played a heavy role in promoting agricultural modernization, Green Revolution technologies, and neoliberal policies, thereby entrenching a top-down, technocratic, and narrow approach to agricultural development (Caporal and Petersen 2012; Martine 1991; Sencébé, Pinton, and Cazella 2020). This strategy has not only disproportionately benefitted more capitalized rural producers and corporations at the expense of peasant farmers, but has also further fueled the concentration of resources, wealth, and land (Martine 1991). However, in more recent years, civil society and social movement advocacy has prompted the state to experiment with alternative agricultural development policies and more democratic forms of governance, creating space for grassroots actors to have a say in agricultural development and rural futures (Grisa and Schneider 2014, 2015).

1.2.2 Bottom-up Alternatives: Food Sovereignty and Agroecology

The negative effects of the Green Revolution and globalization on the environment (through unsustainable resource use and externalities associated with synthetic inputs (Conway 1997; Robertson and Swinton 2005)) and on rural livelihoods (by squeezing family farms and pushing farmers to either industrialize, find work as rural laborers, or out-migrate (Holt-Giménez and Shattuck 2011; Veltmeyer 2020)) contributed to the emergence, strengthening, and evolution of agrarian social movements. In response to these socioecological crises, agrarian movements coalesced under the banner of "food sovereignty" to question and critique the Green Revolution paradigm and neoliberal policies. Instead, they argue that farmers, traditional and Indigenous peoples, and rural workers should have the right to define and control their own agri-food systems (Desmarais 2002, 2008; Nyéléni Forum for Food Sovereignty 2007). Specifically, these social movements advocate for alternatives rooted in *agroecology*, as a rural development

paradigm that would allow peasants and rural people to remain in the countryside, producing food in an environmentally sustainable, dignified, and place-based manner (Rosset and Martínez-Torres 2012, 2014; Wittman 2011).

In direct contrast to one-size-fits-all or "silver bullet" developmental approaches, agroecology aims to incorporate "Western scientific knowledge" with experiential, place-based, and traditional socioecological knowledge held by local peoples to promote long-term sustainability in a way that is appropriate and unique to different sociocultural contexts (Woodgate 2015). Agroecologists articulate how this dialogue between scientific knowledge, which is "general but shallow," and experiential knowledge, which is "deep but narrow", has the potential to build upon the strengths of traditional agricultural practices by linking them to fundamental ecological processes while respecting local cultures (Vandermeer and Perfecto 2013). Yet at the same time, this focus on practices must be linked to politics, as the transformative potential of agroecology is explicitly linked to upending unequal power relations that have dispossessed and exploited rural peoples and lands. Ultimately, agroecology as an alternative to development (Pimbert 2015) or even a "post-development" movement (Giraldo 2019; Woodgate 2015) is intricately linked to a reduction in dependencies introduced via modernization, neoliberalization, and globalization, and instead promotes the "exercise of more autonomy, such that people can again take control of their immediate problems" (Giraldo 2019, p. 86).

1.3 Research Context: Brazil

This dissertation focuses on holistically understanding the evolution of agroecological approaches in Brazil, a country where these competing visions for agricultural development

interact to shape rural lands and livelihoods. Brazil presents a useful case for assessing agroecological approaches to food systems transformation and rural development for a number of reasons. First, it is one of the most agrobiodiverse diverse countries in the world (Convention on Biological Diversity Secretariat n.d.) and is also an agricultural powerhouse, positioned as a world leader in the production of commodities like soy, beef, sugar, coffee, and more (Martinelli et al. 2010). Given that agriculture is a major driver of environmental degradation, and that Brazil is home to ecosystems that are of global importance, Brazil's agricultural development strategies have far-reaching implications. Second, researching agri-food system sustainability in Brazil provides the opportunity to study the relationship between these two competing pathways to agricultural development. On one hand, for over 500 years Brazil's government has been promoting the growth of large-scale farms and agribusinesses, which typically grow cash or flex crops, often for export (Ferreira Filho and de Freitas Vian 2016; Lapola et al. 2014). On the other, since re-democratization in the 1980s and especially under the Luiz Inácio Lula da Silva ("Lula") administration in the 2000s, various government agencies have also been supporting organic and family farming through a number of integrated sustainable rural development programs (McKay and Nehring 2014; Veras Soares et al. 2013; Wittman and Blesh 2015). Comparing these two approaches – within an otherwise shared institutional and environmental context – makes a focus on Brazil informative for this project. Third, Brazil has a rich history of agrarian movements, with groups like the Landless Rural Workers' Movement (MST) at the forefront of global movements promoting agroecology as a new way to relate to one another and the land.

In this dissertation, there is also a specific focus on Brazil's southern region, made up of the states of Paraná (PR), Santa Catarina (SC), and Rio Grande do Sul (RS). This region, and SC in particular, has been selected for ethnographic fieldwork for several reasons. First, my research group has established relationships there with farmer networks, researchers, and non-governmental organizations (NGOs) – namely two NGOs called CEPAGRO and Centro Vianei, which provided a home base for this project. Second, agriculture is one of the primary economic activities in the state, but it is also a driver of negative environmental outcomes, such as deforestation. This is important given that SC is situated in the Atlantic Forest biome – a biodiversity "hotspot" (Ribeiro et al. 2011). Lastly, SC is considered a regional leader for agroecology in Brazil; the MST and the agroecology network Rede Ecovida are very active in SC and throughout Brazil's south. Thus, SC offered a good opportunity to work with agroecological farmers, activists, and practitioners to better understand agroecology as a set of practices and as a movement.

1.4 Research Objectives

Given its status as an agricultural powerhouse and also its reputation for advancing agroecological innovations through state and civil society institutions, this thesis uses Brazil as a case study to assess agroecological approaches to food systems transformation at multiple scales. Specifically, the objectives of this dissertation are to: a) understand the pathways by and extent to which agroecology discourse and policy has become institutionalized, or taken up, by the Brazilian state; b) use agroecological indicators to assess the distribution of agroecological practices and performance in Brazil and identify potential drivers of agroecological transitions; c) understand whether farm size influences the use of agroecological practices among farmers in

an agroecology network; and d) understand and describe how grassroots agroecological actors define and frame agroecology.

The first objective (a) is explored in Chapter 2. In this chapter, I ask: What has been the trajectory of agroecology-inspired policy in Brazil? How have historical context, competing agricultural development paradigms, state and non-state actors, and their interactions shaped land and food policy in the country broadly? To what extent has agroecology policy been successfully institutionalized via state structures, and what were the drivers of institutionalization? The purpose of these questions is to understand the diverse factors and processes that have shaped the current state of agri-food policy in Brazil, as well as to glean lessons from this historical-relational-interactive approach given the current political conjuncture (with the rise of an authoritarian regime).

Looking at the state of agroecology policy also raises questions about the state of agroecological performance. To this end, the second objective (b) is explored in Chapter 3, where I investigate the spatial distribution of key indicators of agroecology in Brazil, based on data collected in its 2017 Census of Agriculture (IBGE 2017). Research questions include: How can an indicator-based approach be used to identify different dimensions of agroecological performance at larger spatial scales? How does the distribution of agroecological indicators differ across Brazil, and which regions and municipalities perform better or worse? Which factors may be influencing agroecological performance?

In Chapter 4, I address the third objective (c) through a quantitative assessment of approximately 600 farm management plans from the agroecology network Rede Ecovida, contextualized with insights from interviews with agroecological actors. In light of recent studies on the organic farming sector in the Global North that have demonstrated a relationship between farm size and agroecological practice use, I ask: Does this relationship hold among farmers embedded in a participatory agroecology network in the Global South? What might condition the relationship between farm size and agroecological practices in this context, and what lessons can be drawn for other contexts?

Finally, using ethnographic methods, Chapter 5 addresses the last objective (d). Given the integral role that the agroecology movement plays in "scaling out" agroecological practices and in developing a vision for food systems transformation, I ask: How do farmers and other actors in the agroecology movement define and frame the concept of agroecology? How can this inform new ideas about development and living well in a context of socioecological crisis?

1.5 Methods and Approach

1.5.1 Engaged Agroecological Scholarship

The methodological approach taken in this dissertation is informed by my commitment to engaged scholarship, with the goal of not only generating and making visible knowledge about the world, but also having this knowledge be of service to community-based groups and society more broadly (Raphael 2019). To this end, engaged agroecological scholarship and praxis is characterized by collaboration and co-generation of ideas and learning outcomes with knowledge

users, an action orientation, and ongoing reflexivity on the part of the researcher (Bell and Bellon 2018; Méndez et al. 2015; Montenegro de Wit et al. 2021; Raphael 2019). Méndez et al. (2015) describe an agroecological praxis as encompassing many or all of the following characteristics: First, it is transdisciplinary and problem-focused, drawing from approaches "that value and integrate different types of knowledge systems, which can include information from scientific or academic disciplines, as well as experiential, local, indigenous, or other forms of knowledge" (Méndez et al. 2015, p. 5). Closely related to this characteristic of being transdisciplinary and problem-focused, agroecological research is systems-change-oriented, collaborative in nature, and engages with a diversity of knowledge systems and perspectives (Bell and Bellon 2018; Montenegro de Wit et al. 2021). The goal is to co-create knowledge that is useful to participants or communities and conduct research in support of social change (FAO 2018b; Méndez et al. 2015). Lastly, agroecological approaches aim to be transformative, and therefore also engage with political economic forces beyond the farm (Gonzalez de Molina 2013; Méndez et al. 2015). As a result, transformative agroecology requires taking an integrated and "holistic approach to the science and practice of agroecology in close dialogue with critiques of rural development put forth by academics, practitioners, and social movements" in pursuit of greater environmental sustainability, equity, and justice (Méndez et al. 2015, p. 8).

In order to gain a more holistic understanding of how agroecological approaches function in the Brazilian context, this project draws upon fieldwork, mixed methods, and concepts that span the disciplines of rural and development studies, environmental sociology, geography and political ecology, and land use science. Fieldwork took place in Santa Catarina, Brazil from April–May 2017 (for a scoping and relationship-building visit), March–June 2018 (for preliminary fieldwork

and further relationship-building), and September 2018–May 2019 (for an extended period of fieldwork). Fieldwork was supported by CEPAGRO and Centro Vianei, two NGOs with which my lab group has an ongoing collaborative relationship. In addition, these two NGOs are member organizations of the agroecology network Rede Ecovida, and play an important role in supporting farmers in agroecological transitions while also being involved in political advocacy from the local to national levels. Reflexive engagement with CEPAGRO and Centro Vianei was instrumental to this research project, as these organizations provided a space for participant observation and learning, and connected me with agroecological farmers, decision-makers, and Rede Ecovida's coordination body.

While the specific methods for each research objective are articulated within each chapter, overall, this dissertation relies on a combination of literature reviews and policy analysis; statistical and spatial analyses of farm management plans and agricultural census data; interviews; and participant observation. To provide a large-scale perspective on agroecology in Brazil, Chapter 2 relies on a literature review, contextualized with interview data, to describe the evolution of Brazil's national agroecology policies, and Chapter 3 utilizes Brazil's 2017 agricultural census data to assess where and to what extent agroecology is being practiced across Brazil. To provide more fine-grained data to complement these coarse-scale findings, I gathered and statistically analyzed data from farm management plans from the regional farmer network Rede Ecovida (Chapter 4). This was made possible through involvement with CEPAGRO and Centro Vianei, which helped to connect me with Rede Ecovida's coordination body.

Lastly, I carried out 51 semi-structured interviews with agroecological actors based in southern Brazil and Rio de Janeiro (including decision-makers, farmers (predominantly settler and *caboclo* farmers), traditional harvester-gatherers (*extrativistas*), NGO coordinators, and extension agents) over the period of 2018-2019. Participants were initially identified through the networks of CEPAGRO, Centro Vianei, and professors at the Federal University of Santa Catarina's Agroecosystems program, and then followed a snowball sampling strategy until reaching a saturation point. Coding of interview data then followed a hybrid deductive-inductive model, with some predetermined thematic codes that aligned with the interview schedule, and with new codes added as necessary based on the data and the semi-structured nature of the interviews. I also used other ethnographic methods, including participant observation at agroecology-related meetings and events hosted by Rede Ecovida and other organizations; traditional food festivals (such as the *pinhão* festival in the *Planalto Serrano* region of Santa Catarina); social mobilizations (such as anti-austerity protests and *Banquetaço*); food policy meetings (such as a state-level CONSEA meeting); and visits to a local *aldeia* (Indigenous reserve) with CEPAGRO. The interviews and ethnographic methods provided valuable data and context for the entire thesis, and serve as the primary data source for Chapter 5.

In line with principles of engaged scholarship as synthesized by Raphael (2019), my primary goal was to generate (and co-generate, when possible) insights about the political processes, practices, power relations, and philosophical underpinnings of agroecology, in a way that could be useful for the agroecology community (scholars, activists, farmers, and decision-makers) in the pursuit of more sustainable and just food systems. As a critical and interdisciplinary social scientist, I am particularly interested in understanding the role of social movements in scaling out

agroecological approaches, and in understanding the systems-level or structural barriers that constrain agroecology's broader potential.

1.5.2 Positionality

I come to this work as a white, middle-class, cis settler woman who grew up in what has been territorialized as the United States. My background afforded me the opportunity to pursue graduate studies in the United Kingdom and in Canada, and both my Master's and PhD work have involved the opportunity to undertake funded fieldwork in Latin America. My position as a white person and non-native Portuguese speaker coming from a well-resourced country in the Global North to carry out research "in the field" certainly introduced a power differential during my fieldwork in Brazil. Nonetheless, my interest in working with community groups, farmers, and social networks in Brazil stems from my commitments to public scholarship[2] and community-engaged research that aims to be of service and contribute to more just and sustainable future(s), with the understanding that visions for such a future(s) is/are contested. For example, while some institutions, scholars, and farmers suggest that increasing economic and productive efficiency are necessary in order to "feed the world" sustainably (Sampson 2018; Connor and Mínguez 2012), my interest in agroecology is grounded in the evidence to date – from various ontological, epistemological, and methodological standpoints – that it holds potential to transform the agrifood system to become more sustainable and just, due to its emphasis on democratizing agrifood system governance by engaging with diverse knowledges

[2] I am a member of UBC's Public Scholars program, which aims to support PhD students in carrying out community-based and collaborative work in the public interest.

and respecting place-based, territorial experiences and ecologies (Gliessman 2016; Anderson et al. 2019).

The community groups CEPAGRO and Centro Vianei carry out action research and extension projects to support and include farmers' and workers' visions for territorially embedded rural development strategies in the pursuit of improved food system sustainability. Our shared commitments to supporting and engaging diverse rural peoples in the development process provided an opportunity for me to partake in this research project over an extended period of time as both a researcher and a learner, and I received valuable input from members of these organizations that shaped the research questions driving this dissertation. Engaging in reflexive processes, seeking various sources of data, and using a mixed-methods approach helped me to triangulate and validate my findings.

1.6 Dissertation Outline

The structure of this dissertation is as follows. Chapter 2 uses a historical-relational-interactive framework to assess the extent to which agroecology-related policy has been institutionalized in Brazil since colonial invasion. Through a literature review and interviews, I find that, while agroecology policy has become progressively implemented in Brazil as a result of democratic political openings and unfolding engagements between social movements, civil society, and the state, the balance of power has never substantially shifted from agrarian elites and agribusiness, who historically and currently exercise disproportionate control over land, resources, governance, and public discourse. This has left the overall political economy of industrial

agriculture intact, although many important food security, nutrition, and sustainability innovations have occurred as a result of bottom-up, grassroots efforts.

Within this overall unfavorable political context, Chapter 3 then aims to assess the current state of agroecological practices and performance in Brazil. Using the Food and Agriculture Organization's (FAO) 10 Elements of Agroecology framework and their newly developed Tool for Agroecology Performance Evaluation (TAPE) as a guide, I use Brazilian agricultural census data to map agroecological indicators at the municipal level across Brazil. I find that, while average scores for agroecological performance at the state and regional levels exhibited small variation, municipal bright spots of agroecological performance can be identified with this approach. I then conduct a literature review to identify drivers of higher and lower agroecological performance in these municipalities.

Zooming in to the sub-national scale, Chapter 4 focuses on the agroecology network Rede Ecovida, which operates in Brazil's southern region. Using a subset of Rede Ecovida's farm management plans for agroecological certification, this chapter investigates the relationship between farm size and the use of agroecological practices. I suggest that in this case, the lack of a relationship between farm size and practice use may be explained by Rede Ecovida's role as a social carrier, or a social force that advances agroecology across diverse farm types through its strategy to promote territorial autonomy (or a reduction in dependency on external inputs, resources, and markets by leveraging place-based socioecological processes and shared values).

Chapter 5 zooms in further on the southern state of Santa Catarina, Brazil, where I interviewed agroecological actors (farmers, workers, NGO coordinators, and decision-makers and advocates) – most of whom have a relationship to Rede Ecovida – in order to understand what agroecology means to these social movement participants. I find that agroecological actors overwhelmingly describe agroecology as a philosophy of life that enhances various dimensions of well-being.

The final chapter, Chapter 6, summarizes and synthesizes the dissertation's findings, and highlights potential limitations of the research. It also points to future directions for research and policy aimed at supporting more sustainable and just food systems in Brazil and beyond.

Chapter 2: (De)institutionalizing Agroecology: A Historical-Relational-Interactive Perspective on the Evolution of Brazil's Agri-Environmental State

2.1 Introduction

Scientists, policymakers, and farmers increasingly agree on the need to transform the industrial food system using an agroecological approach (Nyéléni International Forum for Agroecology 2015; FAO 2018a; HLPE 2019; IPES-Food 2016; Rosset and Martínez-Torres 2012; Val et al. 2019). While described as both a science rooted in ecological approaches to agriculture and a set of practices for sustainably managing agroecosystems, agroecology is also a social movement due to its linkages with the transnational food sovereignty movement (Wezel et al. 2009), which advocates for food systems that benefit people and nature rather than corporations (Desmarais 2007; Nyéléni Forum for Food Sovereignty 2007; Nyéléni International Forum for Agroecology 2015; Wittman 2011).

A key debate in the agroecology and food sovereignty literature relates to the role of the state in promoting – or institutionalizing – agroecology. On one hand, state support is seen as necessary for enforcing rules and minimizing negative agri-environmental externalities, incentivizing agroecological production, and supporting farmers during the transition, yet social movements and scholars articulate concerns over the possible co-optation of transformative approaches to agroecology by political and economic elites, as well as the risks associated with losing movement power (demobilization) once policy gains are made – and perhaps lost (Desmarais,

Claeys, and Trauger 2017; Giraldo and McCune 2019; Mestmacher and Braun 2021; Sauer and Mészáros 2017).

This tension is evident in Brazil, where decades of social movement and civil society advocacy led to the institutionalization of agroecology-related programming and policy, particularly under the 2003-2010 administration of Luiz Inácio Lula da Silva ("Lula"). These perceived successes have led to Brazil being viewed as a "pioneer" or reference point for agri-environmental policy globally (Sabourin, Grisa, et al. 2020). However, subsequent government administrations have begun to systematically dismantle this institutional infrastructure. This chapter asks: How did the institutionalization of agroecology develop in Brazil and what have been the effects? Which historical processes, paradigms, and key actors have contributed to the institutionalization, and now de-institutionalization, of agroecology in the Brazilian context?

2.1.1 Conceptual Framework

To answer these questions, I draw upon Schiavoni's Historical-Relational-Interactive (HRI) framework (Schiavoni 2017) and the literature on the environmental state (Duit 2016; Mol and Buttel 2002) and environmental governance more broadly (Heynen et al. 2008; McCarthy and Prudham 2004). An HRI framework can be used to highlight the *historical* processes which shape and condition current efforts for advancing agroecology; the ways in which these efforts unfold as an ongoing struggle *in relation* to competing agricultural "development" discourses and paradigms; and the ways in which *interactions* between state and non-state actors influence key agroecology outcomes. I combine the HRI perspective with insights from the literature on the environmental state, defined by Duit et al. (2016, p. 5–6) as "a state that possesses a

significant set of institutions and practices dedicated to the management of the environment and societal-environmental interactions." Conceptually, the status of a real-world environmental state is assessed *in relation* to the ideal-type "ecological state," which systematically prioritizes environmental sustainability above the state's economic considerations, and to an ideal-type "neoliberal state", which prioritizes economic concerns over ecological sustainability (Duit 2016; Eckersley 2004; Meadowcroft 2005; Mol and Buttel 2002).

I build upon the concept of the environmental state by explicitly incorporating agricultural development concerns, herein referred to as the "agri-environmental state." I therefore expand upon Duit et al.'s definition to define the agri-environmental state as "a state that possesses a significant set of institutions and practices" to support environmentally and socially sustainable agriculture (Duit, Feindt, and Meadowcroft 2016, p. 5). While the environmental state literature alludes to the threats posed by agriculture to the environment, explicitly integrating agriculture into the environmental state concept highlights the fundamental role that states play in mediating the relationship between the environment, agriculture, and rural well-being through land governance, development, environmental, and social welfare policy.

Duit (2016) notes that there are four faces, or functions, of the environmental state – Administration, Regulation, Redistribution, and Knowledge Production – which I adapt to the agri-environmental state concept and define as follows:

1. **Administration/organization**: The creation of agri-environmental public administration entities
2. **Regulation**: The development of agri-environmental regulations, institutions, and policies

3. **Redistribution**: The ability to redistribute agri-environmental resources and risks/benefits
4. **Knowledge generation**: The production and dissemination of agri-environmental knowledge and norms

Having cross-nationally compared 28 countries according to these four dimensions, Duit finds that countries range across a spectrum from "weak" to "established" environmental states (Duit 2016) (Figure 2.1).

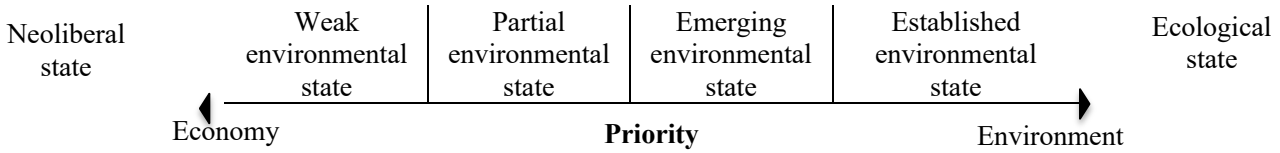

Figure 2.1. Economy-Ecology Typology. A typology for understanding the relationship between economy and environment in the environmental state literature. An ideal-type "neoliberal state" would always prioritize economy over environment, and an ideal-type "ecological state" would always prioritize environment over economy. Typology based on Duit (2016).

Both the concepts of agroecology and neoliberalism are important in shaping the agri-environmental state, and our typology places an ideal-type agribusiness state (linked to neoliberalism) and an ideal-type agroecological state (advocated by agrarian movements) as opposing paradigms that shape the faces of real-world agri-environmental states (Figure 2.2).

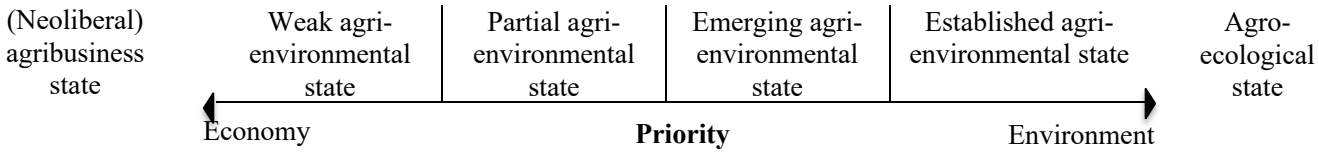

Figure 2.2. Agribusiness-Agroecology Typology. A typology for understanding how the economy and environment interact in the environmental state when agriculture (food, fiber, and fuel for people) is taken into account. An ideal-type "agribusiness state" would always prioritize agribusiness interests over agroecology, and an ideal-type "agroecological state" would always prioritize agroecology over agribusiness interests.

Following economic imperatives, an agribusiness state prioritizes economic growth and profit through deregulation and privatization, enabling the concentration of land, wealth, and power in its pursuit. Following the demands of social movements, the vision for the agroecological state entails prioritizing socioecological rights and responsibilities, with the purpose of scaling out food systems that work for people and planet. Therefore, an ideal-type agroecological state has core institutions that guarantee the right to food and a healthy environment; meet social movement demands for peoples' participation in decision-making; redistribute resources for the development of sustainable rather than industrial food systems; and foster knowledge exchange across different ways of knowing. The spectrum of governance from an ideal-type "agribusiness state" to an ideal-type "agroecological state" informed the creation of our criteria for assessing the four faces of Brazil's real-world agri-environmental state through time (Table 2.1). By incorporating an HRI perspective with this framework, I assess how historical processes, competing agricultural development paradigms, and state-society interactions have shaped Brazil's agri-environmental state, and the degree to which agroecology has been institutionalized over time.

Table 2.1. A comparison of the ideal-type "agribusiness state" and ideal-type "agroecological state" according to the four faces of the agri-environmental state.

Four faces of the agri-environmental state	Characteristics of the agribusiness state	Characteristics of the agroecological state
1. Administration	The minimization of public administration entities with respect to implementing, monitoring, and enforcing environmental and social welfare policies	The creation and organization of public administration entities that implement, monitor, and enforce environmental and social welfare policies
2. Regulation	Deregulation and dismantling of laws and policies that protect human rights and the environment in the name of efficiency; creation of a policy environment favorable to investment; externalization of negative costs	The participatory creation of agri-environmental regulations, institutions, and policies that uphold ecological integrity and the right to food; true-cost accounting
3. Redistribution	Laissez-faire approach to resource distribution, fueling concentration of resources, land, and power; unequal distribution of agri-environmental harm	Redistribution of resources, land, and power to growers and eaters by eliminating unsustainable subsidies and incentives; equal distribution of agri-environmental harm
4. Knowledge generation	Top-down knowledge transfer of agri-environmental knowledge in line with the modernization paradigm	The co-creation and dissemination of agri-environmental knowledge with civil society

In what follows, I describe the political-economic factors that influenced the Brazilian state's development of agroecology-oriented entities, policies, redistributive efforts, and knowledge. I do so through a review of the academic literature by agrifood policy scholars; key laws and policy materials (e.g., Lei Nº 10.831 – A Lei da Agriculture Orgânica, Decreto Nº 7.794 – A Política Nacional de Agroecologia e Produção Orgânica, Lei Nº 11.947 – Programa Nacional de Alimentação Escolar, etc.); and relevant governmental, civil society, and social movement websites (e.g., Ministério do Desenvolvimento Social (dissolved), Brasil Agroecológico, Articulação Nacional de Agroecologia, Associação Brasileira de Agroecologia, Movimento dos Trabalhadores Rurais Sem Terra, Rede Ecovida, etc.). I contextualize this review with insights from ethnographic fieldwork carried out from 2018–2019, which included participant observation at agroecology policy events and meetings as well as interviews with 51

agroecological actors (including political advocates and decision-makers). These interviews were coded in NVivo to identify political economic factors that enable(d) and hinder(ed) the institutionalization of agroecology.

With these data, I trace the evolution of the Brazilian agri-environmental state across various periods – from landed captaincies during colonization and imperial empire; to agricultural modernization during the dictatorship and post-dictatorship period of neoliberalism; to the development of agroecology policy in the Workers' Party (PT) era; to the current regime of agroecological policy rollback. Tracing this terrain helps us to understand how agri-environmental institutions have evolved dynamically in relationship to Brazilian social movements' particular visions for a highly participatory, decentralized, and democratic agroecological state, raising questions for how the agroecology movement might create new relationships and institutions to counter the increasingly unfavorable political situation in Brazil.

2.2 An HRI Perspective on the Agri-environmental State in Brazil

2.2.1 "Coffee with Milk": *Colonização, Coronelismo, and Clientelismo* (1500 – 1960)

Dating back to the Portuguese invasion of Brazil in 1500, historical and ongoing processes of colonial capitalism led to the consolidation of land, resources, and power in the hands of a select few (Robles 2018). In the early 1500s, 12 men chosen by the Portuguese monarchy were "gifted"

with 14 territories[3] known as "captaincies" (Figure 2.3) (Carvalho 2015; Johnson 1987; Wolford 2010a). The "captains" or recipients of these hereditary grants (which would pass down to their sons) were then responsible for dividing up these tracts of land for private interests (Tarlau 2014), forming the basis for Brazil's land inequality. Land became heavily concentrated in the hands of rural elites, known as *ruralistas,* for "one overriding purpose: the settlement and development of 'vacant' territory" (Johnson 1972, p. 211, quote emphasis added) – a common colonial narrative used to justify the dispossession and eradication of Indigenous Peoples, who were subjected to disease, evangelism, enslavement (for example, on rubber baron landholdings in the Amazon), and genocide. Throughout the 16th and 17th centuries, tens of thousands of African people were violently brought to Brazil via the trans-Atlantic slave trade to become enslaved laborers, fuelling what Johnson calls "*latifundia* capitalism" (Johnson 1972, p. 214).

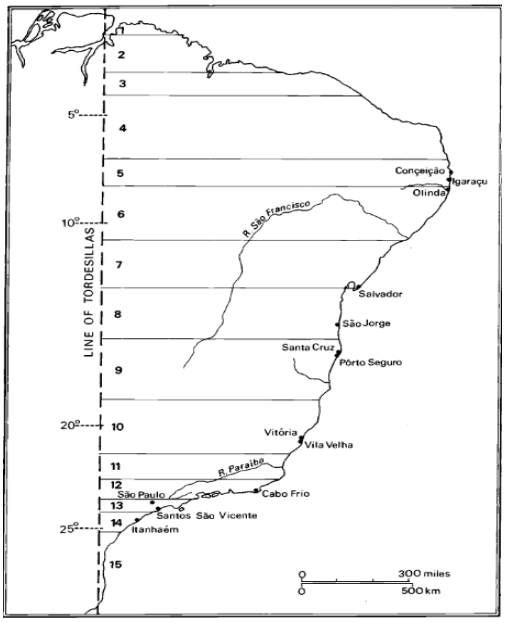

Figure 2.3. Captaincies of 16th century Brazil. Source: Johnson 1987, reproduced with permission by Cambridge University Press.

[3] Two of the 12 captains were each awarded two captaincies, leading to this discrepancy between the number of captains (12) and captaincies (14) (Johnson, 1987).

Following Brazilian independence in 1822, a limited representative system was put in place by the Brazilian empire via the constitution of 1824 (Tranjan 2016). As Tarlau notes, during this time "much of [the previously distributed] private land was supposed to be 'returned' to the Brazilian state...However, through a process of land grabbing and the production of false land deeds – known as *grilagem* – rural elites ensured that they could maintain ownership over their lands" (2014, p. 4-5; see also Paulino 2014). The empire's abolishment of slavery following the leadership of Afro-Brazilian/quilombo communities (Reis and dos Santos Gomes 1996; O'Dwyer 1995; Bowen 2021) in 1888 led to growing resentment harbored by rural elites, many of whom were involved with the export-oriented production of sugar, coffee, and cotton. This resentment culminated in a *ruralista*-backed coup in 1889 that officially ended the empire period and resulted in the formation of the Brazilian republic.

The handful of years following the coup were full of political and economic instability, and political participation was low for a number of reasons[4]. Tranjan argues that there was a "political-institutional arrangement" in place that "made votes irrelevant" due to a high degree of corruption in public administration, such that the outcomes of electoral processes had little to do with the actual number of votes received and more to do with who already held power – state governors and local *coronéis* (locally-dominant agrarian elites) – and how those actors organized amongst themselves to maintain and further consolidate that power (Tranjan 2016). Thus, the

[4] Neither women nor Indigenous people were granted the right to vote; only those men above age 21 who could read and write were permitted to vote, which also excluded most Afro-Brazilian men.

coronéis were able to collude with public administration officials to their own advantage, fuelling the expansion of export-oriented agriculture at the expense of workers and natural ecosystems.

Throughout the late 1800s and early 1900s, political-economic power was mainly concentrated among the agrarian elites of Minas Gerais (MG) and Sao Paulo (SP). MG was the most populous state at the time, with the economy heavily based in dairy cattle; SP was the second-most populous and most prosperous state, with an economy heavily based in coffee plantations. Together, agrarian elites from MG and SP formed a strong alliance to maintain and solidify the status quo, which allowed them to greatly benefit from the export of dairy products and coffee. The absolute political and economic control exercised by this alliance during this period has led to it being dubbed the "coffee with milk" period (Meade 2010; Tarlau 2014; Tranjan 2016).

With an increased lack of opportunity in the countryside for peasants and workers as a direct consequence of land and policy capture by the agrarian elite, the state promoted a strategy of industrialization and urbanization. By 1960, the majority of the southeast's population – 57 percent – was already urban (Tranjan 2016). The continuous flow of people from rural to urban areas put ever more pressure on the need to standardize agricultural production to improve labor efficiency and facilitate mechanization, and to create urban employment opportunities to stave off social unrest.

The intersecting forces of colonialism, *latifundia* capitalism, and industrialization during this period contributed to patterns of inequality that continue to shape the present day agri-

environmental governance regime in Brazil, as many people found themselves pushed off the land while relatively few elites benefitted from land consolidation and concentration. This period set a deeply entrenched foundation for an agribusiness-oriented, weak agri-environmental state: The expansion of agriculture on supposedly "empty" land served as a tool of dispossession, and the sector rapidly became characterized by concentrated land and wealth ownership, labor and environmental exploitation, and commodity export for the financial gain of landed elites. Public institutions were in a fledgling state, so there was little-to-no regulation, oversight, or enforcement by public entities, accompanied by a high degree of corruption due to the collusion of landed elites and public officials, who maintained the political and economic exclusion of non-elite workers (for example, through processes like *grilagem*) (Table 2.2).

Table 2.2. An assessment of Brazil's "Coffee with Milk" period agri-environmental state according to the four faces of the agri-environmental state.

Four faces of the agri-environmental state	Characteristics of Brazil's agri-environmental state: Coffee with Milk era (1500 – 1960)
1. Administration	Public administration entities were in a nascent stage, and public officials were prone to corruption.
2. Regulation	Little-to-no environmental and social welfare policies. Costs of growth are virtually entirely externalized to exploited and/or enslaved people and native ecosystems.
3. Redistribution	Land inequality is extreme, with the entire country initially "owned" by only 12 men. Land redistribution and democratizing efforts were blocked by economic elites. Resource colonialism is pervasive as commodities are produced for export and peasants are pushed off the land. Racialized and poor workers bear the agri-environmental harms.
4. Knowledge generation	State-promoted industrialization contributed to a rural exodus, beginning to erode land-based knowledge.

2.2.2 *"Anos de Chumbo"*: The Military Dictatorship (1961 – 1988)

The emergence of João Goulart – a member of the Brazilian Labor Party (PTB)[5] who intended to take on a number of social reforms, including land reform – as president in 1961 signalled some changes that were favorable to the rural poor, principally European-descended peasants[6]. Goulart passed a Statute on Rural Labor in 1963, which granted rural people the right to organize in unions as part of a confederation, giving birth to the National Confederation of Agricultural Workers (CONTAG) later that same year (Tarlau 2015). Not long after, Goulart was ousted in a US-backed military coup in 1964, marking the start of a military dictatorship that would last 21 years. The military dictatorship regime was repressive and violent, with civil society organizations and mobilizations heavily monitored and restricted. Things worsened further with the 1968 passage of Institutional Act 5, which dramatically reduced civil and social liberties by increasing censorship, placing bans on public manifestations, and criminalizing regime opponents, among other measures[7] (Puzone and Miguel 2019; Tarlau 2014; Tranjan 2016).

It was during the military dictatorship, at a time where "the state had an almost exclusive role in rural development," that the US-funded Green Revolution (GR) took off globally (Schneider, Shiki, and Belik 2010, p. 225). In Brazil, state-sponsored research and extension services assumed a strong position in supporting agricultural modernization. For example, the National

[5] Note that the current PTB has no relationship to the PTB referenced here, which collapsed during the 1964 military coup.
[6] While European-descended peasants, *caboclos* (people of mixed Indigenous and European or African ancestry), *ribeirinhos* (traditional river peoples), Afro-Brazilians, and Indigenous peoples all had very different relationships with the state, that is beyond the scope of what is discussed here.
[7] Institutional Acts were the military dictatorship's principal form of legislation – the highest "law of the land," with implementation being immediate and without review.

Rural Credit System provided farmers with a financing scheme for input investment (Garrett and Rausch 2016; OECD-FAO 2015), and in 1972 the state-owned Brazilian Agricultural Research Corporation (Embrapa) was created to further advance and institutionalize the Green Revolution approach (Sencébé et al. 2020). The research of Embrapa in particular was instrumental in opening up frontier areas that were previously thought to be uncultivable, most notably the vast wooded savanna biome known as the *Cerrado*. Like the Amazon and Atlantic rainforests, the *Cerrado* is considered a biodiversity hotspot, and agricultural extensification and intensification in the region are of increasing concern. Prior to the GR, its soils were commonly considered to be too acidic and infertile to support crop growth (Derli and Antonio 1998; Lathuillière et al. 2014; Martinelli et al. 2010; Rada 2013). Yet Embrapa's top-down plant breeding efforts combined with GR technologies (principally synthetic fertilizers and limes and promotion of mechanization) have largely transformed the region to one characterized by large-scale, industrial, export-oriented commodity production of soy, maize, and sugarcane monocultures and extensive cattle grazing (Brannstrom et al. 2008; Carvalho, De Marco, and Ferreira 2009; Jepson, Brannstrom, and Filippi 2010; Lathuillière et al. 2014).

The military dictatorship's pro-modernization and pro-agribusiness position led to heavily subsidized rural credit tied to the use of GR technologies, such as synthetic pesticides and fertilizers, mechanized infrastructure, and high-yielding varieties of cereal crops (Caporal and Costabeber 2004; da Costa et al. 2017; Franco Lerrer and Servolo de Medeiros 2014; Petersen, Mussoi, and dal Soglio 2013). Because of their poorer access to resources, technical assistance, and markets – and under the threat of violence – many small-scale farmers continued to be pressured off their lands (Martine 1991). These now-landless farmers migrated to urban areas at

a rate that far outpaced job creation, leading to the development of *favelas*. Others invaded Indigenous reserves; for example, scholars have described the military dictatorship's complicity when more than 8000 farming families decided to illegally occupy Indigenous reserves in Brazil's south[8] (Branford and Rocha 2002; Tarlau 2014). Rather than dealing with the politics of unequal land distribution in Brazil's south and elsewhere, the military regime invested in infrastructure and created the National Institute for Colonization and Agrarian Reform (INCRA) in 1970 to incentivize farmers to settle the "agricultural frontier" along the Amazon border (Sencébé et al. 2020). Scores of farmers then headed north only to be (violently) forced off of these lands by large-scale cattle ranchers (Hochstetler and Keck 2007) and, more recently, soy plantation owners (le Polain de Waroux et al. 2017). Tensions between agricultural expansion and environmental protection along the Amazon frontier highlight how throughout most of settler Brazilian history, there has been "direct conflict between the aims of the Ministries of the Environment and Agriculture: with the former seeking to conserve natural resources and the environment, and the latter being responsible for destroying forests and other resources to encourage production" (Schneider et al. 2010, p. 226).

Yet globally, the environmental and human rights movements were taking off, and Brazil's ecological and sociocultural diversity drew international attention. Brazil's National Foundation for Indigenous Peoples (FUNAI) was founded in 1967 following the publication of the Figueiredo report, which extensively documented and publicized the abuses perpetrated by the

[8] Many of these farmers and others would go on to organize occupations of large and unused landed estates, eventually forming the Landless Workers' Movement (the MST).

Brazilian state against Indigenous Peoples (de la Peña 2005; de Sant'Anna, Castro, and Jacó-Vilela 2018). In addition, scholar-activists with connections to rural leaders in Brazil (such as rubber-tapper organizer and environmentalist Chico Mendes) were able to advocate in the halls of development institutions in the Global North (like the World Bank) for the protection of the environment and for the right of traditional and Indigenous Peoples to preserve their way of life (Keck 1995). While still under the military regime, the appointment of the slightly more moderate Ernesto Geisel to the presidency in 1974 initiated a slow process of liberalization, and his appointment created a political opening for social movements to begin building alliances and organizing around on-the-ground land conflicts, including in the agricultural frontier region.[9] New satellite imagery depicting Amazonian deforestation, increasing talk of climate change, and Chico Mendes's assassination in 1988 came together to make Brazil "the emblematic case for discussion of third world environmental problems" (Keck 1995, p. 417). Under global pressure, the government created the *Nossa Natureza* (Our Nature) program to disincentivize ranching by increasing surveillance of forest burning and removing prior economic incentives to colonize the Amazon frontier (such as subsidized credit), yet monitoring and enforcement remained weak and the "withdrawal of fiscal incentives was no match for the growing profitability in the 1990s of the ranching sector" (Hochstetler and Keck 2007, p. 149).

Thus, interactions between local and global actors in combination with changing political dynamics shifted the terrain just enough such that grassroots organizing around human rights and

[9] For example, see Keck (1995) for an overview of the alliance between rubber tappers, CONTAG, and the fledgling Workers' Party (PT).

the environment was able to spring up, even under military rule. Towards the end of the military regime, mounting public pressure led to government entities taking a more active position with respect to regulation and monitoring (for instance, through the *Nossa Natureza* program), but there was no real effort to challenge the rural elite or to redistribute the wealth and resources they had accrued; in fact, in 1985, the largest land-holders – representing under one percent of establishments – still owned almost 44% of Brazil's agricultural land, while 50% of establishments owned less than three percent of agricultural land (Robles 2018). Knowledge transfer was based in the GR paradigm and was highly technocratic and top-down. The Brazilian agri-environmental state during this period could be classified as weak (Table 2.3).

Table 2.3. An assessment of Brazil's agri-environmental state during the *Anos de Chumbo* according to the four faces of the agri-environmental state.

Four faces of the agri-environmental state	**Characteristics of Brazil's agri-environmental state: *Anos de Chumbo* (1961 – 1988)**
1. Administration	Public administration bodies related to agriculture, the environment, and human rights (such as FUNAI) were emerging, but in the context of heavy state repression.
2. Regulation	A pro-modernization and pro-agribusiness position led to heavily subsidized rural credit in support of GR technologies. Environmental and human rights activism, legislation, and policy was mostly repressed until the end of the regime, and programs like *Nossa Natureza* were limited due to the enormous profitability of agribusiness.
3. Redistribution	Efforts to improve land access did not address the root causes of land inequality via redistribution and instead incentivized the dispossessed to colonize agricultural frontiers.
4. Knowledge generation	State-sponsored research and extension services, such as Embrapa, assumed a strong position in supporting agricultural modernization and top-down knowledge transfer.

2.2.3 Re-democratization (1988 – 2002)

In 1988, when Brazil re-emerged from the 21-year-long military dictatorship with its seventh and newest Constitution, there was "a deep-rooted mistrust of the formal political institutions

[including political parties] that had been permeated and corrupted…Direct citizen involvement in political processes was considered the only truly democratic option" (Tranjan 2016). Scholars note that during this process of democratization, "the progressive regaining of public freedoms, the resumption of the organizational processes of popular movements, and the intensification of the debate on alternatives for the democratic development of society" led to a political climate that was "exceptionally favorable" for advancing alternative agriculture (Petersen, Mussoi and Dal Soglio 2013, p. 106). Echoes of this are found in the following exchange, which occurred during an interview with an NGO leader involved in agroecology policy development in Brazil, whom I will call Henrique[10]:

> Dana: In your view, what are the most important political moments for the agroecology movement and for food and nutrition security in Brazil, historically?
>
> Henrique: A very important moment to open the space for the agroecological perspective is the 1988 Constitution. It is important to understand that the entire process of re-democratization of society and the state has an arc, coinciding with the process of democratic reopening after the military dictatorship…The emergence of agroecology during the dictatorship happened exactly in that period when agricultural modernization was implemented, the Green Revolution was implemented in Latin America and worldwide. The Green Revolution process would not have been implemented in the way it was if it had not coincided with the authoritarian process. So the Green Revolution, the

[10] All names used throughout this thesis are pseudonyms to protect participant privacy.

> big agribusiness as we call it today, is the result of a very authoritarian process that imposes technical and economic logics on the rural world. So I would say that we have to demarcate the end of the dictatorship and the 1988 Constitution as the moment that created new conditions for agroecology as an idea.

It was against this backdrop – key to interpreting the institutionalization of agroecological policy – that movements like the Landless Rural Workers Movement (Movimento dos Trabalhadores Rurais Sem Terra, MST) and the Movement of People Affected by Dams (Movimento dos Atingidos por Barragens, MAB) were born, in 1984 and 1991[11], respectively. Worth noting is that the most pressing initial concern for groups like the MST was access to land; the question of *how* land should be managed emerged among the MST a decade later, as it consolidated an overall vision for agriculture and rural life that was compatible with its aim to challenge neoliberalism's effects in the countryside (Wittman 2010; Wolford 2010b). Nonetheless, ongoing social movement pressure from groups united around these common issues (most notably, land reform and the right to land), along with the state's desire to quell social unrest in the countryside, contributed to the Brazilian government creating policies to address some of the needs of small-scale and family farmers. One such example is the National Program for the Strengthening of Family Farming (PRONAF) – a rural credit policy created in 1995 under the Cardoso administration to help family farmers access resources and markets through low-interest, state-sponsored loans (Grisa and Schneider 2015; Sencébé et al. 2020). Yet only a small

[11] The MAB has been active since the 1970s but was institutionalized in 1991.

fraction of family farmers – typically those who were already in a position to access loans for capital investment – were able to access PRONAF, whose ultimate purpose was aligned with the state's modernization goals of economically and technologically advancing the family farming sector.

Even though the family farming sector was beginning to receive political attention, funding for agribusiness-oriented public entities, research institutes, policies, and programs greatly outpaced funding for family farming-oriented equivalents. This was partly due to the importance of the industrial agriculture sector for economic growth, and partly due to the continued blurred lines between the agrarian elite and government: In 1995, *ruralistas* (also known as the Rural Bloc) still occupied 23% of seats in the Chamber of Deputies (Brazil's lower Congressional house), and their opposition to land redistribution resulted in virtually no changes to land inequality (Robles 2018). In response to this stagnation, the MST dramatically escalated land occupations, and a turning point occurred in 1996 when Brazil's military police infamously murdered 19 MST members who had occupied a landed estate at Eldorado do Carajás (Fernandes 2016; Robles 2018). Growing international attention and scrutiny as a result of the violence led to an increase in agrarian reform settlements and the 1999 creation of a public administration entity – The Ministry of Agrarian Development (MDA) – to support family farming and land redistribution (Fernandes 2016; Sauer and Mészáros 2017). In contrast, the Ministry of Agriculture, Livestock, and Supply (MAPA) has existed (under various names) since 1860 to support export-oriented agriculture and agribusiness (Sencébé et al. 2020). These contradictions highlight what Sencébé et al. (2020) call a "parallel path" for agricultural development, where fledgling entities (such as MDA) and policies to support family farming (such as PRONAF) existed alongside agribusiness-

oriented growth; therefore, this period of re-democratization corresponds to a partial agri-environmental state, where "the dual nature of Brazilian agriculture" was institutionalized (Sencébé et al. 2020; Table 2.4).

Table 2.4. An assessment of Brazil's agri-environmental state during the re-democratization period according to the four faces of the agri-environmental state.

Four faces of the agri-environmental state	Characteristics of Brazil's agri-environmental state: Re-democratization (1988 – 2002)
1. Administration	New public administration bodies focused on family farming, such as MDA, were created, but the power of long-standing agribusiness-oriented bodies like MAPA grew as Brazil's economic development strategy depended on agricultural commodity exports.
2. Regulation	Family-farming oriented programs like PRONAF were developed, but they favored farmers in more industrialized agricultural contexts and often supported activities for agricultural modernization.
3. Redistribution	Social movement activity and international scrutiny pushed the government to increase land reform settlements. Civil society actors pushed for participatory mechanisms to redistribute power in policymaking following the dictatorship and had some success, but public offices were still highly influenced by *ruralistas*.
4. Knowledge generation	The Brazilian state institutionalized separate government bodies for family farming and agribusiness, bifurcating its approach to agricultural development, research, extension, and resourcing.

2.2.4 The "Golden Decade": Toward an Established Agri-environmental State? (2002 – 2010)

The growing political capital of social movements following re-democratization contributed to, and benefited from, a new institutional opening in 2002 with the election of Luiz Inácio Lula da Silva – a former factory worker, trade union organizer, and co-founder of the Workers' Party (PT), which had "close historical ties and joint struggles [with] agrarian movements for the democratization of Brazil in the 1980s" (Sauer and Mészáros 2017, p. 408). This relationship between the PT and agrarian movements informed social inclusion policies advanced under the

Lula administration and increased avenues for civil society participation in policymaking. For example, in 2003, pre-existing FSN and poverty-reduction initiatives were consolidated under the overarching *Fome Zero* (Zero Hunger) policy. Led by MDA and the newly created Ministry of Social Development and the Fight against Hunger (MDS), *Fome Zero* brought together policies and programs to address social welfare through income generation, improved food access and public health, and a strengthened family farming sector (Chmielewska and Souza 2011; Wittman and Blesh 2015; Chappell 2018). That same year, the Lula administration also reinstated[12] the National Council on Food and Nutritional Security (CONSEA) to provide an avenue for civil society to play a role in policymaking related to FSN. Comprised of one-third government officials and two-thirds civil society actors, CONSEA served as a direct advisory body to the presidency on FSN (Chmielewska and Souza 2011; Sonnino, Torres, and Schneider 2014). In essence, CONSEA acts as what Fox (1993, quoted in Schiavoni 2017) calls an "institutional access route," linking sympathetic state officials with proactive societal actors, thereby opening up space for new political possibilities that advance representation, participation, and joint policy articulation for food security, nutrition, sustainable agriculture, and rural development more broadly.

Civil society's influence and involvement in CONSEA was central to the development of a suite of food security, agroecology, and sustainable rural development initiatives, like the Food

[12] CONSEA was originally founded in April 1993 (Franco administration) through Decree 807; however, it was cut in 1995 (Cardoso administration) and only re-created in 2003 with the Lula administration (see Grisa and Schneider 2015).

Acquisition Program (PAA), the National School Feeding Program[13] (PNAE), and the National Policy for Agroecology and Organic Production (PNAPO). The PAA (created in 2003) was a structured demand, or mediated market, intervention that targeted both urban consumers and family farmers: The government committed to purchasing from family farmers as a social inclusion strategy to combat poverty, and then directed the purchased food to food insecure people and to institutions like hospitals and food banks. Another structured demand program was established in 2009 (Law 11.947), when the government revamped the PNAE and committed to sourcing 30% of food for school cafeterias from family farmers enrolled in the program – thus linking these producers to a stable market (Veras Soares et al. 2013). Notably, through use of these formal structured demand programs, the Brazilian government began to incentivize a transition to agroecology by providing price premiums as well as access to extension and other services to farmers who were certified organic or agroecological. For PAA the contract ceiling ranged between $1500-2500 *reais* more for certified products than for non-certified products, and certified organic/agroecological PNAE producers received contract priority over non-certified farmers (Guerra et al. 2017; Wittman and Blesh 2015). The aforementioned National Policy for Agroecology and Organic Production (PNAPO) came into effect in 2012 after a policymaking process that involved not only government officials but also over 150 non-governmental organizations, networks, and social movements (McKay and Nehring 2014), further expanding the government's commitment to support joint policymaking and transitions to organic and agroecological farming on family farms. The PNAPO "outlines 134 initiatives for

[13] PNAE has been around since the 1950s, but was modified in 2009 by Law 11.947 to include specific support to local family farmers.

assisting in the transition to organic and agroecological production coordinated across 10 ministries…With an initial investment set at R$8.8 billion over three years, existing programmes such as PRONAF, ATER, PAA, and PNAE will be scaled up to facilitate the transition to agroecological-based production" (McKay and Nehring 2014, p. 12).

As a result of the interplay between civil society and key state actors, the decentralized governance structure of new public entities like CONSEA represented an important innovation allowing for civic participation in formal policymaking spaces at multiple (national, state, and municipal) levels – a feature that stems directly from Brazil's complicated history with democratic participation and representation (or lack thereof). Signalling its commitment to also decentralize regulation, participatory processes for organic/agroecological certification became officially recognized by the state in Lula's first term. In the words of an organic policy consultant I interviewed,

> The country was in a very democratic process – all this happened under the [first term of the] PT government. There were spaces of democracy in which family farmers were greatly strengthened and non-governmental organizations that represented the interests of family farmers were also strengthened, and it was in this moment that participatory certification arrived as a response and as a testament to the strength of the family farmers, because it was a system of certification created by them.

At first glance, Brazil's agri-environmental state during this period might be classified as established. However, gains from the institutionalization of agroecology may be more discursive

than empirical. For example, citing 2010 data from FNDE[14], McKay and Nehring state that in 2011, family farmers should have been provided with $930 million *reais* through the administration of PNAE based on the fact that family farmers are, by law, supposed to receive at least 30% of the total PNAE budget, which was R $3.1 billion in 2011 (McKay and Nehring 2014). However, in the case of PNAE, few states and municipalities actually allocated 30% of the PNAE budget to family farmers, and the law has remained decidedly unenforced. In an interview, an NGO director and agroecology policy participant said:

> The good innovation [with the PNAE] was that in Law 11.947 in 2009 an obligation was included to acquire at least 30% of foods from family farming. Which is the minimum. But there are many municipalities that did not reach this level of 30% – there are municipalities that bought 100%, there are municipalities that did not buy anything. The state of Santa Catarina, for example, does not meet this volume, and it is a state that, in theory, would have the conditions to, because we have organizations that meet the requirements, we have family farmers that meet the requirements, but we don't have the political will to meet this demand that is placed in legislation. So, this is legislation that is from 2009 and we are in 2018. So for you to comply with it, it could take a while, maybe a year or two… but not nine years. So the problem is not production…why isn't it solved in nine years? Because there is a lack of a political will, they don't have perseverance in politics, they don't have the interest to make things work.

[14] The author could no longer locate this data.

Building on this, people participating in the agroecology movement (in both civil society and government spaces) point to a lack of enforcement and accountability protocols, a lack of associated funding to ensure legal compliance, and a lack of accessible data about program expenditures as ongoing hurdles for agroecology policy (Petersen et al. 2013).

With respect to PAA, less than three percent of Brazil's family farmers participated in PAA, and uptake has not been equal across regions; while almost half of organic farms in Brazil are in the northeast, the majority of products sourced through PAA that are certified as agroecological or organic are produced in southern Brazil, indicating "a severe regional bias in PAA organic procurement" (McKay and Nehring 2014, p. 21). This is tied to long-standing patterns of racial inequality and the racialized distribution of resources in Brazil, where the majority of the Afro-Brazilian population lives in the northeast and the majority of the white population lives in the South and Southeast (Lovell 1993). Farmers interested in participating in PAA have expressed concerns about the lack of information shared about the opportunity to enrol (Guerra 2016; Nehring, Miranda, and Howe 2017), and about "institutional complexity, patronage relations, and a failed distribution infrastructure, as well as the inability of the small-scale farming sector to meet food safety regulations and compete with larger scale producers" (Wittman 2015, p. 177; see also Araújo 2010). In addition, although certified organic/agroecological foods would be able to receive a price premium through PAA, "in 2012 (the year in which the PAA had its best performance), [only] around 2% of the total volume of purchases" was certified (Schmitt et al. 2017, p. 60).

In discussing the distribution of state resources, Nowak (2019) reports how public finances received by small-scale and family farming still pale in comparison to funding received by Brazil's agribusiness sector: "In 2003, when Lula came to power, support for agribusiness was five times higher than that for family agriculture. By 2015, one year before [Lula's successor] Rousseff left office, it rose to an amount that was six times higher." While agrarian reform peaked under the Lula administration in 2005 with 117,484 settled families, by the time Lula left office in 2010 only 15,536 families had been settled that year (DATALUTA 2017). By the time Rousseff was ousted, the number of settled families had fallen to 5,490 (DATALUTA 2017). In addition to this decreasing number of land redistribution efforts, the quality of redistributive reforms also declined. As Giraldo and McCune note, "despite distributing more than 51.2 million hectares to 721,442 families, the Workers' Party (PT) governments of Brazil mostly allocated public and marginal lands, attempting the least possible impact on landlords" (Giraldo and McCune 2019, p. 10; see also Sauer and Mészáros 2017). For instance, most families were settled in agricultural frontier areas in the Amazon, where the government could buy land cheaply and provide land titles without having to confront the land-owning class or expropriate land – a kind of spatial fix that resulted in an overall "failure to diminish structural inequality" (Sauer and Mészáros 2017).

In sum, while representing important advances toward an established agri-environmental state, the Golden Decade era could be characterized as partial-to-emerging (Table 2.5). While government-sponsored policies and programs that aimed to support family farmers and facilitate the transition toward agroecology, such as public procurement, were important innovations, they were also significantly underfunded in comparison to the agribusiness sector. The Lula

administration never broke rank with agribusiness in Brazil, and investments in and exports from industrial agriculture largely fuelled Brazil's economic growth under his watch (Sauer and Mészáros 2017). In fact, throughout Lula's term (2003–2010), agricultural exports on average accounted for almost 40% of Brazil's total exports and the agribusiness sector accounted for, on average, almost a quarter of Brazil's GDP (Robles 2018). The administration's contradictory strategy opened Brazil to a commodity boom while simultaneously weakening state power to regulate, control, and enforce agri-environmental rules in the face of growing transnational agribusiness power. The commodity boom in turn "led to a boom in both demand for land and land prices" such that "the state's financial margin of action for land reform was substantially diminished, since market price was the basis upon which the compensation value of expropriated land was determined" (Sauer and Mészáros 2017, p. 402). The increase in the value of rural land as a result of the commodity boom has negatively affected possibilities for structural land reform. The Lula administration's inability to reconcile the contradictions between the agribusiness and agroecology paradigms and the competing interests of their proponents (*ruralistas* on the one hand and social movements and civil society on the other) ultimately led to a legitimacy crisis for the PT, the consequences of which are described in the following section.

Table 2.5. An assessment of Brazil's agri-environmental state during the Golden Decade period according to the four faces of the agri-environmental state.

Four faces of the agri-environmental state	Characteristics of Brazil's agri-environmental state: The "Golden Decade" (2002 – 2010)
1. Administration	Important bodies allowing for civil society participation in FSN, such as CONSEA, were reinstated, democratizing policymaking. Ministries like MDS and MDA supported family farming and sustainable agriculture programming but were drastically underfunded compared to MAPA.
2. Regulation	FSN policies were consolidated under *Fome* Zero and there was development/expansion of innovative public procurement programs with mechanisms to support transitions to agroecological/organic management, such as PAA and PNAE, but effects were limited. At the same time, the Lula administration heavily relied on agribusiness growth as part of its neo-developmentalist strategy, dramatically subsidizing/investing in this sector.
3. Redistribution	Land redistribution efforts peaked and then steeply declined, and never challenged the structural inequality embedded in the Brazilian countryside; the land reform strategy involved settlement in agricultural frontiers rather than expropriating land from the landlord class.
4. Knowledge generation	The democratization of policymaking spaces allowed for inclusion of more diverse forms of knowledge, including the knowledge and experience of social movement actors and civil society.

2.3 The Agri-environmental State "Under Pressure": Underestimating Contradictions

The described political-economic contradictions boiled over during the presidency of Lula's successor, Dilma Rousseff (also PT) from 2011–2016. In struggling with economic downturn and growing social discontent (including very public and widespread strikes), the party again allied itself with industrial, financial, and agrarian elites as well as "centre-right parties at all levels of government in order to guarantee its electoral viability...leaving the status-quo intact. It did not challenge the ideological dominance of neoliberalism to any significant extent" (Braga and Purdy 2019 p. 205-6), ultimately eroding the support of their original voter base (Carter 2011; Grisa and Schneider 2015; Saad-Filho 2015).

Political and economic turmoil and media-fuelled public outrage[15] over Operation Car Wash (*Lavo Jato*), the largest corruption scandal in Latin American history[16], bolstered the political factions that lost the tight 2014 election – including the *ruralistas,* who held over 30% of seats in the lower house of Congress during Rousseff's term (Robles 2018) – to build a movement pursuing Rousseff's impeachment (Braga and Purdy 2019; Saad-Filho 2015; Sauer, Acácio Leite, and Shankland 2019). President Rousseff was impeached in 2016 under the pretenses of inappropriate budgetary conduct and replaced by Michel Temer of the opposition party. To avoid corruption charges himself and to "repay" the Rural Bloc (which was instrumental in orchestrating Rousseff's impeachment), Temer advanced a deeply neoliberal political platform that heavily favored agribusiness (Leite, Tubino, and Sauer 2019; Sauer et al. 2019), aiming at the "wholesale privatization of Brazil's remaining state-owned enterprises and public resources" (Pahnke 2017). This marked the beginning of a radical decline of what were tenuous agroecology policy gains to begin with.[17] For example, in 2016 the Temer administration extinguished MDA,[18] which housed programs that encouraged the promotion of agricultural development in line with the principles of agroecology and social participation, like the Technical Assistance and Rural Extension program (ATER) (MDA 2015).

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[15] As multiple sources note, the "corporatized" media particularly singled out the PT for blame in Operation Car Wash, despite virtually every political party and numerous prominent politicians being implicated (Saad-Filho 2015; Braga and Purdy 2019).

[16] Operation Car Wash was a corruption scandal that involved construction executives defrauding and laundering money through the state-owned oil company *Petrobras*, and bribing public officials and *Petrobras* executives (Andrade 2019; Saad-Filho 2015).

[17] For a comprehensive review of the policy rollback during this time, see Leite, De Castro, and Sauer 2018 and Sabourin et al. 2020.

[18] MDA was extinguished and its programs were ultimately downgraded via a transfer to a Secretariat, the Special Secretariat for Family Agriculture and Agrarian Development (Sabourin, Craviotti, and Milhorance 2020).

Another example relates to *grilagem,* or the theft of public land through the falsification of private property deeds (Paulino 2014; Schmink et al. 2017). As previously mentioned, *grilagem* dates back to colonial era in Brazil. It has been particularly problematic in the Amazon frontier region, where extensive cattle and soy production, logging, and land speculation are the leading drivers of deforestation, but where various past government policies have also incentivized colonization by small- and medium-scale farmers. During the Lula administration, the federal government led an inquiry into this process, and proposed a new law (Law 11.952) to, in theory, regularize the land claims of small- and medium-scale farmers who had settled in the area. But a number of scholars have criticized the law for loopholes that also legalized – and even favored – the claims of large-scale landowners at the forefront of land speculation and *grilagem*, essentially "granting amnesty" to the *ruralistas* (Caetano 2019; May et al. 2016; Paulino 2014). As Paulino (2014, p. 136) describes,

> Since 2009, with the enactment of the Law 11.952, [67 million hectares] of inappropriately occupied public land have been recognized as private property… Peasants occupied only around an eighth of this area – some 8.3 million hectares. Their gain with 'regularization' allowed legislators and the state to spin a discourse of having advanced agrarian reform goals by legalizing the land claims of these smallholders, while transferring the vast majority of the land involved – the remaining 58.7 million hectares – to large land grabbers.

The passing of Law 11.952 under Lula set the precedent for the Temer administration to propose 2016's Provisional Measure 759 (MP 759/16), which – again under the guise of regularizing land

claims of family farmers who migrated to the Amazon Frontier in the 1970s–1980s – further legalized the privatization and financialization of land, extended the time period within which land grabbers could apply for title, increased the size of properties that were eligible from 1500 to 2500 hectares, and in essence accepted deforestation as legal proof of occupation, and thus ownership (1º Defensoria Pública Especializada em Atendimento Fundiário do Estado do Amazonas et al. 2017; Caetano 2019; Leite et al. 2019). Despite strong pushback, MP 759 was amended and then passed into Law 13,465/2017. As a result of policies (and political lock-ins) like these, land grabbing and concentration in Brazil has continued to increase, with recent figures for Brazil's Gini coefficient for land inequality reported as 0.86 and trending upwards (DATALUTA 2017; GRAIN 2014), further fueling a vicious cycle of inequality and deforestation.

Political and economic turmoil following the parliamentary coup and Operation Car Wash set the stage for the ultra-right wing Bolsonaro administration to come into power in 2019. This "anti-institutional" and "anti-state" administration has sowed confusion about public data as part of its overall dismantling strategy (Sabourin et al. 2020) and has continued to systematically roll back agroecological policy in favor of agribusiness as it pushes "an ultra-neoliberal economic agenda, which includes the scrapping, dismantling and mischaracterization of the state apparatus" (Sauer, Leite, and Tubino 2020, p. 286). The first of Bolsonaro's attacks on the state apparatus occurred on the first day of his presidency, when the administration introduced Provisional Measure (MP) 870 and eliminated the National Council on Food and Nutritional Security (CONSEA) – the primary mechanism for civil society participation in food-related policymaking. Immediately after MP 870 was introduced, CONSEA representatives and civil society networks began

actively denouncing and protesting the move through petitions and rallies, working to get it reinstated. Through this political struggle, CONSEA became not just an "object" of social movements' demands for increased participation in FSN policymaking, but also a "field of action" or site of struggle in and of itself (Silva and Schmitt 2012, p. 23).

On January 2, 2019 – the day after the provisional measure was introduced – the national councilors who represent CONSEA on behalf of civil society wrote a public letter declaring:

> The institutionalization of the participation of representatives of different sectors of civil society in a direct advisory body of the Presidency of the Republic, such as CONSEA, has been an important instrument for listening to civil society *in order to improve public policies and strengthen the Brazilian State*…It is necessary to strengthen and consolidate the National Council of Food and Nutritional Security (CONSEA) *as a democratic space of the Brazilian State – and not only as a strict government forum* – in order to give voice to representative social organizations so that public policies can respond to the problems of the most vulnerable sectors of Brazilian society (Councilors of CONSEA 2019, emphasis added).

Here, agroecology civil society actors discursively and strategically highlight the difference between the *government* and the *state*. This framing makes it clear that agroecology advocates in Brazil view civil society participation as a crucial part of "the state" and its authority, and that the function of the state should be to institutionalize policy that protects citizens' rights to food, a healthy environment, and dignified work. This vision for a deeply democratized state apparatus

is rooted in an understanding of the need to protect against the highly variable changes that can take place across government administrations – as seen through the evolution of Brazil's agri-environmental state – and to temper the clientelism and corruption that has long plagued notions of rural "development" in Brazil. In the words of another agroecology policy leader in Brazil,

> The example is very clear: Why did they extinguish CONSEA? CONSEA was exactly the space where civil society and government representatives participated to monitor policies and propose new measures. This means ruling out the possibility of social participation. It is a blow to citizenship, to democracy.

Historically in Brazil, the institutionalization of agroecology policy and programming has advanced in direct relationship to processes of democratization *outside* of the state (through social movement mobilizations for redistributing land and power), *within* the state (through mechanisms for civil society participation in policymaking, such as CONSEA), and as a result of *interactions and dialogue between state and non-state actors* (for instance, through the relationship of agrarian reform movements to the PT). Historical patterns, competing paradigms, and state-society interactions have contributed to a particularly Brazilian vision for an agroecological state that is deeply tied to democratization processes and direct civil society participation in politics and policymaking (Schmitt et al. 2017). As stated by an NGO leader and policy advocate,

> Our last [national] agroecology meeting [in 2018] had the motto "agroecology and democracy: uniting the countryside and the city." Because so many people understand

that agroecology is an approach to democratize society and the state – the democratization of the state and society is a necessity for us in agroecology.

We talk about radicalizing democracy, and democratizing agrifood systems…to institutionalize agroecology, then, it's necessary to break this vision that was built with modernization and which was a top-down process, very structuralist, very vertical, where the role of farmers and their organizations are passive recipients of policies. We don't understand it that way, we understand that not only must local organizations design policies, they must also execute and monitor policies, together with the state…Public policy is not exclusive to the government, public policy is a co-production between the government with civil society. That is, civil society itself not only prepares proposals, but it executes policy proposals in partnership with the government. So it is a democratization of public resources.

If we don't move in that direction, agroecology will have a hard time moving forward as an idea…the role of agroecology is to re-embed agrifood systems and bring production closer to consumption, and create new institutions and new forms of governance of agrifood systems. Because otherwise, agrifood systems will always be dominated by large corporations. The government has no way, it has no strength alone to overcome the power of corporations, especially in the world of neoliberal globalization. And the WTO rules – the governments end up being hostage to the norms of neoliberal globalization. So, one way to face this is exactly to create [state-society] partnerships and create territorial mechanisms for regulating agrifood systems.

2.4 Discussion and Conclusion

How and to what degree states successfully institutionalize agroecology remains in need of deeper theoretical and empirical engagement. However, there are limitations to state-centric analyses – particularly in settler-colonial contexts, where jurisdiction and the legitimacy of any state policy is unsettled and highly contested, and amid the emergence of authoritarian state regimes. Similarly, creating economy-ecology dichotomies can obscure the fact that any economy is always embedded in an ecology, and runs the risk of subsuming heterogeneous economic modes into a homogenous, globalized, and neoliberalized market. Nonetheless, linking an HRI approach with the concept of the agri-environmental state can be useful to understand these highly contested processes of agroecology institutionalization and de-institutionalization, with the understanding that progress is structured by the historical context in which competing agricultural development paradigms dialectically emerged (neoliberal/agribusiness and agroecological), and how state and non-state actors interact and shape (and are shaped by) their relationship to one another and these paradigms (Schiavoni 2017).

Certainly, iterations of Brazil's agri-environmental state have fallen short of prioritizing agroecology over agribusiness. While re-democratization and the rise of the PT provided institutional openings for agroecology, policy gains were tenuous even during the PT era due to alliances with agrarian elites. This led to a kind of "institutional fragility," particularly because many public policy innovations were still lacking regulatory teeth and sufficient budgets to support their activities (Sabourin, Grisa, et al. 2020). Yet despite the Lula regime's ongoing ties to the neoliberal economic order, state-civil society relations qualitatively changed during the

Lula administration, where progressive actors who were once side-lined by state processes found new opportunities to articulate their demands (Grisa and Schneider 2015). Thus, the political moment that arose with the election of Lula, while not representing a large political-economic transformation, did open up space for social movement and civil society actors to co-construct public policies that institutionalized a (fragile) agroecological approach.

Particularly instrumental to constructing and institutionalizing agroecological approaches have been democratization processes *outside of* (through movements to democratize land and the means of production) and *within* (through struggles to democratize access to public resources, knowledge, and policymaking spaces) the state. The agroecology movement's emphasis on democratization and decentralization of the state apparatus has emerged directly out of long-standing and legitimate concerns over how centralized state power has led to historical and ongoing inequities, repression, clientelism, and corruption – forces that largely stymied or watered-down past efforts to transform approaches to agricultural development, which aimed to completely upend these dynamics. As noted in an interview by an NGO coordinator and agroecology organizer,

> Here in Brazil, if we're not careful, we can lose, right? It's not that all is conquered and consolidated. Nothing is consolidated. At least not in Brazil. And we see this setback that we are experiencing worldwide [the turn toward authoritarian neoliberalism], we see we can lose a lot…But I keep dreaming, that with agroecology we are advancing. Moving forward. It's not that we're going to make a revolution in the sense that society realizes this in the short term. But if we see what we've advanced in the last 30 years – we've

> advanced a lot. I don't think we achieved little, considering the financial conditions and opportunities we had…we were always few. There was always everyone against us. Even so, we managed to materialize some things…This is a hell of a legacy, right. I would say that it is no small thing.

In the current political moment – where basic democratic principles are again under attack and human rights and agri-environmental policy are being rolled back and hollowed out – it remains to be seen how social movement and civil society actors will adapt their advocacy efforts. As Schiavoni (2017, p. 28) states, "nothing is predetermined" in food sovereignty and agroecology construction, and the policy landscape in Brazil has already experienced some remarkabe shifts – no small thing, indeed.

Chapter 3: Assessing Agroecological Performance: An Indicator-based Approach to Identifying "Bright Spots" of Agroecology

3.1 Introduction

Globally, the drive towards food production gains and efficiency has led to an increasingly industrialized agricultural sector, contributing to a number of ecosystem disservices, including deforestation, biodiversity loss, and climate and water pollution (Campbell et al. 2017; Foley et al. 2011; Power 2010). Additionally, the social and public health costs associated with the industrial food system are high: two billion people are moderately or severely food insecure and healthy diets are unaffordable for at least three billion people, many of whom are farmers or agricultural workers themselves (FAO et al. 2020). These negative outcomes have led to renewed calls for redesigned, territorially embedded agrifood systems that provide affordable, accessible, nourishing, and culturally appropriate food for all, while improving social equity, respecting environmental boundaries, and enhancing local-to-global ecosystem services.

Scholars, civil society actors, governments, and intergovernmental organizations have increasingly highlighted the transformative potential of agroecology as an alternative to the industrial agrifood paradigm: "Rather than tweaking the practices of unsustainable agricultural systems, agroecology seeks to transform food and agricultural systems, addressing the root causes of problems in an integrated way and providing holistic and long-term solutions" (FAO 2018, p. 2). Agroecology is commonly described as a science, a practice, and a social movement (Wezel et al. 2009). As a science and practice, agroecology entails applying traditional,

experiential, and/or scientific socioecological knowledge to agricultural systems in order to produce food, maintain or enhance ecosystem functions, and contribute ecosystem services (beyond food production) to people (Méndez et al. 2013; Vandermeer and Perfecto 2013; Wezel et al. 2009). Additionally, agroecology is rooted in agrarian movements' calls to rectify the power imbalances at play within the global agrifood system, which benefit corporate actors at the expense of human and environmental health and well-being (Patel 2009; Wittman 2011).

Despite the promise of agroecology, the United Nations Committee on World Food Security's High-Level Panel of Experts states that there remains a need to "develop practical, scientifically grounded and comprehensive performance metrics, and indicators of agriculture and food systems as a basis for assessment, policy implementation, and investment decisions" (HLPE, 2019, p. 24). Indeed, a major challenge in assessing global transitions to agroecology is understanding how to measure and monitor agroecological progress and performance across space and time. Here, we use the Food and Agriculture Organization's (FAO) 10 Elements of Agroecology framework (Barrios et al. 2020; FAO 2018b) and adapt its Tool for Agroecology Performance Evaluation (TAPE) (Mottet et al. 2020) to provide a baseline assessment of agroecological indicators at the municipal level across Brazil, using data from the 2017 *Censo Agropecuário* (Agricultural Census) (IBGE 2017). We then identify "bright spots" of agroecology – defined here as municipalities where indicator-based agroecological performance[19] is better than the surrounding regional context (Frei et al. 2018) – and provide a

[19] Agroecological performance is based on our identification of agroecological indicators, based on TAPE, in the Brazilian agricultural census, and include a mix of practices (or processes) and outcomes.

counter-example of a municipality with weak performance relative to its context. Lastly, we conduct a literature review to identify the roles of local actors, institutions, and geographic conditions in influencing agroecological performance in these relatively high- and low-performing municipalities. This approach can serve as a novel way to use existing census data to evaluate agroecological indicators across contexts to develop broad-based evidence on agroecological transitions.

3.1.1 Background on FAO's 10 Elements of Agroecology and TAPE

While intended to be a neutral body, the FAO (in conjunction with other international organizations and foundations) has historically promoted technical advice rooted in Green Revolution approaches to agricultural development (Sampson 2018; Loconto and Fouilleux 2019). However, internal shifts began to occur in response to the long-term advocacy of civil society organizations promoting food sovereignty and agroecology in the 1990s and following the 2008 food price crisis. These events provided new institutional openings for agroecology in the FAO – including the appointment of José Graziano da Silva, the Minister of Food Security in Brazil under the Lula administration, to Director General in 2012 (Loconto and Fouilleux 2019). Lastly, key member states – particularly Brazil, Switzerland, and France – and civil servants played a major role in promoting and ultimately institutionalizing agroecology within the FAO (Anderson and Maughan 2021; Loconto and Fouilleux 2019).

Along with the increasing institutionalization of agroecology came the need for monitoring and evaluating agroecological performance (including both practices and outcomes) on the basis of a common definition. Agroecological data are often collected at more localized scales, which can

limit cross-context comparisons and larger-scale policymaking (Mottet et al. 2020). To address the need for comparability and to build broad-based consensus among scientists, practitioners, and civil society (thereby ensuring its approach didn't dilute or misrepresent the tripartite nature of agroecology), the FAO consulted with diverse stakeholders to create the 10 Elements of Agroecology framework. This framework defines the social, cultural, economic, ecological, health, and governance dimensions of sustainable and equitable agrifood systems in line with the FAO's Common Vision for Sustainable Food and Agriculture (FAO 2018b). The 10 Elements of Agroecology emerged from a comprehensive approach involving a review and synthesis of the agroecology literature; a consensus-building process with 1400 participants from civil society, government, academia, and the private sector at a series of regional meetings from 2015–2017; and consultations with academics and FAO practitioners (Barrios et al. 2020; FAO 2018b). The 10 Elements of Agroecology were approved by the Member States of the FAO in 2019, and now represent a common framework from which to assess and compare indicators of agroecological practice, progress, and performance and "[guide] countries to transform their food and agricultural systems, to mainstream sustainable agriculture on a large scale" (FAO 2018, p. 2).

To facilitate the construction of a large-scale evidence base for agroecology, the FAO took a participatory approach to develop a tool, TAPE, for evaluating agroecology according to the 10 Elements. Development of TAPE again involved a review of existing sustainable agriculture indicator frameworks, a "multi-stakeholder consultation phase based on a review and prioritization of over 70 indicators by more than 450 participants," and the formation of a technical working group tasked with finalizing a framework and indicator-based tool that could be operationalized globally (Mottet et al. 2020, p. 3). Applying TAPE involves a multi-step

process comprised of two major assessment phases: the first step, Characterization of Agroecological Transition (CAET), "provides a diagnostic on where the system stands in terms of its transition toward sustainability" (Mottet et al. 2020, p. 3). In other words, this step aims to characterize progress toward agroecology in a particular context. Subsequent steps take a mixed qualitative-quantitative approach to assess how agroecology shapes outcomes for a subset of the Sustainable Development Goals (SDGs) (Mottet et al. 2020).

Our analysis uses and adapts the first step, CAET, due to its utility for assessing the status of agroecological transitions according to the 10 Elements. According to the authors of the tool, using CAET can help provide an overall "territorial snapshot" of agroecological progress as well as highlight specific indicator-based differences. Underpinning CAET is the assumption that:

> units belonging to the same territory are more similar to each other than units in different territories. Therefore, it is hoped that the majority of differences between observations (variance) belonging to the same territorial group should come from their level of application of practices. This methodology can be adapted to any level of analysis; in fact, the generic terms 'region' or 'territory' may refer here to different strata such as a municipality, a watershed, a province, an administrative region, or any other defined area (Mottet et al. 2020, p. 5).

While currently TAPE is designed to be used at the farm level and the FAO is in the process of adapting this tool to be used at higher levels, including community and regional levels (Mottet et al. 2020), we modify the CAET step of the tool to assess the status of agroecological transitions

at the municipal level across Brazil using data from the agricultural census. We do so to see whether and how agricultural census data can offer an assessment of agroecological performance, given that farm-level data collection is often both expensive and time-consuming (for both researchers and participants), and considering that agricultural census data is often used to set policy at national and international levels. The Brazilian case offers a unique opportunity to derive data that mirror questions from the CAET step of TAPE because the IBGE agricultural census documents detailed information about practices relevant to agroecology. That is, the IBGE agricultural census data provides a more comprehensive suite of data that encompasses not only outcomes (e.g., yield) and demographic information (e.g., age or gender information), but also includes data on processes and practices that are relevant to agroecology (e.g., crop rotation, agroforestry, seed-saving, etc.).

In what follows, we describe our methodological approach for using agricultural census data to assess a range of agroecological indicators associated with the 10 Elements of Agroecology, present the results of our assessment, and zoom in on municipalities that our application of CAET identifies as high- or low-scoring on agroecological performance relative to their context. Our primary goal is to test the efficacy of this modified CAET approach for expanding the toolbox for assessing agroecological performance across diverse global contexts using publicly available data. Secondly, we provide possible explanations for certain municipalities that present higher and lower agroecological performance relative to their regional contexts. Considering that Member States of the FAO, including Brazil, have approved the 10 Elements of Agroecology to guide the FAO's work and to promote the operationalization of these Elements for assessing agroecological transitions, our approach to harmonizing the CAET indices with agricultural

censuses could be useful and replicated to measure progress toward agroecology across contexts and over time.

3.2 Methods

We used publicly available data that were collected by the Brazilian Institute of Geography and Statistics (IBGE) for the most recent (2017) agricultural census (IBGE 2017). The Brazilian agricultural census data is collected every 5–10 years by enumerators who administer questionnaires to farming households, defined as any farming unit that is partially or entirely dedicated to subsistence or commercial agricultural activities, regardless of size, ownership, land access, or geography (IBGE 2019). The data is then aggregated to the municipal level before being made publicly available. As such, the data we use here are not microdata (farm-level data), but rather provide coarse-scale insights on agroecology.

A limitation of this approach is that we cannot identify which agroecological indicators co-occur at the level of specific farm agroecosystems. In addition, when there was not a high number of farmers (typically three or fewer) using a certain practice or represented for a certain variable in a municipality, they were not reported in the census (indicated in census tables with an "X") to protect farmer confidentiality (IBGE 2018). As an example of how this was treated in our analysis, if three indicators were identified for an Element in the agricultural census, but a given municipality only had data available for two of the indicators and didn't report data on the third in order to protect farmer confidentiality, the average score was taken from the two indicators for which there was available data for that Element. While considering these limitations, undertaking a municipal-level analysis is useful for describing local and regional level agroecological

performance, detecting differences, and discerning potential drivers of differing performance, thereby generating new insights and learning that could be relevant across contexts. In addition, influential policy decisions are often made locally. As such, conducting an analysis using agricultural census data at the municipal level can provide scale-relevant information to local policymakers, while also enabling researchers to assess any potential effects of policy changes over time using a regularly collected dataset.

We compared the IBGE agricultural census data to variables suggested as indicators for CAET and compiled IBGE data that corresponded to the CAET indices (Table 3.1). For all but three Elements – Culture and Food Tradition, Co-creation and Sharing of Knowledge, and Circular and Solidarity Economy – we were able to obtain at least one indicator drawn from the 2017 census that aligned with the respective CAET indices.

Table 3.1. The CAET indices for FAO's 10 Elements of Agroecology and corresponding indicators available from the 2017 Brazilian Agricultural Census. Numbers in parenthesis refer to table numbers from the census.

10 Elements	CAET Indicators	Agricultural census data (Table number)

1. Diversity	• Crops
	• Animals
	• Trees/perennials[20]
	• Diversity of activities, products and services
		• Crops
		  ○ Simpson's Index of Diversity for temporary (annual) production (municipal level)[21] (6957)
		  ○ Percentage of farms in a municipality with horticultural production (6954)
		• Animals
		  ○ Simpsons Index of Diversity for livestock[22] (6908)

2. Synergies	• Crop-livestock-aquaculture integration
	• Soil-plants management system
	• Integration with trees (agroforestry, silvopastoralism, agrosilvopastoralism)
	• Connectivity between elements of the agroecosystem and landscape
		• Crop-livestock-aquaculture integration
		  ○ Simpson's Index of Diversity for crop-livestock-aquaculture-forest land use[23] (6878)
		• Soil-plants management system
		  ○ Percentage of farms in a municipality that use crop rotation (6846)
		• Integration with trees (agroforestry, silvopastoralism, agrosilvopastoralism)
		  ○ Percentage of farms in a municipality that practice agroforestry (6881)
		• Connectivity between elements of the agroecosystem and landscape
		  ○ Percentage of farms in a municipality with streams or rivers that have riparian buffers (6860)
		  ○ Percentage of farms in a municipality that have preserved/legal reserve forest (6881)

[20] The publicly available area-based data for perennials only captures farms growing more than 50 individuals of each species, likely underestimating actual diversity, especially of small-scale and subsistence farmers. For this reason, we did not include this calculation in our analysis.

[21] Simpson's Index of Diversity (SIDI) accounts for species richness and evenness (Nagendra 2002; Simpson 1949). We use the formula [SIDI = $1 - \sum p_i^2$]. As described in Mottet et al., "p_i is the relative importance of each variety or breed used for production (also called abundance) and *i* the proportion of agricultural land (or number of animals) found in the *i*th species. [This summed value] is subtracted from 1 in order to have 100% as the highest diversity score and 0 as the lowest" (Mottet et al. 2020, p. 12).

[22] Following the equation outlined in footnote 21, SIDI for livestock at the municipal level was calculated based on the number of heads per livestock species (richness) and their relative abundance (evenness).

[23] Following the equation outlined in footnote 21, SIDI for land use per municipality was calculated using proportional area per land use type (e.g., annual production, livestock, etc.), based on the number of different land cover types (richness) and how evenly distributed those land cover types were in terms of area (evenness).

3.	Efficiency	• Use of external inputs
		• Management of soil fertility
		• Management of pests and diseases
		• Productivity and household's needs
			• Management of soil fertility / use of external inputs
			  ○ Percentage of farms in a municipality that only use organic fertilizers (6847)
			• Management of pests and diseases
			  ○ Percentage of farms in a municipality that don't use agrochemicals (e.g., pesticides, fungicides, herbicides) (6653)

4.	Recycling	• Recycling of biomass and nutrients
		• Water saving
		• Management of seeds and breeds
		• Renewable energy use and production
			• Management of seeds and breeds
			  ○ Percentage of farms with annual cultivation in a municipality that save native/traditional seed (6958)
			  ○ Percentage of farms with annual cultivation in a municipality that exchange native/traditional seed (6958)

5.	Resilience	• Stability of income/production and capacity to recover from perturbations
		• Mechanisms to reduce vulnerability
		• Environmental resilience and capacity to adapt to climate change
		• Average diversity
			• Mechanisms to reduce vulnerability
			  ○ Percentage of farms in a municipality that accessed government credit programs (6895)
			  ○ Average income for farms in a municipality[24] (6902)
			• Average diversity
			  ○ Score from Element 1

6.	Culture & food tradition	• Appropriate diet and nutrition awareness • Local or traditional identity and awareness • Use of local varieties/breeds and traditional knowledge for food preparation	• No census data identified
7.	Co-creation & sharing of knowledge	• Platforms for the horizontal creation and transfer of knowledge and good practices • Access to agroecological knowledge and interest of producers in agroecology • Participation of producers in networks and grassroots organizations	• No census data identified

[24] Average income includes production income; on-farm, non-production income (e.g., from agritourism or other activities that occur on-farm but are not directly production-related); and off-farm income. Municipal-level average income was then normalized on a 0-100 scale based on the minimum and maximum average incomes in the sample.

8. Human & social values	• Women's empowerment
	• Labor (productive conditions, social inequalities)
	• Youth employment and emigration
	• Animal welfare
		• Women's empowerment
		  ○ Percentage of women-run farms in municipality (6755)
		• Labor (productive conditions, social inequalities)
		  ○ Percentage of farms in a municipality where owner-operator lives on-farm (not absentee) (6773)
		  ○ Percentage of family farms in a municipality (6778)
		• Youth employment and emigration
		  ○ Percentage of producers under age 35 in a municipality (6755)
		• Animal welfare
		  ○ Percentage of animal farms in a municipality that are organic (6853)

9. Circular & solidarity economy	• Products and services marketed locally (or in fair trade schemes) • Networks of producers, relationship with consumers and presence of intermediaries • Local food system	• No census data identified

10. Responsible governance	• Producers' empowerment
	• Producers' organizations and associations
	• Participation of producers in governance of land and natural resources
		• Producers' empowerment
		  ○ Gini coefficient for land per municipality[25] (available for download (IBGE n.d.))
		• Producers' organizations and associations
		  ○ Percentage of farms in a municipality that are members of farmers' associations or movements[26] (6846)

All indicators are either percentage-based (e.g., the percentage of farms that use a given agroecological practice per municipality), or are normalized from 0-100 (e.g., income-based

[25] While equity is not the same as empowerment, agrarian movements and scholars describe land equity and the right to land as a crucial component of rural peoples' agency and empowerment, often framed under the banner of "land sovereignty" (Borras and Franco 2012; Borras, Franco, and Suárez 2015).

[26] While Element 7 (Co-creation & sharing of knowledge) has a similar indicator for "Participation of producers in networks and grassroots organizations," the authors' interpretation is that the TAPE tool (Mottet et al. 2020, Supplemental Material) characterizes this indicator as more to do with the degree or quality of participation in farmers' groups (i.e., farmers' level of engagement or involvement), while the indicator "Producers' organizations and associations" in Element 10 (Responsible governance) has to do with whether farmers' organizations exist for farmers to participate in. We therefore decided to include Table 6846 data under Element 10.

indicators reported in Brazilian *reais* were normalized from 0-100). Indicators within each Element were then summed to get the average Element score, and all Element scores were averaged to get the final scores per municipality. As the IBGE census data is spatially explicit, we were able to map the total scores and each Element index at the municipal level across Brazil using the "geobr" package in the statistical software R. We then averaged the municipality scores for each state, and the state scores for each of Brazil's five regions – the North, Northeast, Centre-West, Southeast, and South. This allowed us to identify the states and regions with the overall highest and lowest agroecological performance. In those areas with lower agroecological performance, we identified "bright spot" municipalities whose scores were much higher than the average for their state or regional context and conducted an exploratory literature review on agroecology and agricultural production in each of these municipalities to understand the possible conditions contributing to their better performance. We also provide a counter-example of a low-performing municipality located in an overall high-performing agroecological state and region in order to further round out our analysis and identify potential negative drivers or pressures on agroecological performance in an otherwise high-performing context.

3.3 Results and Discussion

According to the CAET indicators and agricultural census data, the North is the overall best-performing region for agroecology in Brazil (Figure 3.1 and Table 3.2), with a region-averaged score of 38.37. Acre, an Amazonian state that has the highest average score (42.51), is also in this region. The North is closely followed by the Northeast, which has a region-averaged score of 38.11. In general, these trends reflect relatively high scores in these areas for the elements of Synergies (specifically, practicing agroforestry); Efficiency (specifically, use of only organic

fertilizers); Recycling (specifically, seed saving and to a lesser extent, seed exchange); and Human and Social Values (specifically, family farming and to a lesser extent, on-farm residence) (Figure 3.2).

In contrast, the Centre-West region, comprised of the states of Mato Grosso (MT), Mato Grosso do Sul (MS), and Goiás (GO), has the overall weakest agroecological performance according to our analysis, with a region-averaged score of 31.42 (Figure 3.1 and Table 3.2).

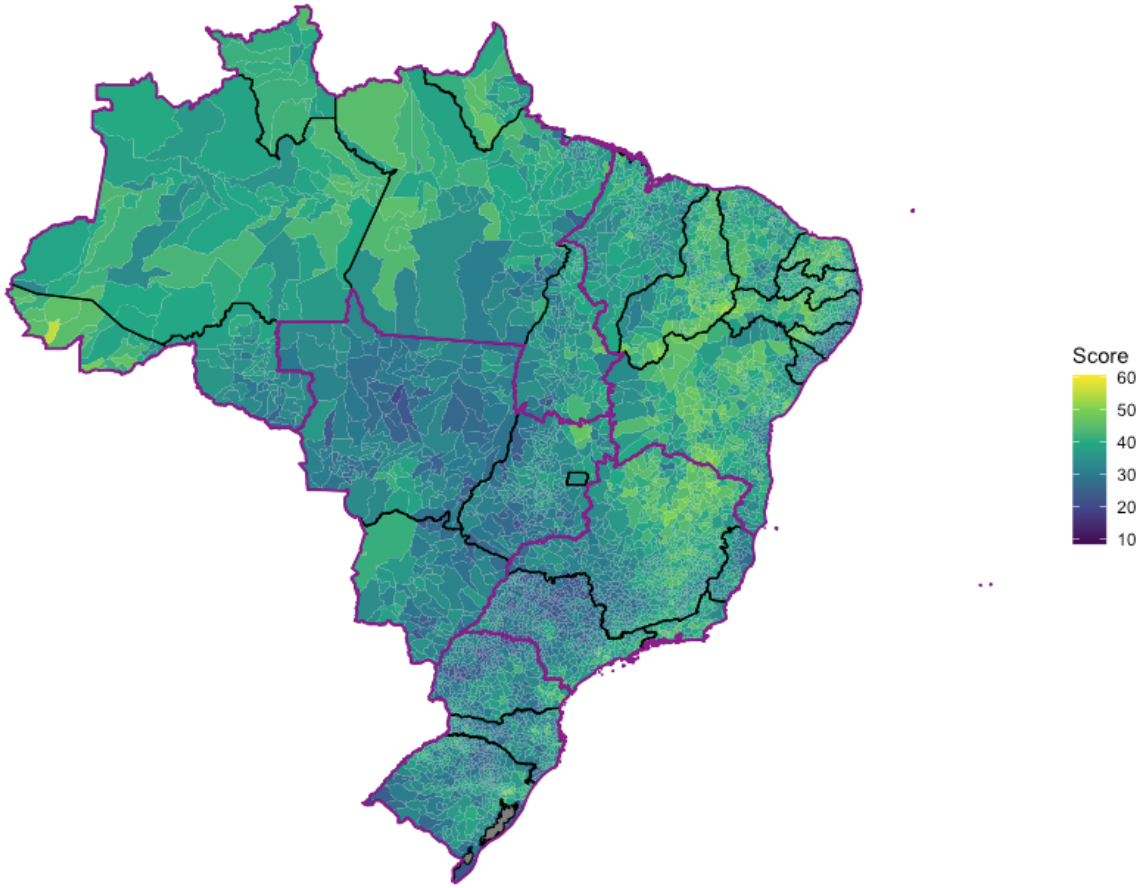


Figure 3.1 Municipal-level agroecological performance in Brazil in 2017, using the total averaged score of the FAO Elements. State boundaries are in black while region boundaries are purple. Brighter areas correspond to higher scores for agroecological performance.

While our analysis identifies the Centre-West as Brazil's least agroecological region overall, the individual states with the lowest composite scores are São Paulo (SP, 30.11) in the Southeast, followed by MT (30.34) in the Centre-West and Paraná (PR, 30.37) in the South. The Centre-West region and the states of SP and PR have particularly low scores for the Elements of Diversity (specifically, diversity in livestock production and temporary crop production); Synergies (specifically, practicing agroforestry); Efficiency (specifically, no use of agrochemicals for pest control and exclusive use of organic fertilizers); Recycling (specifically, seed saving and seed exchange); Human and Social Values (specifically, relatively low scores for family farming, on-farm residence, and gender equity in farm-owning/operating); and Responsible Governance (specifically, land equity) (Figure 3.2).

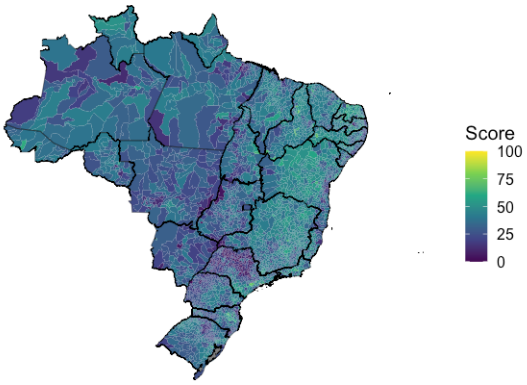
Table 3.2. Average state and region scores for agroecological performance.

State	Average state score	Average region score
GO	32.12	
MS	31.79	31.42 (CW)
MT	30.34	
AC	42.51	
AM	39.66	
AP	40.51	
PA	36.79	38.37 (N)
RO	33.43	
RR	40.31	
TO	35.39	
AL	34.71	
BA	39.33	
CE	38.15	
MA	36.44	
PB	39.87	38.11 (NE)
PE	38.79	
PI	41.14	
RN	41.41	
SE	33.12	

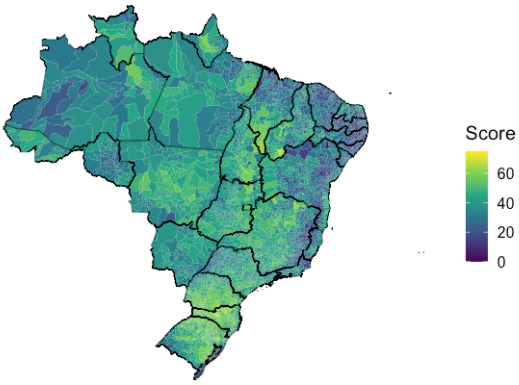
PR	30.37	
RS	33.85	32.41 (S)
SC	33.02	
ES	33.24	
MG	36.83	34.81 (SE)
RJ	39.05	
SP	30.11	

Overall, the average scores across the regions and states do not range widely. At the regional level, the average scores vary from 31.42 – 38.37, while at the state level they range from 30.11 – 42.51. This indicates that, in the aggregate, there isn't a large difference in agroecological performance across Brazil and that overall scores are relatively low. This is consistent with the fact that the Brazilian state promotes agriculture largely as an economic growth strategy, with state support and investment encouraging and favoring agricultural modernization and the production of commodities like soy, beef, and poultry, often for export (Sencébé et al. 2020). However, the low variation could also in part be attributed to limited data availability. That is, if a larger suite of agroecological indicators would have been captured in the agricultural census data, then perhaps the average state and regional level scores may have exhibited greater variation. Nonetheless, greater differences did emerge at the municipal level, with the highest-scoring municipality (Osasco, SP) receiving a score of 60.49 and the lowest-scoring municipality for which we have complete information (Alvorada do Sul, PR) receiving a score of 18.48.

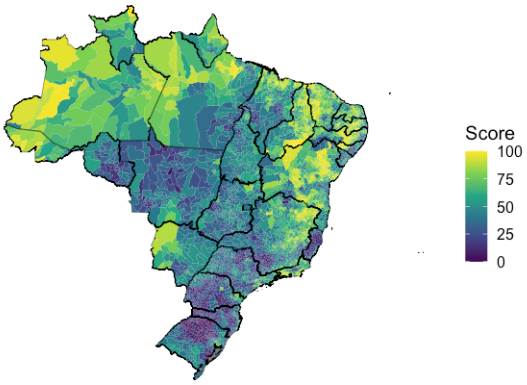
Diversity score per municipality, 2017



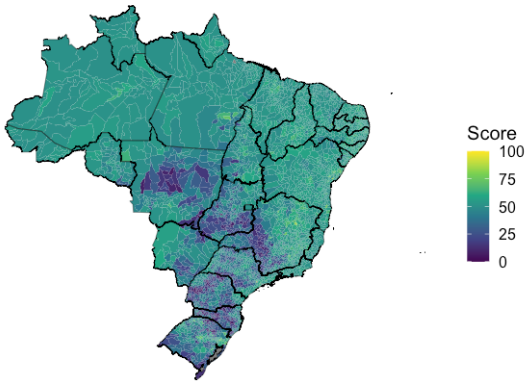
Synergies score per municipality, 2017



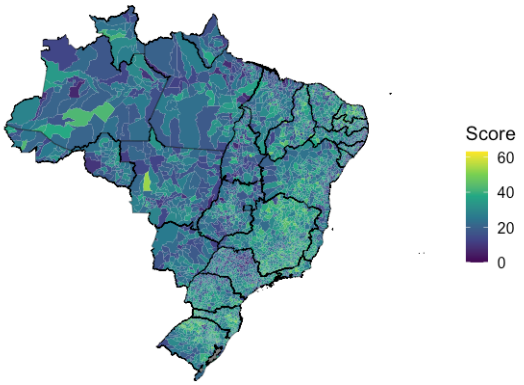
Efficiency score per municipality, 2017



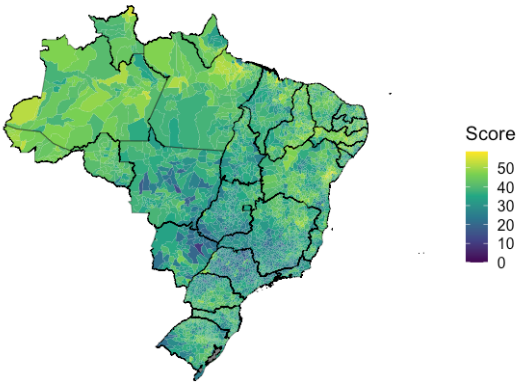
Recycling score per municipality, 2017



Resilience score per municipality, 2017



Human and social values score per municipality, 2017



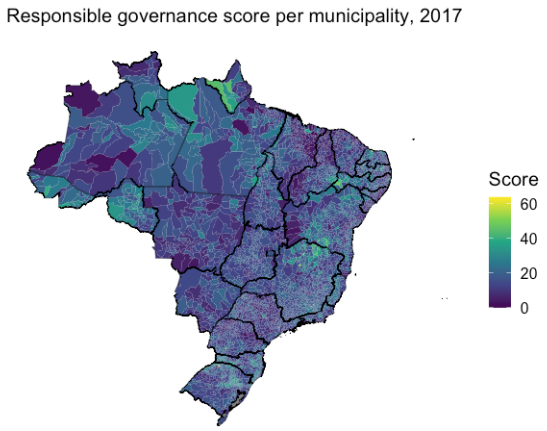


Figure 3.2 Municipal-level performance for each Element of Agroecology, where each map is scaled according to the maximum performance for that Element in order to better see variation. Brighter areas correspond to higher scores for agroecological performance.

Due to their low average scores for agroecological performance, we focus on the Centre-West, SP, and PR to explore how or why some municipalities in these areas manage to perform much better than the average within an overall industrialized context, and provide possible explanations for these municipalities' better performance; for ease of comparison, we look at the top 1–2 municipalities per state. As a counterpoint, we also investigate the lowest scoring municipality in the state of Acre, which was the highest scoring state, in the highest scoring region. Overall, this allows us to explore the efficacy of using an indicator-based approach rooted in TAPE to identify relatively high- and low-performing agroecological municipalities.

3.3.1 High-performing Municipalities in the Centre-West

Ecologically, the Centre-West of Brazil is largely dominated by the *Cerrado* (savanna) and *Pantanal* (wetland) ecosystems. This area was historically viewed as unsuitable for agriculture due to acidic, highly-weathered soils that have low fertility (Derli and Antonio 1998). However, during the Green Revolution in the 1970s there was a large increase in state-sponsored research,

development, and investment in the *Cerrado*, which has transformed this region – and Brazil – into an agricultural powerhouse, particularly for export-oriented agricultural commodities like soy and beef as well as cotton and sugarcane (Blesh and Wittman 2015; Brannstrom et al. 2008; Capellesso et al. 2016; Coy, Barrozo, and de Souza 2020). Intensive agricultural production by agribusiness in the *Cerrado* and along the Amazon frontier has raised significant and well-documented environmental concerns related to deforestation, biodiversity loss, and land degradation, as well as human rights concerns related to land rights and public health (Martinelli et al. 2010; Oliveira 2013; Song et al. 2021; Thomas, Freitas, and Pignati 2014). Yet within this overall unfavorable context for agroecology, some municipalities are performing notably better than the regional and state averages (Figure 3.3), which we will explore next.

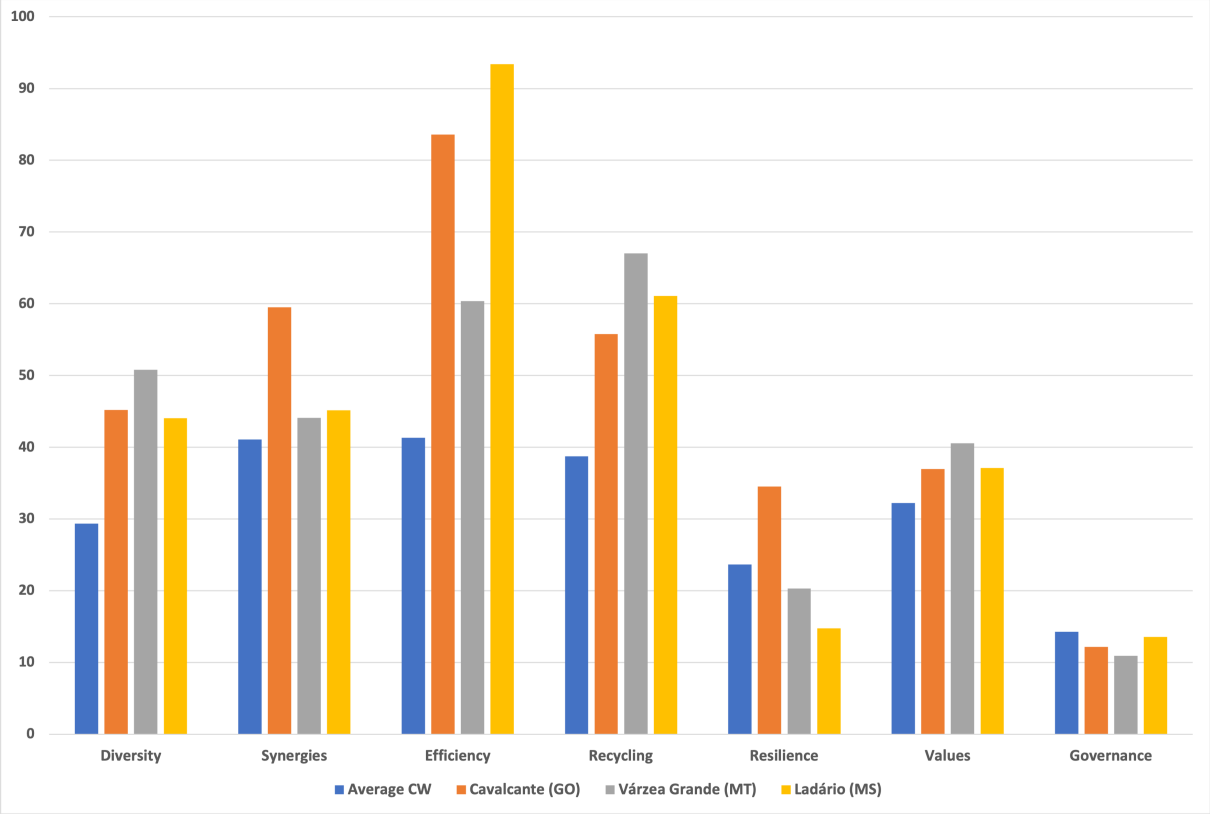


Figure 3.3 Average agroecological index scores for each available Element in the Centre-West region compared to the best-performing municipality for each state in the region.

Goiás

The best-performing municipalities in Goiás are the municipalities of Cavalcante and Teresina de Goiás, neighboring municipalities located in the center north of the state in the Chapada dos Veadeiros region. Their scores are 46.81 and 46.68 respectively, in comparison to the average overall score of 32.12 for Goiás. Active in these municipalities is an agroecological network called *Rede Pouso Alto Agroecologia* (Pouso Alto Agroecology Network), which was founded in 2014 to consolidate the efforts of numerous local organizations that had already been promoting agroecology in the years prior (Rede Pouso Alto Agroecologia n.d.). The organizations that make up *Rede Pouso Alto Agroecologia* aim to improve rural well-being and the quality of life of rural people by strengthening agroecology and supporting traditional peoples in maintaining biocultural heritage through *extrativismo* (sustainable harvesting) (Rede Pouso Alto Agroecologia n.d.). They carry out an array of activities with producers, ranging from providing trainings and organic certification, supporting with business plans and management, supporting with fundraising for obtaining farm equipment, and hosting native seed fairs; they also conduct public campaigns to promote agroecological and organic foods among consumers (Rede Pouso Alto Agroecologia n.d.). The network works with and forges alliances between a range of rural peoples, with a specific emphasis on serving traditional peoples (*populações/povos tradicionais)* – a designation in Brazil used to describe social groups with a relationship to sustainable territorial development, including family farmers, Indigenous peoples, *ribeirinhos* (river dwellers), *extratavistas* (harvester-gatherers), and *quilombolas* (communities of Afro-Brazilians descended from people who escaped slavery).

As *Rede Pouso Alto Agroecologia* states, "within the network, the Kalunga *quilombolas* play a prominent role in maintaining and supplying traditional foods, genetic resources, and associated production methods" (Rede Pouso Alto Agroecologia n.d.). Cavalcante is home to the largest Kalunga community in the Kalunga territory, which covers the municipalities of Cavalcante, Teresina de Goiás, and Monte Alegre. Here, the Kalunga produce food using traditional methods, without inorganic fertilizers and agrochemicals (Slow Food Brasil 2020), as reflected in their relatively high score for Efficiency. They mainly grow a diversity of crops and livestock for home consumption or to barter and exchange with other community members, but also sell surplus production through local markets or the Kalunga association (Slow Food Brasil 2020). In this context, agroecology may provide an alternative agricultural development pathway that relies less on external markets and more on internal community resources and relationships (Medina, Gosch, and DelGrossi 2021; Tiburcio 2007).

Mato Grosso

Várzea Grande (42.01) and Nossa Senhora do Livramento (41.00) are the highest-scoring municipalities in Mato Grosso in our analysis and perform notably better than the state average (30.34). These municipalities are located in the Baixada Cuiabana, a cluster of 14 municipalities in the south-central part of Mato Grosso that include and surround the capital city, Cuiabá. Operating in these municipalities is *Rede de Cooperação Solidária de Mato Grosso* (Mato Grosso Solidarity Cooperation Network), which takes a participatory action research approach to advancing agroecology and family farming in order to improve conservation of natural resources, food security, and income in accordance with solidarity economy principles

(Recoopsol n.d.). This area has some of the highest rates of organic production in the state (Sebrae 2016), however, much of the production remains uncertified (Araújo 2017).

Scholars have noted how traditional peoples have contributed to tree, crop, Non-Conventional Food Plant (PANC), and medicinal plant diversity in this area for both subsistence and commercialization, including through Brazil's National School Feeding Program (PNAE) (Bortoluzzi, Moreira, and Vieira 2019; Laranja et al. 2020; Paraguassu et al. 2019). Other reasons this region appears to have performed well include the presence of urban agroecological farms, including *Terra Estrela* in Várzea Grande, which has become "a reference point for organic marketing" in the region. This is largely due to its success in opening an organic store, developing a contract with a local supermarket, and organizing local organic farms to create a model similar to a community-supported agriculture (CSA) initiative, linking growers with supportive consumers to provide some stability for farmers (Araújo 2017; Naime 2016; Pantaleão et al. 2014).

Mato Grosso do Sul

Our analysis identifies the municipalities of Ladário (44.17) and Corumbá (41.23), both located in the far west of the state, as the best-performing municipalities in Mato Grosso do Sul (state average: 31.79). In both of these municipalities most of the population – more than 90% – lives in urban areas, but both municipalities have *assentamentos* (agrarian reform settlements) with diversified crop production and livestock – particularly dairy and beef cattle, but also bee-keeping – for home consumption and income generation (da Conceição 2016). Scholars have noted how public procurement programs, including PNAE, have increasingly incentivized

settlement farmers in the area to grow more horticultural products due to the possibility of better financial returns (Martins et al. 2018). Additionally, the participatory guarantee system (PGS) *Associação de Produtores Orgânicos do Estado de Mato Grosso do Sul* (Association of Organic Producers in the State of Mato Grosso do Sul) has been active in these municipalities since 2000 (da Conceição 2016). PGS programs can play an important role in facilitating agroecological transitions by providing a way for local producers to certify one another as agroecological in a manner that is more cost-effective and less bureaucratic for small-scale farmers than third-party certification (Brancher 2004). Nonetheless, documenting the information necessary for certification is still a challenge for some of the settlement farmers (Martins et al. 2018).

While access to public programs, the quality of local infrastructure and education, soil type and fertility, and land use history vary considerably among the eight *assentamentos* present in these two municipalities, scholars have noted the overall important role that these settlements play in advancing agroecology in the region (da Conceição 2016; Cuyate et al. 2011). In some cases, younger members of the settlements who temporarily left to study agroecology at technical schools or university have returned to promote agroecological methods, and in other cases, settlement farmers were encouraged to experiment with agroecology through interactions with government or university-based extension agents who were knowledgeable about agroecology, provided guidance, and offered workshops and trainings (Carbunck et al. 2018; da Conceição 2016; da Costa and Feiden 2020; Cuyate et al. 2011). In qualitative research carried out with two of the *assentamentos*, members generally indicated that their primary motives for participating in the agroecological transition had to do with their involvement with local social movements, non-

governmental organizations (NGOs), unions, or associations, and their desire to produce healthier foods (da Conceição 2016).

3.3.2 High-performing Municipalities in São Paulo

São Paulo, one of Brazil's most important agricultural states, has an agricultural and historical context that differs substantially from that of the Centre-West. During Brazil's colonial period, the state was dominated by coffee and sugarcane plantations that relied on the exploited labor of people who were enslaved (Gonçalves 2017; Luna and Klein 2018). These histories still inform the São Paulo landscape: there continues to be industrial, export-oriented production of sugarcane, coffee, oranges, corn, and soy; there is intensive use of agrochemicals to manage monocultures; and land inequality is high.

Against this backdrop (SP average: 30.11), the best-performing municipality is Osasco (60.49), part of the metropolitan area of the capital city of São Paulo (Figure 3.4). According to our analysis, Osasco performs well due to having a high percentage of farms with horticultural production (Diversity element), and all farms here reported using only organic fertilizers and not using any agrochemicals (Efficiency element), probably in part due to higher urban demand for organic foods. Additionally, all farms here reported access to government credit programs (Resilience element), likely due to having fairly good access to services as an urban municipality. However, a lack of data for some indicators provides caveats to Osasco's reported score; for example, data were not reported (i.e., were missing) for the indicators of seed saving and seed exchange (the two indicators identified for the Recycling element), nor for diversity in temporary production. In addition, the publicly available census data do not provide information

on number of livestock for Osasco due to farmer confidentiality, which prevents us from calculating SIDI for livestock. Were these indicators available, the score for Osasco would likely change.

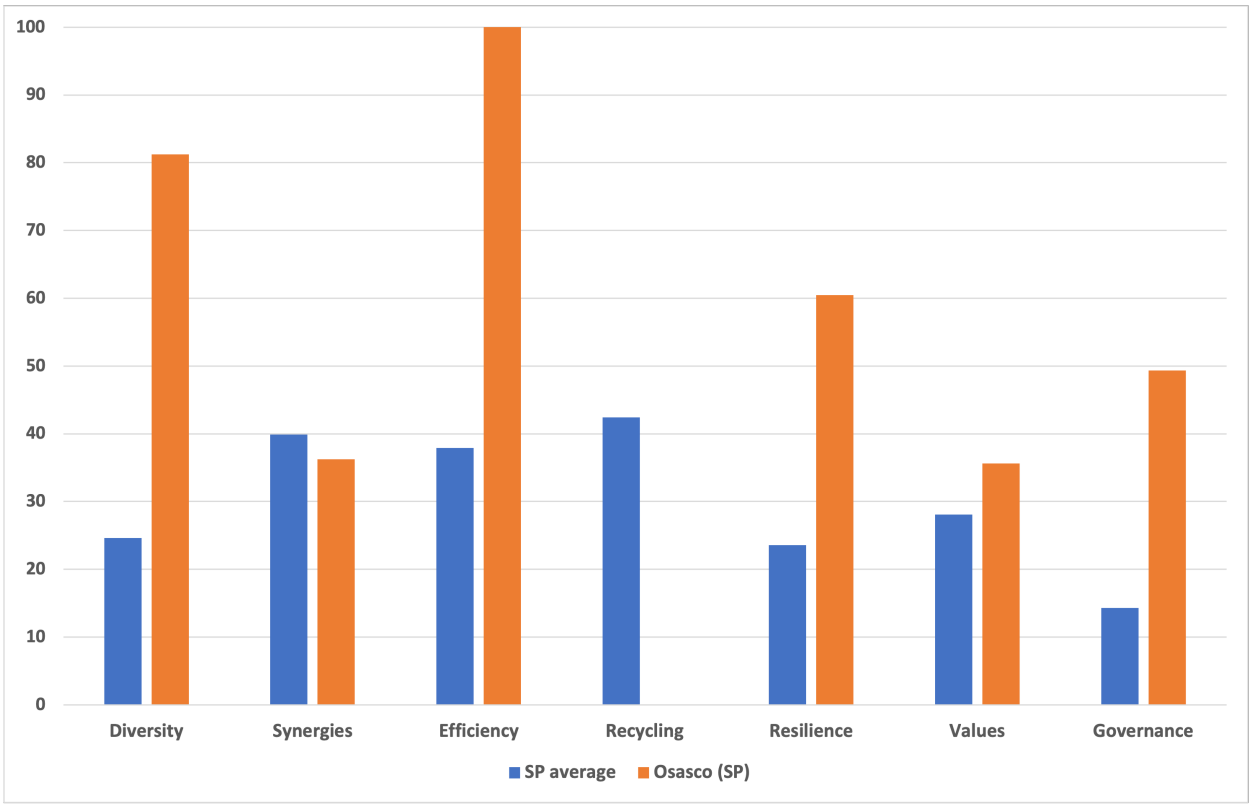


Figure 3.4 Average agroecological index scores for each available Element for the state of São Paulo compared to the best-performing municipality, Osasco.

That such a highly urbanized municipality emerges as a bright spot points to the role that cities and urban areas can play in agroecological transitions. For example, Osasco is home to *Instituto AUÁ*, an NGO with the goal of promoting community-based environmental projects and a solidarity economy in the greater São Paulo area. Since its founding in 1997, the NGO has advocated for agroecology as a pathway for sustainable development and to support family farmers (Instituto AUÁ 2016a). It has since expanded in a number of ways; for example, since 2014 it has been running its *Banca Orgânica* project, which operates similarly to a CSA model

(Instituto AUÁ 2016a). Additionally, *Instituto AUÁ* organizes numerous urban gardens for community members and for schools, encouraging youth environmental education across Osasco. The group has partnered with the Urban Agriculture Program of Osasco's Department of Social Development, Work and Inclusion (SDTI) to support local community members in building gardening skills, while also generating some income for the participating gardeners, who are often socially marginalized (Instituto AUÁ 2016a). The horticultural products and medicinal plants that participants grow are then sold directly on-site or at the local organic market. According to their 2016 Annual Report, that year alone of the program involved seven urban gardens growing more than 30 horticultural and medicinal species and trained 50 local residents in urban agroecology (Instituto AUÁ 2016b). Together, *Instituto AUÁ* and SDTI have even published a manual for urban vegetable gardeners, focused on agroecological production techniques as well as how to market and sell products in the city (Instituto AUÁ 2016b).

3.3.3 High-performing Municipalities in Paraná

In Paraná, particularly in the interior of the state, soy and corn production dominate; it is the second-largest producer of grains in Brazil after Mato Grosso (IBGE 2020). In addition, Paraná has a strong animal agriculture sector. It is the national leader in poultry production (hosting a quarter of Brazil's poultry) and the second-largest national producer of milk, hogs, eggs, farmed fish (particularly tilapia), and honey (IBGE 2020). The highly specialized and industrialized production in this area contributes to Paraná's fairly low municipal-level diversity, its reliance on agrochemicals and synthetic fertilizers, and high land inequality relative to the other two states in the southern region.

Within these broader conditions (PR average: 30.37), Paranaguá (46.51) emerges as the best-performing municipality for agroecology in Paraná, followed by the municipality of Itaperuçu (46.42) (Figure 3.5). Paranaguá scores well on indicators such as land use diversity and proportion of farms protecting rivers and streams (both Synergies element), proportion of farms that don't use agrotoxins (Efficiency element), proportion of farms that save seed (Recycling element), proportion of farms accessing government credit programs (Resilience element), and proportion of farms where the owner-operator resides on-farm (Values element), and scores relatively high for proportion of farms that are part of farmers' associations (Governance element). It scores less well on youth involvement in agriculture (Values element), proportion of farms with agroforestry (Synergies element), and proportion of farms practicing horticulture (Diversity element), likely because this region is primarily focused on field crop and livestock production. Itaperuçu scores well for indicators on use of only organic fertilizers and no use of agrochemicals (Efficiency element), on-farm residence (Values element), and proportion of farms accessing government credit programs (Resilience element), while having relatively low scores for land equity (Governance element), proportion of farms with horticultural production (Diversity element), and proportion of farms practicing agroforestry (Synergies element) – again, likely because of the investment in field crop and livestock production in this area.

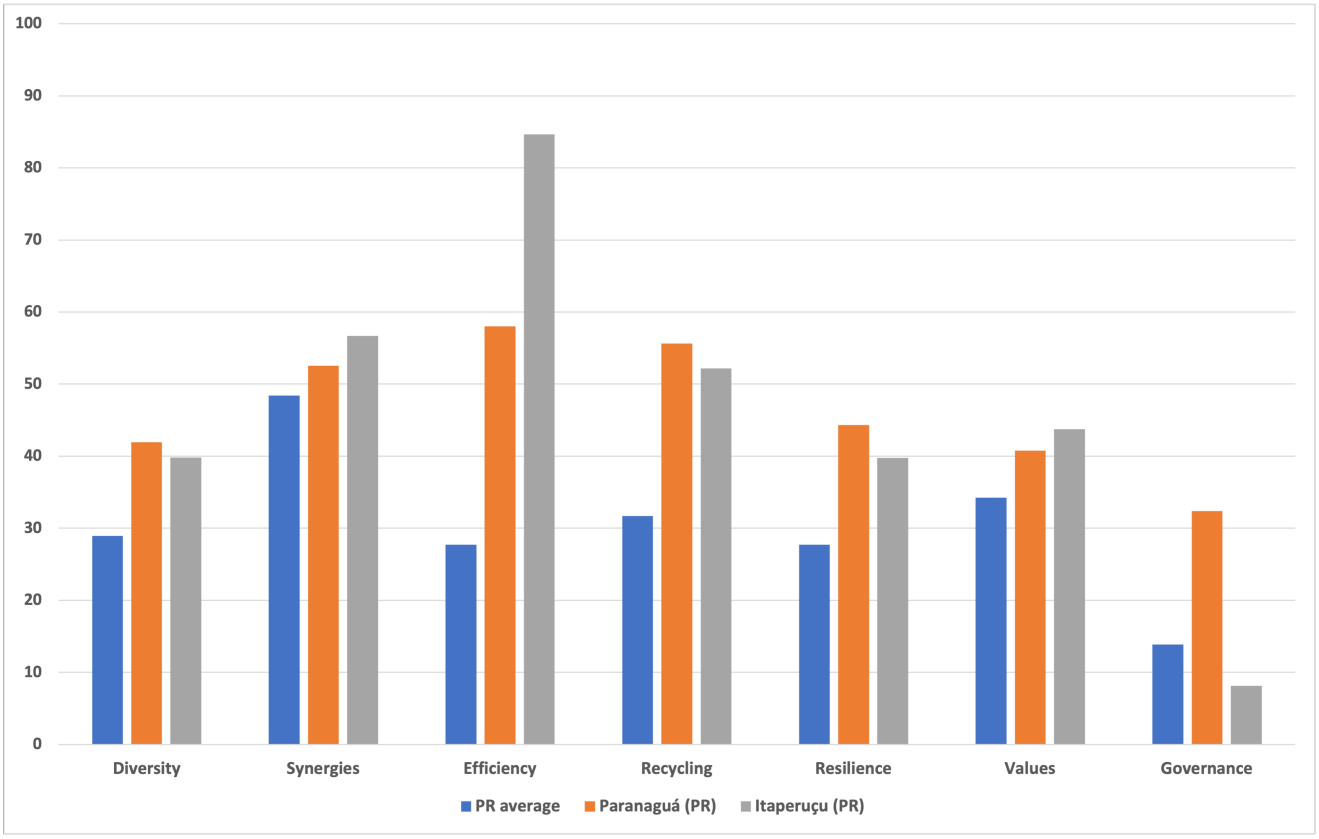


Figure 3.5 Average agroecological index scores for each available Element for the state of Paraná compared to the best-performing municipalities, Paranaguá and Itaperuçu.

Paranaguá is one of the oldest settlements in Paraná and is situated along the Bay of Paranaguá. The municipality's ecologically sensitive location has resulted in the municipal government's efforts to implement an environmental conservation policy, with funding from the state, which involves promoting rural tourism, reforestation, soil conservation, sustainable aquaculture, and organic agriculture, while also promoting mangrove preservation (Articulação Nacional de Agroecologia 2020; Municipio de Paranaguá 2019).

Paranaguá has been part of an inter-institutional "Agroecology Hub" that started in 1999, involving seven municipalities and participating institutions ranging from local city halls, state governmental bodies, NGOs, and farmers' associations (Mendes do Amaral 2007). The aim of

the Hub was to provide "a permanent forum for discussion and implementation of integrated actions aimed at local development, with an emphasis on agroecology and family farming" (Mendes do Amaral 2007, p. 1731). Outcomes associated with the Hub include various workshops to support farmers in transitioning to organic farming methods and standards, in line with organic and environmental legislation; the certification of over 200 farmers practicing agroecology and support for regionally focused commercialization; and encouraging farmers' involvement with the agroecology network and PGS Rede Ecovida (Mendes do Amaral 2007).

Itaperuçu is located within an hour's drive of the state capital, Curitiba, likely providing good access to markets; more than half of the state's certified organic producers are located in the capital region (Silva et al. 2018). Additionally, Itaperuçu's strong scores appear to be linked to a number of public policies and programs. For example, the program *Produção Agroecológica Integrada e Sustentável* (Integrated and Sustainable Agroecological Production) is funded and implemented here through a partnership between the *Banco do Brasil* Foundation, the National Bank for Economic and Social Development, and the National Union of Cooperatives of Family Agriculture and Solidarity Economy (UNICAFES) in conjunction with local partners, including Itaperuçu's Secretariat of Agriculture and the Environment and the local rural workers' union (UNICAFES 2014). This program provided training to 17 local farm families on agroecological production methods, the development of cooperatives, and collective marketing, with a primary focus on improving food security for the participating families and a secondary focus on income generation (UNICAFES 2014).

In addition, the municipality has a progressive local government, which has instituted a policy initiative called *Itaperuçu Sustentável* (Sustainable Itaperuçu). This policy aims "to strengthen the economy in an ecological way based on cycle tourism, agroecology and waste management" (Mandato Goura 2019). By linking agroecological producers along a sustainable tourism route, the policy aims to support the livelihoods of local agroecological farmers and encourage production of agrochemical-free foods. Lastly, Itaperuçu has also received a contract through the *Assistência Técnica e Extensão Rural* (Technical Assistance and Rural Extension, abbreviated ATER) policy to encourage and scale out PGS (MDA 2017).

Finally, the decentralized PGS *Rede Ecovida* is already very active in this municipality and area, as are a number of others (Centro Paranaense de Referência em Agroecologia 2017). For example, the *Associação para o Desenvolvimento da Agroecologia no Paraná* (Association for the Development of Agroecology in Paraná, abbreviated AOPA) is located in this area and provides direct support to farmers who make up the Maurício Burmester do Amaral nucleus of *Rede Ecovida* (a farmer nucleus is made up of smaller, more localized groups of *Rede Ecovida* farmers) (AOPA n.d.; Brancher 2004; Silva et al. 2018). Scholars describe AOPA, founded in 1995, as "the best and most well-recognized institution in the region" for agroecology and a "historical reference" and "pioneer" of agroecology in the state (Silva et al. 2018). For example, AOPA hosts an associated cooperative, COAOPA, that helps market agroecological foods (COAOPA 2019), and was a founder of *Rede Ecovida*'s innovative alternative marketing system, the Southern Circuit for the Circulation of Agroecological Foods, which distributes and trades *Rede Ecovida* products across all three southern states based on solidarity economy principles of regional cooperation and embeddedness, social justice, appropriate economic valuation, and

transparency (Magnanti 2008). Given the reputation and success of AOPA and *Rede Ecovida* in the area, extension agents from the Paraná government's *Empresa de Assistência Técnica e Extensão Rural* (Enterprise for Technical Assistance and Rural Extension) entered into a partnership with AOPA to learn from their experience and better understand the specific needs of agroecological farmers, which included technical support with production planning and identifying marketing channels (Silva et al. 2018). This collaboration has now resulted in the design of two new courses for extension agents (on the basic principles of agroecology and on homeopathy), creating opportunities for extension agents to better serve agroecological and organic farmers in the area, possibly further expanding the sector (Silva et al. 2018).

3.3.4 Low-performing Municipalities in Acre

Lastly, we used our method to identify low-performing municipalities in areas otherwise characterized by overall higher scores for agroecological performance. The region with the overall highest agroecological performance was Brazil's North, made up of the states of Acre, Rondônia, Amazonas, Roraima, Pará, Amapá, and Tocantins. Ecologically, this region encompasses the Amazon basin and a small portion of the *Cerrado* (savanna). While agricultural expansion over the past three decades has increasingly put the ecological integrity of this region at risk, with export-oriented cattle and grain expansion in particular being major drivers of deforestation, land grabs, and human rights abuses (Kehoe et al. 2019; Oliveira 2013), Amazônia also has a long history of agricultural and ecological use by Indigenous and traditional peoples, whose complex subsistence strategies include traditional fire management, development of *terra preta* (Amazonian dark earth, an Indigenous technique to build fertility in low-fertility rainforest soils), *extrativismo* (sustainable harvesting and gathering of native products, like açai, Brazil

nuts, and rubber), and polyculture agroforestry (Glaser 2007; Maezumi et al. 2018). These management practices have not only shaped tree species domestication and the current forest composition (i.e., the "hyperdominance" of edible tree species (Maezumi et al. 2018)), but also strongly influenced crop domestication for crops like manioc, squash, beans, rice, and even maize (Koch et al. 2019; Watling et al. 2017, 2018). In short, many of these traditional practices and their legacies remain on the landscape and are in use by local cultural groups today.

Overall, the highest-scoring state was the Amazonian state of Acre (42.51), which has "a long tradition of agroforestry and resource management…over millennia" (Watling et al. 2017, p. 1871). In our analysis, Acre performed well on the elements of Synergies (particularly for protection of water sources and native forest preservation); Efficiency (for not using agrochemicals and for using only organic fertilizers); Recycling (particularly for saving seed); and Human and Social Values (particularly for family farming and owner-operator on-farm residence, while also scoring relatively high for the percentage of both women- and youth-run farms). Yet within this overall context, the lowest-scoring municipality was Senador Guiomard (33.90), whose scores for annual production diversity (Diversity element); land use diversity, water protection, and native forest preservation (Synergies element); non-use of agrochemicals and use of organic fertilizers (Efficiency element); and farmers' association membership (Governance element) were among the lowest in the state. This reflects the fact that Senador Guiomard seems to be a part of the unsustainable agricultural expansion complex: according to the agricultural census data, 94% of its agricultural area is used for animal production (primarily a split of cattle and chickens), while 86% of its annual production area is used for maize. One possible factor influencing Senador Guiomard's performance could be its strategic geographic

location; as stated in an official government investment report, the municipality is located on the now-concluded Interoceanic Highway, "which connects Brazil to ports on the Pacific coast, thereby connecting Acre with Andean markets, the US west coast and Asian markets…and contributes to Brazilian exports and the development of Brazil's Northern Region" (RENAI et al. n.d., p. 80). In light of this, Senador Guiomard has been designated as an "Export Processing Zone," which confers an industrial area designation with special tax and other incentives and benefits in order to increase exports and attract investment (Ministry of Industry Foreign Trade and Services n.d.; RENAI et al. n.d.). This status has been granted for 20 years and will be renewable for another 20 after the initial period is completed (RENAI et al. n.d.), with likely negative implications for its agroecological performance into the future.

3.3.5 Insights on Elements of Agroecological Success

Our analysis allowed us to identify municipalities that were performing well relative to their context, which can provide insights into the conditions that may advance progress toward agroecology. Our literature review points to the following factors as potential drivers of higher agroecological performance: involvement with grassroots farmer networks and NGOs; proximity to urban areas and markets; access to public policies, programs, and trainings; and maintenance of traditional and cultural agricultural practices.

Involvement with grassroots farmer networks and NGOs is often discussed in the agroecology literature as a key feature for scaling out agroecology across communities (Hart et al. 2016; Mier y Terán Giménez Cacho et al. 2018; Rosset and Martínez-Torres 2012). This seemed to be the case in our study, as participation in social movements, networks, or local NGO activities

featured strongly in all bright spot municipalities, indicating that these factors may play an integral role in encouraging and supporting agroecological transitions through place-based horizontal knowledge exchange and capacity-building. Agroecology networks like *Rede de Cooperação Solidária* in Mato Grosso's Baixada Cuiabana and *Rede Ecovida* in Paranaguá and Itaperuçu, Paraná, actively promote farmer-to-farmer knowledge sharing and provide local marketing opportunities for participating farmers. In Osasco, São Paulo, a local NGO (*Instituto AUÁ*) promotes community-based projects to engage youth through environmental education programs and train local and low-income community members on organic urban agriculture, which supports residents in acquiring new skills and generates livelihood opportunities.

As has also been discussed in the agroecology literature, proximity to urban areas seemed to emerge as important across the bright spot cases. This proximity strengthens rural-urban relations, enhances access to markets, and serves to re-embed or re-territorialize food systems in the pursuit of larger scale food-systems change (Gliessman 2016; James and Bowness 2021; Vaarst et al. 2018). As part of the São Paulo metropolitan area, farmers in Osasco, São Paulo, have better access to resources and services like credit and also have more marketing opportunities, particularly thanks to *Instituto AUÁ's* additional focus on providing marketing and distribution trainings. The municipalities of Várzea Grande and Nossa Senhora do Livramento in Mato Grosso are located in the Baixada Cuiabana, or the cluster of municipalities surrounding Mato Grosso's capital city of Cuiabá. Here, urban agroecological farms like *Terra Estrela* serve as models for other farms in the region and have generated overall greater support for agroecology by opening a store for organic products and organizing local organic farms to create a CSA-like model that benefits both agroecological farmers as well as eaters.

Proximity to urban areas can also enhance farmers' access to public policies, programs, and trainings, which can play an important role in supporting transitions to agroecology (Giraldo and McCune 2019; Valencia, Wittman, and Blesh 2019; Wittman and Blesh 2015). In Itaperuçu, Paraná, programs like the Integrated and Sustainable Agroecological Production program provided local farmers with training on agroecological production methods and cooperative development and marketing while the Sustainable Itaperuçu initiative provided agroecological farmers with an extra income opportunity through sustainable rural tourism. In Mato Grosso's Baixada Cuiabana and the municipalities of Ladário and Corumbá in Mato Grosso do Sul, farmers have benefitted from accessing public policies like PNAE, which acts as a mediated market to support and incentivize organic production. These findings indicate that government support can be important for scaling out agroecology but is most effective when it supports place-based initiatives (e.g., linking agroecological farmers with sustainable tourism through Sustainable Itaperuçu) and is joined up with other local or national policy priorities (e.g., improving youth food security through PNAE). An important caveat is that access to public policies is not uniform across Brazil (Grisa and Schneider 2014; McKay and Nehring 2014), which will require reducing geographic, class-based, and racial bias in the distribution of public resources and services.

Lastly, we found that place-based and traditional agricultural practices serve as an important basis for maintaining and enhancing agroecology, which has also been discussed in the literature (Altieri et al. 2015; Vandermeer and Perfecto 2013). In the Baixada Cuiabana of Mato Grosso, in Ladário and Corumbá in Mato Grosso do Sul, and in Cavalcante and Teresina de Goiás in Goiás,

traditional peoples (including *extrativistas, quilombolas*, and family farmers) have played an integral role in stewarding agrobiodiversity and biocultural heritage and in promoting management methods that do not rely on synthetic external inputs. Discussing and sharing knowledge about traditional agricultural methods through participatory learning in social networks could further expand and build upon the potential of these practices.

Despite the apparent importance of the above sociocultural or socioeconomic factors for driving agroecological performance, the Brazilian agricultural census doesn't capture a number of these variables; for example, we did not identify any indicators suited to the Elements for Culture and Food Tradition, Co-creation and Sharing of Knowledge, and Circular and Solidarity Economy. This points to important data gaps in, and limitations to, the agricultural census data and our analysis.

3.3.6 Data Gaps and Limitations

Although Brazil has one of the most thorough agricultural censuses in the world, our analysis highlighted limitations to using publicly available agricultural census data for assessing agroecology according to the 10 Elements. First, a basic limitation for studies that use agricultural census data is the need to maintain farmer confidentiality. As mentioned, when there were too few farmers in a municipality that used a certain practice (e.g., crop rotation) or were represented in a certain indicator (e.g., too few farms grew a certain crop), they were not reported by IBGE in the publicly available, aggregated municipal census data to protect farmer confidentiality. This limitation could possibly have affected the results in some cases (for example, in Osasco).

Another limitation to our study is that, as mentioned, no indicators were identified from the Brazilian agricultural census for three of the 10 Elements of Agroecology: Culture and Food Tradition, Co-creation and Sharing of Knowledge, and Circular and Solidarity Economy. This indicates that there are major data gaps in terms of measuring the full breadth of agroecology using the agricultural census. This is particularly notable as these three Elements are related to social, cultural, and economic dimensions of agroecology, which may be important drivers of agroecological transitions. To enable more robust quantitative assessments of agroecology in the future, agricultural census data could better account for these Elements and their indicators. As one example, for "Co-creation and Sharing of Knowledge" (Element 7), census questions could gather information about whether and from which sources farmers receive and/or share agroecological knowledge, and about farmers' level of engagement in informal or grassroots networks (which could be assessed according to a Likert-type scale). In addition, several of the other Elements have census data available for relatively few indicators. For example, we only identified data for one of the four indicators for the Recycling Element: management of seeds and breeds, with notable gaps for key agroecological practices that could fall in this category, such as use of on-farm compost, cover crops, and details on management of animal manure and crop residues.

Finally, some of the Brazilian agricultural census data as currently collected and presented are limited for characterizing agroecology according to the CAET indicators because the data that are provided are fairly coarse, obscuring finer-scale variability in management systems that relates to key functions. For example, census data on use of crop rotation for the Synergies

element is only provided in terms of the use or non-use of this practice, and do not include information on the diversity of rotations. In this case, this means that the use of crop rotation currently lumps simplified corn-soy rotations together with highly diverse crop rotations (e.g., with non-harvested cover crops or perennial forages), even though these have very different implications for the level of agroecological transition and associated socioecological benefits (Bowles et al. 2020; Stratton, Wittman, and Blesh 2021). As another example, census data on use of organic versus non-organic fertilizers and use of agrochemicals for the Efficiency element are again only reported in terms of use or non-use. As documented in the agroecology literature, part of increasing efficiency can involve gradually reducing use of or dependency on external synthetic inputs, so providing more granular data on input-use intensity and where inputs are sourced (e.g., from on- or off-farm) could provide more valuable information on the state of transitions (Duru, Therond, and Fares 2015; Pretty 1995, 2008). Similarly, we were not able to locate data on the recycling of biomass and nutrients indicator for the Recycling element, but if the census questionnaire was adapted to include data on the type of organic fertilizers used (e.g., legume green manures, animal manure, compost, other organic-approved products), and again, whether these are sourced from on or off the farm, then assessment of this Element could become more robust. Making relatively straightforward changes such as these to how data are collected and calculated in agricultural censuses would improve researchers' abilities to more accurately assess agroecological indicators and characterize agroecology moving forward, which is necessary for agroecological approaches to receive greater policy support.

3.4 Conclusion

The objectives of this analysis were two-fold: 1) To adapt and test the ability of FAO's TAPE (specifically, the CAET step) to be used with existing and publicly available agricultural census data to assess indicators of agroecology at a territorial scale, and 2) To evaluate agroecological performance and identify high- and low-performing municipalities relative to their context in particular territories in Brazil. Even with the data limitations, the CAET step of TAPE proved useful for assessing agroecological performance in our study. We found that, in general, agroecological scores are highest in the North and Northeast regions of Brazil and lowest in the Centre-West region and the states of São Paulo and Paraná, aligning with historical and ongoing production patterns in these areas. Our analysis also allowed us to identify municipalities that were performing well relative to their context, allowing us to explore the conditions that seem to be contributing to more advanced progress toward agroecology, such as involvement with grassroots farmer networks and NGOs; access to public policies, programs, and trainings; proximity to urban areas and markets; and maintenance of traditional and cultural agricultural practices.

While a coarse-scale indicator-based approach can facilitate cross-context comparisons, it can also risk obscuring complex realities and privilege certain ways of knowing. To this end, future research could investigate the drivers and nuances of agroecological performance through qualitative and quantitative explorations of the on-the-ground experiences of farmers in municipalities that perform better or worse on agroecology relative to their geographic context. For example, a remaining question that could be explored is to what extent high-performing regions (i.e., the North and Northeast) or states are characterized by agroecology "by design"

(i.e., driven by farmer choice) or "by default" (i.e., out of necessity due to a lack of access to resources or alternative options). While our study included income as an indicator (Resilience Element), and while the Northeast and North regions have the lowest farm household incomes on average, scholars have found that income is not a consistent predictor of rural peoples' livelihood strategies or environmental behaviors in this context, as farmers' options and decision-making are heavily influenced by social and historical factors (including factors like identity and social prestige), alternative and non-economic values (including lifestyle and security), and other assets and capabilities (Garrett et al. 2017). Additionally, future work could use time series data to explore, to the extent possible, how trends in agroecological performance change over time, and to and link their level of transition to key outcomes, such as food security, health, and perceptions of well-being. Doing so would help further explain the "conditionality" of agroecological performance (Sampson et al. 2021) and lend important insights for how to design context-appropriate policy instruments that can foster a more sustainable and just food system.

Chapter 4: The Role of the Social Carrier in Mediating the Relationship between Farm Size and Agroecological Practice Use

4.1 Introduction

There is an urgent need to transform global agri-food systems to better align food production with environmental sustainability and social equity (Anderson et al. 2019; Bezner Kerr 2020; FAO 2018a; IAASTD 2009; IPES-Food and ETC Group 2021). Studies have drawn attention to the role of both *farm size* and *farm management*, as well as their interaction, in realizing more equitable and sustainable agri-food systems. A number of scholars have now illustrated how *farm size* shapes a range of important food system outcomes; in particular, smaller farms have been shown to disproportionately contribute to global food security and nutrient diversity (Herrero et al. 2017; Ricciardi et al. 2018; Samberg et al. 2016), and may be higher in yields and biodiversity (Ricciardi et al. 2021).

Additionally, it is now well-documented that industrial *management practices* have numerous negative social and ecological externalities, including water and land pollution and degradation, biodiversity loss, climate change, increased incidence of disease outbreaks, and pesticide toxicity, among others (HLPE 2019; Kremen, Iles, and Bacon 2012; Lin et al. 2011; Matson et al. 1997). In contrast, agroecological management practices can reduce negative externalities associated with agriculture; enhance biodiversity and ecosystem services while maintaining or increasing yield (Beillouin et al. 2021; Kremen and Miles 2012; Tamburini et al. 2020; Vandermeer 1981); and strengthen food security and nutrition (Bezner Kerr et al. 2021; Sampson

et al. 2021). These benefits occur through use of "substitution" practices that replace synthetic inputs (e.g., fertilizers and pesticides) with organic inputs (e.g., organic fertilizers and pest control methods, with limited increases in cropping system diversity); "redesign" practices that holistically transform agroecosystems to function based on ecological complexity (e.g., diversifying agricultural production to support soil fertility and reduce pest pressure, integrating non-crop diversity, etc.); and relational practices that support social and cultural sustainability (e.g., respecting local traditions) (Gliessman 2009; Hill 1985; Pretty 2018; Wezel et al. 2014).

The evidence that agroecological approaches can improve food security, nutrition, and environmental outcomes has led social movements, civil society, scholars, and policymakers to increasingly endorse agroecology – commonly defined as a science, practice, and social movement (Wezel et al. 2009) – as a promising pathway for improving agri-food system sustainability (Barrios et al. 2020; FAO 2018b; HLPE 2019; IPES-Food 2016; La Via Campesina 2010). However, despite the fact that farm size plays a role in shaping agri-food system sustainability outcomes, and that industrial farm management methods are typically associated with larger and more specialized farms – which often rely on mechanization, agrochemicals, and other fossil-fuel based inputs and labor-saving practices to produce a large volume of relatively few crops – only a few studies to date have empirically assessed the role of farm size in influencing farmers' use of agroecological practices.

There are three recent studies that empirically assess this relationship. All three focus on organic farms in the Global North, where the most dominant certification model is third-party certification, and all three found farm size to have an important yet variable effect on

agroecological practice use. In a regional survey in France, Pépin et al. (2021) found that small organic vegetable farms (median farm size 3 ha) were more likely to use agroecological practices than their larger counterparts, but that farm size did not have an equal influence on all practices. Similarly, in a national survey of US organic fruit and vegetable growers, Liebert et al. (under review) found that large farms (> 405 ha) used fewer agroecological practices than small farms (< 39 ha), and that the influence of farm size varied based on the practice. They suggest that the overall lower probability of agroecological practice use on larger farms is due to a greater degree of conventionalization, or "the process by which organic agriculture is becoming more similar to the dominant industrial model of farming" by incorporating features such as increased simplification and standardization. Finally, Esquivel et al. (2021) interviewed 20 California organic lettuce growers and found that mid-size (8–142 ha) farms are more likely to use on farm-diversification practices than large (> 202 ha) or small (< 8 ha) farms. They attribute this to the fact that mid-size farms benefitted from access to secure tenure, capital, and buyers who shared their values, whereas small and large farms were economically constrained – the former due to resource poverty (e.g., lack of access to productive assets, including land and labor) and the latter due to market pressures (e.g., supply chain constraints, such as buyer-imposed food safety restrictions).

While farm size had an influence on agroecological management in each case, all three studies draw attention to the need to consider the broader political and economic contexts within which farmers make management choices. In this vein, a recent systematic review highlighted the need to better understand the role of social and structural forces in shaping farmers' use of management practices (Prokopy et al. 2019). These socio-structural factors, or political,

economic, and production "lock-ins" – such as concentrated corporate power (Clapp 2021; IPES-Food 2016); warped policies that subsidize use of unsustainable management practices (FAO et al. 2021); and a lack of support for agroecological research (Buttel 2006; Miles, DeLonge, and Carlisle 2017; Mortensen and Smith 2020) – are often major drivers of unsustainable land management. Indeed, Buttel (2006) argues that addressing the "social structural processes" that constrain farmer decision-making is crucial for shaping more sustainable agricultural systems, noting that "farm size is, to be sure, associated with or related to these other structural processes, but farm size or scale *per se* tends not to be the direct cause of unsustainability."

To overcome socio-structural barriers to scaling out agroecology and improving sustainability, agrarian social movements emphasize the importance of building collective power to act as a counter-force to promote sustainability (Desmarais 2002, 2007, 2008; Meek 2014; Rosset and Martínez-Torres 2012). Agrarian scholar Jan Douwe van der Ploeg refers to this "social force that actively moves agroecology forward" as the "social carrier," or a group that "identifies with this particular way of farming, that defends it [against] material, political, economic and symbolic threats and attacks and that is prepared to develop agroecology further" (van der Ploeg 2012, p. 47-48). He goes on to argue that the social carrier's defense of agroecology from material, political, economic, and symbolic threats is rooted in

> an ongoing struggle for autonomy and progress in a world characterized by often harsh dependency relations and (often high levels of) deprivation. To counter dependency and deprivation, autonomy is sought … through the co-production of [humans] and living nature. Nature – that is, land, animals, plants, water, soil biology and ecological cycles –

> is used to create and develop a resource base, which is complemented by labour [and] knowledge, networks, access to markets and so forth (van der Ploeg 2008, p. 14).

In particular, van der Ploeg argues that "territorial autonomy" is needed to counter dependency relations. This form of autonomy stands in contrast to what has been called "neoliberal" or individualized autonomy (Stock et al. 2014), which relies on the exploitation and commodification of resources in pursuit of profit. Instead, territorial autonomy is constructed through the collective social organization of agroecological actors (the social carrier), who aim to democratize regional economies and provide socioecological services at the territorial scale (van der Ploeg 2017). Because the construction of territorial autonomy aims to reduce dependency on external synthetic inputs, resources, and actors by instead relying on place-based socioecological processes and resources, van der Ploeg suggests that the social carrier acts as an important sustainability driver. Building on the theory of autonomy, Stock et al. (2014) propose that "autonomy can mediate environmental [processes and] outcomes on the farm" (p. 12). Specifically, they hypothesize that territorial autonomy and the behavior it shapes "is more likely (but by no means certain) to deliver environmental goods and prevent environmental bads," as territorial autonomy "encompasses a wider variety of livelihood and personally valued things beyond simple financial gain" including the ability to "organize one's own work" and work with nature and others "to realize collective interests" (Stock et al. 2014, p. 412-413).

In this paper, we are interested in investigating this interplay between agroecology *movements* – which act as a "social carrier" to advance agroecology at a socio-structural level through the pursuit of territorial autonomy (van der Ploeg 2012) – and the use of agroecological *practices*,

which include farming practices that leverage socioecological processes for sustainable food production (Bezner Kerr 2020; HLPE 2019; Wezel et al. 2009, 2020), across a farm size spectrum. Specifically, we ask: To what extent does farm size influence the use of agroecological practices, in a context where support for agroecology is deeply embedded in a social carrier that promotes territorial autonomy? To test this relationship, we assess farm management plans from the agroecology network Rede Ecovida, based in southern Brazil, and contextualize the findings with interview data. Rede Ecovida is made up of agroecological farmers and allies who *choose* to practice agroecology; that is, they practice agroecology "by design" and not "by default." Collectively, they organize to advance territorial autonomy and the political recognition of agroecology, making it a strong example of a social carrier.

In what follows, we first provide background on Rede Ecovida in order to describe how the network functions as a social carrier, including insights into the development process for their management plans for agroecological certification. We then outline the methods used to analyze the relationship between farm size and the use of agroecological practices using data from farm management plans provided by Rede Ecovida. We complement the farm management plan analysis with insights from interviews with 51 agroecological actors (farmers, community organizers, extension agents, and decision-makers) who are involved with Rede Ecovida to contextualize how Brazilian agroecological actors view the role of farm size in wider debates about agroecology.

4.1.1 The Activities of a Social Carrier: The Case of Rede Ecovida

Rede Ecovida, officially founded in 1998, operates in the southern region of Brazil, in the states of Paraná, Santa Catarina, and Rio Grande do Sul. It is one of the oldest participatory guarantee systems (PGS) in the world and is considered a global reference point for agroecological food production and certification (IFOAM 2014; Rover, de Gennaro, and Roselli 2017; Sacchi, Caputo, and Nayga 2015). PGS are "locally focused quality assurance systems [that] certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange" (IFOAM n.d.). That is, in contrast to the more familiar third-party certification systems typically used for organic farming, where farmers rely on a paid external auditor, PGS act as a form of "social control" (Sacchi et al. 2015; Zanasi et al. 2009), where participants certify one another as conforming to agroecological principles based on peer review, thereby providing an alternative route to certification that requires members to build trust by actively investing time and effort in the process (Loconto and Hatanaka 2018; Niederle et al. 2020; Rover et al. 2017).

In Rede Ecovida's case, this alternative certification method "assures compliance with [environmental and social] values through a participatory guarantee system that *builds internal capacity and relationships rather than perpetuating reliance* on external certification" (Mier y Terán Giménez Cacho et al. 2018, p. 658, emphasis added). In the certification process, participants (who act as certifiers) are obligated to consider the ecological practices used and assess sociocultural dimensions of agriculture (Zanasi et al. 2009), such as whether workers and family members are encouraged to participate in formal and informal educational opportunities (which build capacity for agroecological management) and whether farmers are actively

involved in local cultural activities (which promote territorial identity). In addition, all of Rede Ecovida's participants must actively engage in the network through regular meetings and visits to one another's farm properties, which facilitate farmer-to-farmer horizontal knowledge sharing. As one Rede Ecovida coordinator and NGO leader said,

> As Rede Ecovida understands it, *agroecology is not simply a technical model, it implies social organization.* And to have social organization, the citizen has to interact. You have to be leaving the property, interacting with other farmers, organizing with other farmers...This is necessary. [Emphasis added.]

Studies in Brazil and elsewhere have demonstrated the value of PGS in promoting more sustainable and equitable farming systems through the creation of a shared vision, social learning, transparency, and mutual accountability (Hirata et al. 2019; Home et al. 2017; Nelson et al. 2010). The emphasis on collectivism and horizontalism in the pursuit of territorial autonomy has led to some notable social innovations within Rede Ecovida (Rover et al. 2017). For example, the network has set up an alternative marketing and distribution system called *o Circuito Sul* (the Southern Circuit) to organize and support participating farmers with selling their products, and to improve the regional supply of affordable, fresh, and agroecological foods (Magnanti 2008; van der Ploeg, Jingzhong, and Schneider 2012).

Rede Ecovida functions through a nested and decentralized structure. Within the network, the smallest collective unit is the farm household. These farm households are aggregated into local farmer groups (*grupos*), usually spread across several municipalities. The *grupos* are aggregated

into regional farmer nuclei (*nucleos*), which are the largest collective sub-unit under the umbrella of the network (Figure 4.1). To receive certification through the network, farmers must complete farm management plans, which then undergo peer reviews through farm visits from network members (usually fellow farmers, but also NGO members and consumer members) and are ultimately approved by an ethics committee. Approved plans are sent to the network coordination body, which forwards the plans to the Ministry of Agriculture, the national body that permits the use of the official organic seal.

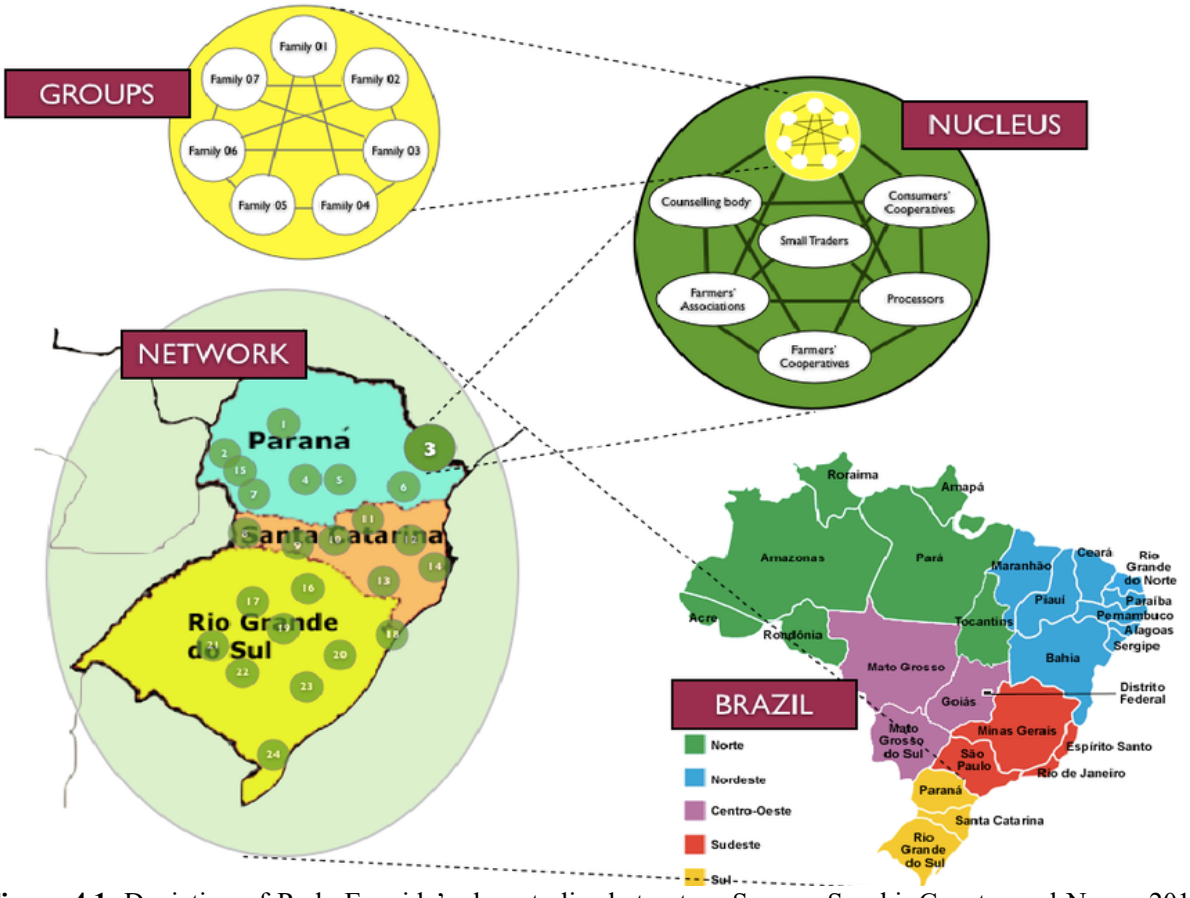


Figure 4.1. Depiction of Rede Ecovida's decentralized structure Source: Sacchi, Caputo, and Nayga 2015, licensed under a Creative Commons Attribution 4.0 License.

The question of tracking practices in the management plans emerged during Rede Ecovida members' discussions at annual multi-day workshops, which have been held since the early 2000s. These meetings are one of the main mechanisms for deliberation and consensus-building among participants in the network. They usually have around 80-120 members present – typically a mix of farmers and some NGO extension agents – with representation from every *nucleo* (currently around 36). The first discussions around creating a common management plan template occurred from 2001–2002, with the first iteration of a management plan appearing a few years later. Since the inception of the management plans, Rede Ecovida has included both ecological and sociocultural practices, with value placed on local and traditional ecological knowledge, maintenance of local cultures, and equitable working relationships – factors that are also well-documented in the agroecology literature (Dumont and Baret 2017; FAO 2018b; Vandermeer and Perfecto 2013). While the network's discussions have always covered many different topics (including gender and youth empowerment, for instance), one long-time NGO leader and Rede Ecovida coordinator noted that not all of these topics have been included in the plans. This is due to the need to balance the fact that the management plans can be complex to complete (as they also have to meet requirements for the Ministry of Agriculture) and that many of the participating farmers have low levels of formal education. Another long-time NGO leader and Rede Ecovida coordinator echoed this:

> When you are talking about filling in the material for certification by Rede Ecovida, for most farmers that is a huge challenge despite the questions being extremely simple. When you hand over a 25-page form like this for the farmer to fill out, they quickly panic. But if you sit with them, drinking *mate*, asking how they farm…they have most of the answers,

> they just have writer's block. This is a difficulty. Because the majority of our farmers, those over 40 years old, the vast majority have not had access to high levels of education. And since they left school, they haven't practiced writing anymore. So, historically they were excluded from [the organic certification] process.

To democratize access to organic certification, Rede Ecovida and other farmer networks have pushed to broaden the state's recognition of organic certification processes. Initially, organic certification emerged at an official level in Brazil largely through adoption of international organic standards and third-party certification models. Taking the position that the standards and certification process should reflect certain principles and ethics, Rede Ecovida and other grassroots groups pushed for adapting the requirements to better reflect the Brazilian context, and for alternative certification models that are less techno-bureaucratic, more accessible, and more aligned with the ethos of agroecology (placing value on the relational and participatory components), which spurred the emergence of the PGS model. Their advocacy ultimately led the Brazilian state to officially recognize the PGS model as a legitimate alternative pathway to organic certification for selling organic products within Brazil. As a result, the documentation of agroecological practices and processes included in our analysis have emerged through Rede Ecovida's own mechanisms for internal deliberation and external advocacy and negotiation. This "practical creation and development of agroecological practices" and processes is a key feature of a social carrier (van der Ploeg 2012, p. 48).

4.2 Methods

With support from the coordinating body of Rede Ecovida, which granted us permission to access their network's data[27], a web scraper (webscraper.io) was used to pull farm management records for 2908 unique farm properties from the participant database. Of these, 2469 properties had accessible farm management plans associated with them for the period 2017–2020. These management plans are used for agroecological certification and contain detailed information about the characteristics of each farm property, including total farm size (ha) and use of each ecological and sociocultural practice as a binary response, either "yes" (use the practice) or "no" (do not use the practice) (Table 4.1).

[27] Research ethics for this project are covered by UBC BREB H15-00600. The request to access management plan data was brought to a Rede Ecovida coordinator, who in turn brought the request to the Rede Ecovida coordination body. Following their internal decision-making processes, which included getting approval from Rede Ecovida members at a plenary meeting, Rede Ecovida granted permission to access their farm management plan database to understand agroecological management patterns.

Table 4.1. Ecological and sociocultural practices specified in Rede Ecovida plans that were used in our analysis.

	Practice	Description
Ecological	Varietal diversity	Diversifying varieties of crop species
	Production diversity	Diversifying crop and animal species
	Soil cover	Use of mulch or cover crops to maintain ground cover and reduce erosion
	Intercropping	Planting two or more crops in consortium
	Organic fertilizer	Use of animal manure or compost to improve soil fertility
	No-till direct seeding (*plantio direto*)	Directly planting a crop into mulch or crop stubble to reduce soil erosion
	Green manure	Use of nitrogen-fixing cover crops to improve soil fertility and maintain ground cover
	Crop rotation	Planting different crop types in a field over time
	Windbreaks	Hedgerows or other vegetation planted primarily to block wind, but also for other benefits like shade
	Agroforestry	Managing trees for food production, or integrating trees with crops and/or animals
	Alley cropping	Intercropping of perennials (trees, forage, native vegetation) with or without crops
	Vegetative strips	Strips of vegetation (such as buffer strips) for wind and soil protection, improved water filtration and retention, etc.
	Flower strips	Planting flowers and/or native vegetation to improve pollinator habitat and attract beneficial insects for pest management
	Reforestation / protected areas	Reforesting degraded on-farm areas or establishment of areas for permanent preservation (*áreas de preservação permanente*, APP) to protect biodiversity, water, and soil
	Ecological corridors	Maintaining forest or other natural areas to promote wider landscape-level connectivity
Sociocultural	Associations	Participation in a farmers' or community association
	Cultural activity participation	Participation in activities that valorize local culture
	Courses	Incentivizing family members and/or workers to take informal courses
	Schooling	Incentivizing family members' and/or workers schooling
	Cultural activity promotion	Promotion of activities that valorize local culture

To ensure geographic representation across the three states where Rede Ecovida is active, we created a sampling strategy for data analysis that reflects the network's nested structure. We sampled the management plans of the two largest *grupos* in each *nucleo* in each state, which gave us an initial sample of 686 management plans (28% of the total management plans). After removal of duplicates, screening plans for incomplete information, and filtering to exclude farms that were exclusively certifying livestock or seed, we arrived at a sample of 596 plans representing a range in farm size from 0.03–295 ha (median = 9.5 ha; mean = 14.0 ha) and which included crop (horticulture and grains), mixed crop-livestock, and agroforestry systems, some of which are fully organic and some of which have parallel organic and conventional production. The properties range from those that have almost all of their land in production to those that have almost all of their land in protected areas, typically forests.[28]

Management plans in our sample were binned into farm size classes based on classifications used in the Brazilian agricultural census data and the World Census of Agriculture: < 2 ha (n = 60), 2–5 ha (n = 128), 5–10 ha (n = 121), 10–20 ha (n = 167), 20–50 ha (n = 101), and > 50 ha (n = 19) (Table 4.2). While 50 ha would be considered a large farm globally, it would not necessarily be considered a large farm within some regions of Brazil[29]. Size is dependent on context, including biophysical and political economic factors as well as farm type. In the context of southern Brazil (where Rede Ecovida is active), hilly topography and a strong tradition of small-scale family farming have contributed to farm sizes remaining relatively small: the median farm size in

[28] Having at least some area in a forest reserve is a requirement for most agricultural properties, in accordance with Brazil's Forest Code.
[29] Globally, 84% of farms are < 2 ha (Lowder, Sánchez, and Bertini 2019), while the average farm size across Brazil is around 70 ha (IBGE n.d.) and the median is around 17.5 ha (Pinto et al. 2020).

Paraná, Santa Catarina, and Rio Grande do Sul is 11.5, 13.3, and 13.9 ha, respectively (Pinto et al. 2020). Farms > 50 ha in size can therefore be considered relatively large for this region. Of note is that our sample only includes 19 farms in the largest size category, and a limitation to our analysis is that very large farms are not well represented in Rede Ecovida. This could be because it would likely benefit small farms more than large farms to join an agroecological network (a form of selection bias). That is, while larger farms can benefit from economies of scale, small farms may be outcompeted unless they can make local connections and identify differentiated marketing opportunities, as is made possible through Rede Ecovida (for example, through its Southern Circuit).

Table 4.2. Rede Ecovida Farm management plans analyzed per farm size class in our sample.

Farm size classifications (ha)	Number of plans (*n*)
< 2	60
2–5	128
5–10	121
10–20	167
20–50	101
> 50	19

Data preparation and statistical analyses were performed in R version 1.3.1093 (R Core Team 2021). Binomial logistic regression (*lme4* package, Bates et al. 2015) was used to test whether farm size affected the predicted probability of practice use. For these models, the responses for each practice were binary, use (1) or non-use (0), and the single categorical predictor was farm size (< 2, 2–5, 5–10, 10–20, 20–50, and > 50 ha). Practice use was then summed to also assess whether farm size predicted total number of ecological and sociocultural practices used. We used analysis of variance (ANOVA) to assess the effect of farm size on each ecological practice and sociocultural practice, and on total use of ecological and sociocultural practices. We then

conducted a *post hoc* means comparison using the Tukey Method to identify differences ($p < 0.05$) among the six farm size categories (*emmeans* package, Lenth 2021).

In the following section, we present the results of the statistical analyses of the relationship between farm size and use of ecological and sociocultural practices. In the discussion, these results are further contextualized with findings from semi-structured interviews with 51 agroecological actors that took place during fieldwork from 2018–2019, while I was based in Santa Catarina, Brazil. These actors were identified through the networks of two local NGOs that promote agroecology, CEPAGRO and Centro Vianei. The agroecological actors who were interviewed included family farmers (including generational family farmers and new family farmers) and harvester-gatherers (45), state extension agents (2), an organic consultant (1), NGO coordinators/organizers (3), and food sovereignty, food security, and nutrition advocates (2) who have played a role in shaping agroecology policy in Brazil (n=51; two of the NGO coordinators are also involved with policy advocacy). Participants were based in southern Brazil except for two NGO leaders/policy advocates, who were based in Rio de Janeiro. In the interviews, participants were asked about their use of agroecological practices and whether they experienced any barriers in the agroecological transition, as well as their perceptions of large-scale agroecological farming. These data were coded in the qualitative coding program NVivo using a hybrid deductive-inductive approach.

4.3 Results and Discussion

4.3.1 Ecological Practices

We found no effect ($p > 0.05$) of farm size on practice use for 13 of the 15 practices that we assessed from the management plans (Table 4.3). We found a weakly significant difference in the use of organic fertilizer *(*$p = 0.038$), where the means comparison indicated that farmers who manage 2–5 ha (95% predicted probability) are more likely to use organic fertilizers than those who manage 20–50 ha farms (83%, $p = 0.041$). While this does not provide strong evidence of a relationship, a possible explanation for this relationship is that smaller farms may be more likely to use on-farm sources of organic fertilizer to reduce their input costs. We additionally found a weak effect of farm size on use of ecological corridors ($p = 0.047$), where the means comparison indicated that farms < 2 ha (12% predicted probability) are less likely to use ecological corridors than farms that are 5–10 ha (32%, $p = 0.007$), 10–20 ha (26%, $p = 0.068$), and 20–50 ha (29%, $p = 0.060$). This could perhaps be attributed to the fact that very small farms are land-scarce and may not be able to set aside significant portions of land for non-production uses, or they may already benefit more from edge effects if situated in a landscape context with relatively high ecological complexity (Ricciardi et al. 2021).

Table 4.3. Results from the analyses of variance for the relationship between farm size and ecological practices.

Practice	Effect of farm size (*p*-value)
Varietal diversity	0.127
Production diversity	0.679
Soil cover	0.330
Intercropping	0.690
Organic fertilizer	0.038
Direct seeding/no-till	0.466
Green manure	0.100
Crop rotation	0.950
Windbreaks	0.112
Agroforestry	0.276
Alley cropping	0.562
Vegetative strips	0.563
Flower strips	0.324
Reforestation/APPs	0.323
Ecological corridors	0.047

In addition, we found no effect ($p = 0.503$) of farm size on the total number of ecological practices used, with the average number of practices used ranging from 7.58 on farms in the 20–50 ha farm size class to 8.44 on farms in the 10–20 ha farm size class (Figure 4.2), where farm sizes spanned all cropping system types (horticultural, grain, mixed crop-livestock, agroforestry).

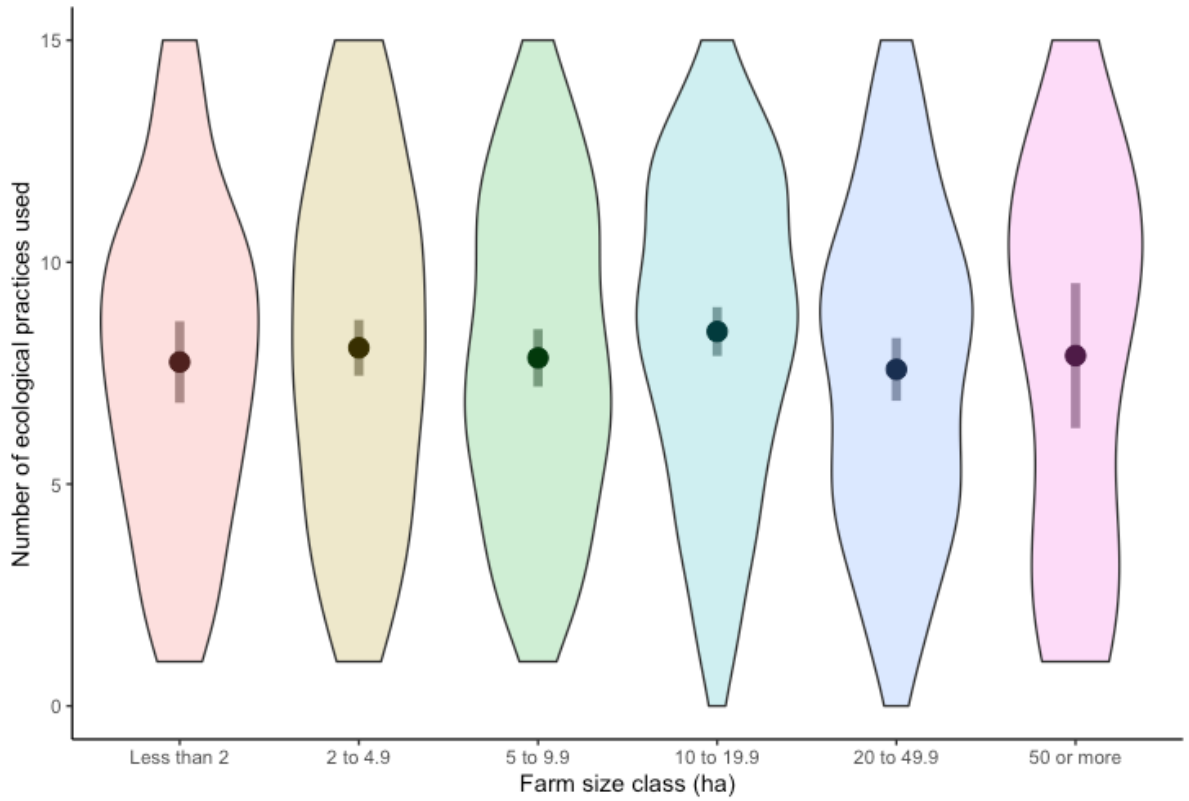


Figure 4.2. Violin plot showing total number of ecological practices used per farm size class. The violin depicts the distribution of the raw data, where the width indicates the density of responses. The points represent the means from the model with a 95% confidence interval.

While farm size was not predictive of the use of individual practices nor the total number of ecological practices, we found significant differences in the use of practices when averaged across all farm sizes (Figure 4.3). The probability of use was highest for organic fertilizers (90%), while the practice least likely to be used was alley cropping (23%). In general, the following practices were most likely to be used: organic fertilizers, green manure, crop rotation, varietal and production diversity, soil cover, and intercropping, with predicted probabilities of use that ranged from 62% (intercropping and varietal diversity) to 90% (organic fertilizers). More frequent use of these practices may be explained by farmers' desire to reduce use of and

dependency on external inputs, by instead replacing them with on-farm inputs and alternative practices that leverage ecological processes.

In contrast, practices that are less likely to be used include alley cropping (23%), agroforestry (27%), ecological corridors (27%), flower and vegetative strips (37% and 40%, respectively), and direct seeding (40%). These practices may be harder to adopt for a number of reasons; they may require taking land out of crop production (e.g., forest regeneration, ecological corridors, flower and vegetative strips); making long-term investments in perennial production (e.g., alley cropping, agroforestry); or may be generally challenging for organic farmers to adopt due to the need to manage pest and weed pressures without chemicals (e.g., direct seeding) (Gliessman 2016; Wezel et al. 2014). However, these practices serve important functions, including biodiversity conservation, natural predator and pollinator habitat, resilience to economic or environmental shocks, carbon sequestration, and other ecosystem services (Beillouin et al. 2021; Kremen et al. 2012; Kremen and Miles 2012; Leippert et al. 2020). Promoting their adoption could occur by increasing supports for farmer-to-farmer learning focused specifically on the management of perennials and agroforestry systems and by further highlighting the socioecological benefits of non-crop vegetation on farms.

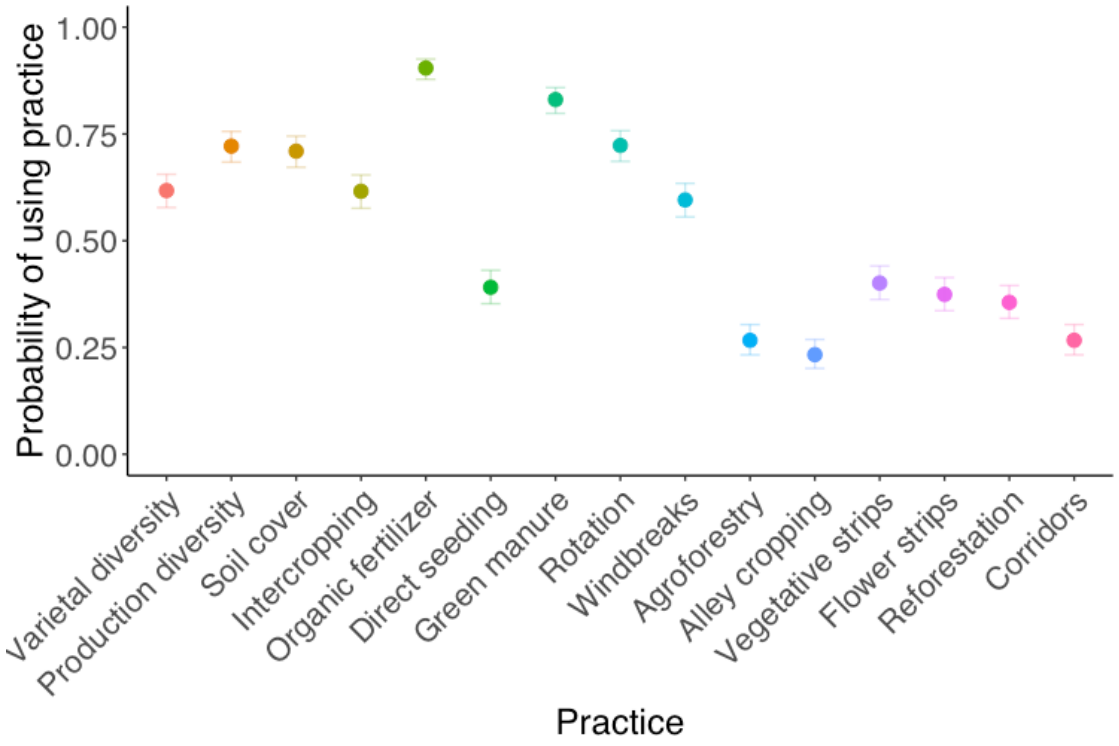


Figure 4.3. Probability of ecological practice use among Rede Ecovida farmers.

An exception to the trend of lower adoption for practices that require taking some land out of production is the use of windbreaks (60%), which was 1.5 times more likely to be used than the next most common non-cropping practice (vegetative strips). The higher use of windbreaks may in part be explained by many farmers' concerns about potential contamination from nearby transgenic crops and chemical drift, which can strain neighborly relations. For example, a farming couple and extension advisor noted,

> Advisor: When producing with synthetic inputs, there must always be a strip on the border with organic properties: 20 meters between the organic and conventional. It cannot be transgenic. There was an argument [with the neighbors], because as the

> neighbors didn't have a strip, it was a problem for these two [Sebastião and Antônia], who were organic... But the Ministry of Agriculture went to support *them* [the conventional farmers], not Sebastião and Antônia here. It's non-organic farmers who should respect the rule.
>
> Antônia: And then the neighbors got angry, thinking that we were going to report them somehow.
>
> Sebastião: I don't know who reported this situation. MAPA [the Ministry of Agriculture] came to inspect us, right. And what are we going to do? They sent two guys here, with all the materials for taking the transgenics test and everything. We were not to blame. And then they [pointed to our crops and] asked, "whose crops are those?" I cannot lie…
>
> Advisor: You have problems that go beyond the technical part. They go into the social dimension. Because the way you are seen by your neighbors...

Another farmer, Geraldo, said,

> Geraldo: Our property is organized by zone … Zone 5 is a system containment barrier … It surrounds and insulates us from the crap the neighbors do.

Given farmers' specific concerns and challenges related to preventing chemical drift and potential contamination from surrounding conventional crops, targeted efforts could support

farmers in installing windbreaks, hedgerows, and other perennial border plantings to buffer farmers' exposure to contamination-related risks (Ucar and Hall 2001). This would serve a dual purpose by also creating wildlife habitat, harboring beneficial insects, and promoting other ecological benefits.

4.3.2 Sociocultural Practices

Among the sociocultural practices included in our analysis, farm size influenced farmers' participation in farmer or community associations ($p = 0.039$; Table 4.4). No effect ($p > 0.05$) of farm size was detected for the probability of incentivizing schooling, incentivizing courses, farmers' participation in cultural activities, or farmers' active promotion of cultural activities. When comparing size-related differences in participation in associations, farmers managing 2–5 ha farms (83%) were marginally less likely to be involved with associations than those who manage 10–20 ha farms (93%, $p = 0.065$), perhaps because small farms can be more time- and resource-constrained than larger farms (Esquivel et al. 2021).

Table 4.4. Results from the analyses of variance for the relationship between farm size and sociocultural practices.

Practice	Effect of farm size (*p*-value)
Associations	0.039
Cultural activity participation	0.222
Courses	0.816
Schooling	0.394
Cultural activity promotion	0.904

We also found no effect ($p = 0.327$) of farm size on the total number of sociocultural practices used, with the average number of practices used ranging from 2.58 on farms in the > 50 ha farm size class to 3.05 on farms in the 10–20 ha farm size class (Figure 4.4).

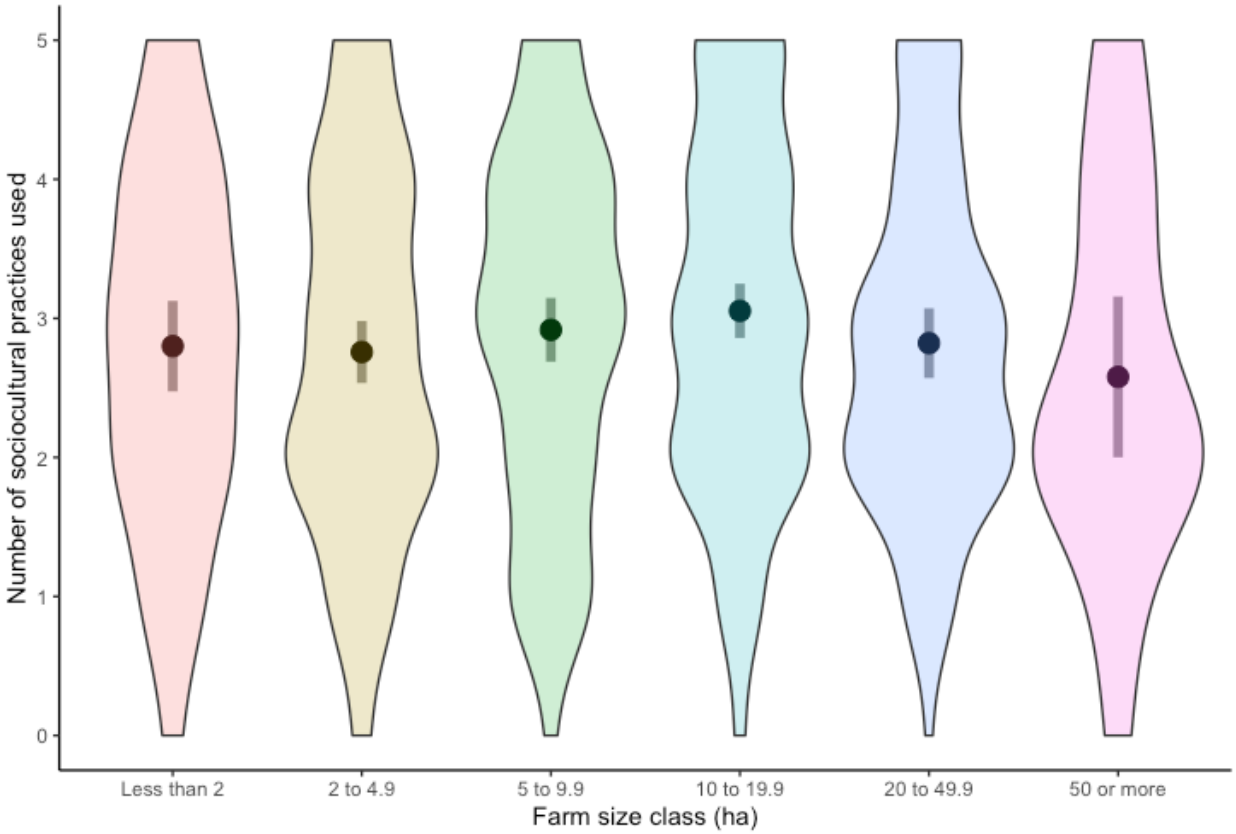


Figure 4.4. Total number of sociocultural practices used per farm size class. The violin depicts the distribution of the raw data, where the width indicates the density of responses. The points represent the means from the model with a 95% confidence interval.

However, there were notable differences in the use of sociocultural practices on farms when averaging across sizes for each practice (Figure 4.5). Farmers in Rede Ecovida were most likely to participate in a farmer or community association (88%), while they were three times less likely to promote activities that valorize local culture (29%). Predicted probabilities of use for the remaining practices fall in between: 64% of farm households participate in cultural activities, 59% encourage family members and workers to take informal courses, and 48% encourage formal schooling for family members and workers.

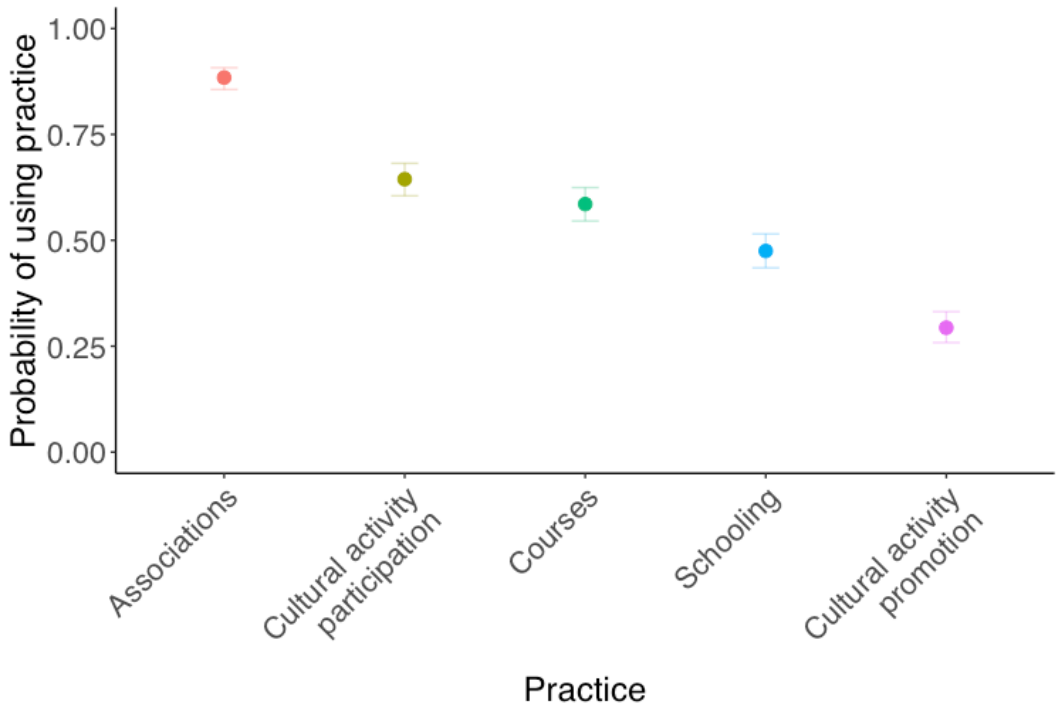


Figure 4.5. Probability of sociocultural practice use among Rede Ecovida farmers.

In general, participation-based practices (e.g., association membership and participation in cultural activities and events, such as local food festivals that celebrate traditional foods like *pinhão* (Brazilian pine nut) and national festivals that take place in the region, like the *Festa Nacional da Maçã* (National Apple Festival)) are more likely to be used than practices that require more active involvement through farmer-led promotion and organizing (e.g., promotion of cultural activities/events, encouraging formal schooling for family members and workers, and incentivizing courses for family members and workers). This seems to indicate that there is a negative relationship between additional level of effort required outside of the network's immediate activities and the use of sociocultural practices, where practices that require more time and effort (e.g., promotion of cultural activities such as community festivals) are less commonly used than practices that require a comparatively lower investment of time and effort

or are of more direct benefit to the farmer (e.g., participating in an association). Many farmers in Rede Ecovida already spend a significant amount of time participating in the network's meetings and plenaries (which is required), and due to financial and labor market constraints, they are not typically able to hire much extra labor to support with knowledge- and labor-intensive agroecological management, and they may have off-farm jobs themselves. These factors likely limit their ability to take on responsibility for organizing additional off-farm activities.

4.3.3 Contextualizing the Influence of the Social Carrier

Overall, our results indicate that in the case of farmers associated with Rede Ecovida, farm size is not a strong predictor of farmers' use of individual agroecological practices nor their cumulative use, with farm size having no effect on the use of the majority of ecological and sociocultural practices in our study. That is, for farmers associated with Rede Ecovida, a broad suite of agroecological practices – including diversification and conservation practices at multiple spatial and temporal scales – were used across a range of management systems regardless of farm size, with the caveat that our sample did not include any extremely large farms. These findings point to the influential role of the social carrier and contrast with previous findings on the relationship between farm size and agroecological practice use on organic farms in the Global North, which found that small and medium-sized farms used more agroecological practices than large farms (Esquivel et al. 2021; Liebert et al. under review; Pépin et al. 2021). However, an important consideration is that these prior studies focused specifically on the organic vegetable sector, while Rede Ecovida farms are often highly diversified generally. Indeed, in our study, the farms in the > 50 ha category – which include fruit, vegetable, grain, mixed crop-livestock, and agroforestry systems, as well as a mix of fully organic farms and those

with parallel production – managed to come up with various combinations of labor, resources, and knowledge arrangements that enabled them to grow food agroecologically: These farms ranged from having 10–100% of their land in production and certified between 1–60 crops as agroecological, and about half of them rely only on family labor while the other half either hire workers or have a labor "partnership" in place (i.e., they trade labor with other farmers when support is needed). Indeed, size in general was not associated with any particular management system in our sample, likely because Rede Ecovida supports diversification broadly. However, given the selection bias that may be associated with joining Rede Ecovida, whether these relationships would hold for farms larger than those represented in our sample is in need of further empirical investigation.

Notably, participants often specifically mentioned agroforestry in interviews as a particularly promising strategy for large-scale agroecological production, while other recent scholarship has highlighted the potential for implementing context-specific practices on large farms, such as designing fields to increase edge density (the ratio of edges to area) through flower strips and hedgerows (Tittonell et al. 2020). However, as is evident in the distribution of farm sizes in our sample, larger scale agroecological farms remain uncommon. This could likely be attributed to the fact that larger farms are typically rewarded for economies of scale and other aspects of what one farmer on an agrarian reform settlement described as the "industrial relationship":

> I was thinking that the industrial relationship maybe doesn't depend on farm size nor on the amount of production, but it is very much a matter of division of labor to optimize the

> workforce, be it in small or large areas. But [in contrast], in agroecology, *this optimization occurs through collective and agroecological work*. [Emphasis added.]

Here, the settlement farmer articulates that in their view, it is not size *per se* that has an influence on sustainability outcomes, but rather the kind of relationships – individualized/neoliberalized or collective – that are enacted at various scales. Participants also considered how broader political economic conditions have resulted in high levels of inequity with respect to land ownership and access to public resources in Brazil. In this regard, they clearly linked the technical practice component with the social movement component of agroecology by positioning the debate about farm size and practice use within this larger context of needing to address social injustice and improve autonomy for rural people, in order to move toward more transformative sustainability changes in the food system. One agroecology advocate and NGO leader was clear that agroecology as a set of technical practices can be applied across farm sizes, but that the mechanism for transformative, sustained change is by way of the social carrier's role in promoting territorial autonomy and re-embedding the economy in socioecological relationships:

> Can agroecology be applied on a large scale? You can apply technical agroecological principles on a large scale … but *the explanation [for agroecology] is by a logic of socio-technical and economic organization* …we have to change the [socioecological] metabolism, and to change the metabolism from the perspective of agroecology we need to change the social organization and the economic logic. [Emphasis added.]

The values, relationships, and logics that are cultivated, enacted, and *maintained* through the social carrier may be an instrumental factor in diminishing the direct or indirect effects of size on the use of agroecological practices among participating farmers. This aligns with the broader literature on scaling, which suggests that a social carrier plays a central role in scaling out agroecology in a sustained way because participants are invested in their own struggle for territorial autonomy and emancipation from unfavorable political economic conditions (Ferguson et al. 2019; González De Molina and Lopez-Garcia 2021; van der Ploeg 2012, 2017). Echoing Stock et al., this finding has potentially transformative effects because it "creates an opening in theoretical and political dialogue to bridge concerns about farmers, livelihood, and environmental outcomes without resorting to typical dichotomies … and other unhelpful distinctions" (2014, p. 12) – including the binary of large versus small, as even relatively large farms may be located in relations of dependency.

Therefore, through these ongoing processes that promote territorial autonomy and position farmers and workers as the protagonists of rural development, the "scaling out" and use of agroecological practices becomes more viable and sustainable – across diverse farm types. The methods by which this scaling occurs are through horizontal knowledge-sharing, co-creation of agroecological practices that are suited to the territorial context, construction of regional markets that link agroecological growers and eaters (such as Rede Ecovida's *Circuito Sul*), and the formation of a collective identity (Ferguson et al. 2019). To foreground the importance of this socio-organizational component for scaling out agroecology, Latin American-based agroecologists have proposed alternative terms for "scaling" that better describe the new kinds of relationships that are needed. For example, Ferguson et al. (2019, p. 722) use the term

"massification" in order to better communicate the need for both "engagement with masses of people and development of a movement that is increasingly dense in terms of the practices and relationships involved in any given territory." This new terminology helps to distinguish the meaning of "agroecological scaling" from other notions of "scaling" that are tied to imposed technology transfer and processes of industrialization (e.g., achieving "economies of scale" via simplification, mechanization, standardization, etc.) (Ferguson et al. 2019).

To maintain – and even drive – the use of agroecological management practices in the face of highly unfavorable political economic forces requires building collective power and values, "guided by the notion that ecological change in agriculture cannot be promoted without comparable changes in the social, political, cultural and economic arenas that conform and determine agriculture" (Altieri and Nicholls 2008, p. 477). In this sense, supporting the efforts of social carriers – as they build territorial autonomy by re-embedding socioecological relationships – may accelerate the transformative power of agroecology (González De Molina and Lopez-Garcia 2021). In Brazil, many social carriers like Rede Ecovida exist that are pushing the practice of agroecology forward across diverse farms. Public policies also exist that provide promising examples of how state support can be re-directed toward networks promoting territorial autonomy. For example, agroecological actors mentioned the innovative *Ecoforte* program as embodying the kinds of ways that the state can support agroecology in line with the agroecological ethos. *Ecoforte*, a novel public program nested within Brazil's National Policy for Agroecology and Organic Production (PNAPO), aims to advance agroecology in a bottom-up manner by directly funding and strengthening local networks that are already implementing territorially-based expressions of agroecology, or agroecological initiatives and solutions that are

tailored to their respective contexts (Job Schmitt et al. 2020; Petersen 2020). That is, in this program, the state provides funding directly to existing social carriers (such as Rede Ecovida), who allocate the funds according to their own territorial needs and visions (Job Schmitt et al. 2020). This provides an alternative model for the state, where the state *enhances* rather than reduces or weakens territorial autonomy through the more traditional top-down, technology-transfer model (which can introduce a new form of dependency).

4.4 Conclusion

Together, these findings expand upon the literature on farm size and use of sustainable management practices in a number of ways. While the importance of farm size for food security and some sustainability outcomes has been well-documented (Lowder, Sánchez, and Bertini 2021; Ricciardi et al. 2018, 2021; Samberg et al. 2016), and while recent studies in the organic vegetable sector in the Global North provide evidence that small or mid-sized farms are more likely to use agroecological practices (Esquivel et al. 2021; Liebert et al. under review; Pépin et al. 2021), our study offers a new perspective on the possible conditions that support the use of agroecological practices across a range of farm sizes. Our analysis suggests that in the context of a strong social carrier that promotes re-embedding socioecological relationships to create territorial autonomy across diverse farm types – in this case, the agroecological network Rede Ecovida – farm size does not strongly predict agroecological practice use. This is likely because size *per se* is not the overarching driver of management practices, but rather the broader sociopolitical context of agriculture shapes management decisions. As a social carrier, Rede Ecovida is able to mobilize knowledge and resources (including market opportunities) that can support the use of a broad suite of agroecological practices across a range of farm sizes. To this

end, future research could follow up with the largest farms in the network in order to understand those farmers' motivations for participating in the network and the specific strategies they employ to manage large farms agroecologically. Finally, decision-makers interested in encouraging transitions to more sustainable and equitable food systems should consider ways to support the crucial role that territorially based agroecology movements play in scaling out agroecology.

Chapter 5: Agroecology as a Philosophy of Life: Contributions to Well-being

5.1 Introduction

Use of the term "agroecology" has greatly increased over the past few decades, with scholars (e.g., Anderson et al. 2019; Bezner Kerr 2020), civil society actors (e.g., HLPE 2019; IPES-Food 2016), social movements (e.g., La Via Campesina 2019), and intergovernmental organizations (e.g., FAO 2018b, 2018a) engaging in platforms that identify agroecology as a promising pathway for realizing more equitable and sustainable food systems. While the term agroecology emerged in the late 1920s in the scientific work of ecologists and agronomists, it expanded to include applied social and cultural dimensions that engaged with traditional agricultural techniques in the 1970s and was further taken up by social movements, with political and social justice elements, in the 1990s. This history has contributed to agroecology being perhaps most commonly described in academic and policy circles as a science, practice, and social movement (Wezel et al. 2009). Yet given that agroecology is commonly associated with the food sovereignty movement, largely comprised of Indigenous, small-scale, and peasant farmers and civil society actors in the Global South, another question emerges: What does agroecology mean to these grassroots actors?

Drawing on 13 months of ethnographic fieldwork with agroecology movements in southern Brazil, I explore how "agroecological actors" – family farmers, traditional peoples[30], community

[30] The phrase "traditional populations" is used in the Brazilian constitution and context to refer to a variety of land-based social groups, including Indigenous peoples, *quilombolas* (Afro-Brazilians), *ribeirinhos* (small-scale fishers who live along rivers), and *extrativistas* (forest harvester-gatherers), among others.

organizers, extension agents, and policy advocates engaged with or practicing agroecology – describe and define agroecology. I find that – as a counter-narrative to global discourses on "development" that promote economic growth and productivism as the path to well-being, and in recognition of the important role that Indigenous and traditional peoples have played in stewarding land and life (La Via Campesina 2019) – agroecological actors more fundamentally describe agroecology as a *philosophy of life* that promotes *well-being*, whereas only two NGO coordinators involved in agroecology policy-making mentioned the science-practice-movement definition of agroecology that is prevalent in the academic literature. As one farmer succinctly stated,

> Ricardo: In agroecology, you think of society as a whole and the well-being of humanity.

Yet another said,

> João: Agroecology is a philosophy of life for me…we are in harmony with nature. This is what gives the satisfaction to be here. And another point – tranquility, calm. I wouldn't trade this life for anything.

And in the words of a farming couple,

> Camila: For us [agroecology] is everything, it is life.

> Carlos: It's a philosophy of life, we enjoy it, we love it, and we cannot live without agroecology…there is no turning back…agroecology is love. We are what we eat. You are contributing to life in people's homes, and that is love.

These statements were not limited to the farmer participants. An NGO leader who owns a small rural property and has spent decades working with and facilitating the development of agroecological farmer networks said,

> Miguel: It is a way of life, above all. Then, it's a method for life. But first, it's a way of life. Agroecology is this for me. I chose to live in the countryside … when I bought this *sitio* here, I said to my colleagues, 'I bought freedom of expression.' From now on, I can say what I think, what I want, how I live … but if I were going to live off this land, isolated, I wouldn't be able to; as I told you, going to the market you have to partner with more people to share in your dreams, right. So for me, agroecology is a way of life: We need to relate, build, in order to survive.

Upon hearing so many different descriptions in this vein – of agroecology as well-being and a way of life – I became interested in further exploring how agroecological actors were defining and "operationalizing" the concept of well-being in the context of southern Brazil. Discussions with research participants and lab group members resulted in the development of a conceptual framework (see Wolff, 2021) to characterize the relationship between food sovereignty, agroecology, and well-being – a relationship that, despite being understudied, is of high interest to grassroots actors in Latin America (c.f. Blesh and Wittman 2015; Walsh-Dilley, Wolford, and

McCarthy 2016). The conceptual framework was developed through a meta-narrative review of the English, Portuguese, and Spanish language literature using the methodology laid out by Greenhalgh et al. (2011, p. 2), which provides "systematic, theory-driven interpretative techniques…to help make sense of heterogeneous evidence" across disciplines and contexts. The results of the meta-narrative review across disciplines, languages, and worldviews identified that food sovereignty and agroecology are linked to well-being through the key themes of physical wellbeing, environmental wellbeing, social-political-economic wellbeing, and cultural-spiritual wellbeing (Wolff 2021).

In what follows, I empirically assess agroecological actors' accounts of agroecology according to these four themes. First, I outline the methods used in this study, as well as the study context. I then describe the findings – namely, how agroecology is articulated by social movement actors as contributing to the four dimensions of well-being. Drawing on the work of philosophers in Indigenous and European traditions, I end by examining the broader literature on "living well" and raise possible future directions for research on the ways in which agroecology can enhance well-being.

5.2 Methods

This research took place in the southern state of Santa Catarina, Brazil, where a confluence of biophysical and socioeconomic conditions has contributed to a long history of small-scale family farming. Santa Catarina has a sub-tropical climate that allows farmers to grow a wide variety of crops, while the hilly terrain throughout the state doesn't lend itself well to mechanized, large-scale production. Various waves of European colonization have shaped the social, cultural, and

economic fabric of the regions across Santa Catarina. Beginning in the 1500s, Spanish and then Portuguese invasion and colonization violently dispossessed the original peoples of the land, among them the Guaraní/Mbyá, Kaingang, and Laklanõ peoples. This was later followed by a government-sponsored push to settle the interior of the state in 19th and 20th centuries, resulting in the arrival and settlement of many German and Italian families, who were given plots of land to farm. These families brought with them a tradition of agricultural cooperativism, which has shaped the high levels of social organization throughout the southern region of Brazil.

From 2018–2019 I was based in Santa Catarina, where I was involved in ethnographic, community-engaged research with two non-governmental organizations – CEPAGRO and Centro Vianei – that work with agroecological farmers and traditional peoples across the state. Broadly, the goal of ethnography is "to understand and make sense of the social worlds of others, albeit using ourselves as key research instruments" (Coffey 1999). Ethnography, then, is ultimately a relational endeavour: to understand social worlds, the researcher partakes in "social interaction and shared experiences," and the quality of the data reflects the quality of the relationships (Coffey 1999). Critical to ethnographic research is reflexivity, or cultivating an awareness of one's own role in the research (Coffey 1999; Davies 1999). My positionality as a white, female researcher and non-native Portuguese speaker from a foreign university certainly shaped the research interactions, particularly considering that agroecological actors in this region already receive many research requests from universities and students. As a community-engaged researcher, my affiliation with CEPAGRO and Centro Vianei – two organizations with which I share the commitment to investigate pathways to more equitable and sustainable food systems –

was important for building trust with participants, as were my efforts to learn and speak Portuguese (rather than work through an interpreter).

To understand how agroecological actors describe and understand agroecology from their own points of view, I relied on ethnographic methods including interviews and participant observation at NGOs, farmer-to-farmer network meetings, local and traditional food festivals, and social mobilizations (among other events) (Davies 1999). The interviews were conducted with family farmers (including those whose families had farmed over generations as well as neo-rural, or "back-to-the-land," family farmers) and sustainable harvester-gatherers (45), state extension agents (2), an organic consultant (1), NGO coordinators/organizers (3), and food sovereignty, food security, and nutrition policymakers/advocates (2) who have played a role in shaping agroecology policy in Brazil (n=51; two of the NGO coordinators are also involved with participatory policymaking). Twenty of the participants are women and the remaining 31 are men, with an age range spanning the early 20s to age 60 and over. Almost all of the participants are based in Santa Catarina, with the exception of one grain farmer (based just over the southern border of Santa Catarina, in Rio Grande do Sul) and two NGO leaders who are also involved with policy (both based in Rio de Janeiro). All farmer interviews included a visit to and tour of the farm. Farms ranged from subsistence to commercial farms that were rented, purchased, or inherited to collective landholdings that were obtained through Brazil's agrarian reform program. All of the farmers interviewed had diversified farming systems, but the level of diversification varied substantially between them – some were primarily commercial livestock, dairy, or grain farms, while others were more highly diversified with horticultural and tree crops that they sold to local markets, including public procurement programs such as Brazil's National School

Feeding Program (PNAE). Having noted these differences, all farmers were affiliated with agroecological networks.

Interviews were recorded with permission, and I also recorded my own fieldnotes and reflections. The interviews were semi-structured and covered an array of topics, ranging from the property and participants' background and history, to production and management, to participation in social movements, to barriers and enabling factors shaping the on-farm process of transitioning to agroecology. As part of the interview, participants were invited to reflect on their definition or description of agroecology in their own words – to explain what agroecology meant to them. These perspectives quickly emerged as important to the research, and subsequently became the focus of this paper. Interviews were analyzed in the program NVivo and coded deductively, according to specific well-being themes that were identified in a recent review on the relationship between food sovereignty, agroecology, and well-being (Wolff 2021). Representative quotes (using pseudonyms) were chosen to illustrate these sub-themes in the findings section that follows.

5.3 Findings

5.3.1 Physical Well-Being

The agroecological actors interviewed repeatedly noted how agroecology contributed to physical well-being, with 80% of the participants describing occupational and mental health benefits. These benefits are framed by participants as intrinsic to agroecological work, but are also described in comparison to both their prior experiences with either industrial agricultural

production or an urban lifestyle. With respect to occupational health, Brazil has been the top purchaser of pesticides in the world since 2008, and is the top consumer of Highly Hazardous Pesticides (HHPs), where HHPs are defined as pesticides that pose an extreme risk of acute or chronic illness or may cause irreversible harm to people or the environment (Dowler 2020; Firpo de Souza Porto 2018; Rigotto, Paixão e Vasconcelos, and Rocha 2014). Within this context, 63% of farming households in the south of Brazil use agrochemicals, making it the region with the most agrochemical-dependent households in Brazil (a distant second is the southeast, where 28.5% of farm establishments use agrochemicals) (Bombardi 2017). As one farmer stated,

> Luis: In Brazil, besides using pesticides that the whole world does not use, the dosage is very large. It's the indiscriminate use … sometimes the person gets lost and sometimes uses twice the amount. The tags are poorly written. You can't even read with glasses. And along with pesticides, we are seeing diseases growing. Where is there the most cancer in Brazil? Santa Catarina and Rio Grande do Sul, where there is more family farming, tobacco production. It's data that no one even wants to know.

As Luis notes, in Santa Catarina there is a long history of tobacco production for export. Multinational tobacco companies will typically contract family farmers to grow tobacco year after year, although studies have noted that tobacco companies are increasingly recommending that farmers implement efficiency-based ecological management practices, such as crop rotation between cash crops and cover crops, in order to improve input-use efficiency and build soil organic matter in heavily-depleted soils (Stratton et al. 2021). Despite these management-based improvements, farmers who produce tobacco remain exposed to health hazards through two

main pathways: a) as a result of the intensive agrochemical use associated with commercial tobacco production; and b) due to direct handling of toxic tobacco leaves, which can lead to green tobacco sickness (acute nicotine poisoning) (Fassa et al. 2014; Da Mota E Silva et al. 2018). A typical description of this is as follows:

> Danilo: When we came here the structure was geared towards tobacco production, and we had to work with it because it was what we had. But my father never wanted to, the idea was never to work with it. But we did until my father got intoxicated with poison [agrotoxins] and then decided to change radically. Overnight, everything stopped: We started to work with organic production in 2001.

In addition to improving the physical health of the farmer and their family, farmers perceive the health benefits as traveling beyond the borders of the farm to extend to the larger community. In particular, they highlight the role of agroecological farmers in growing food for local people, as well as the fact that they can keep a good conscience in knowing that agroecological food is pesticide-free. As one grower mentioned,

> Vitor: I planted conventional for two years. In order not to plant with poison, I started in organic. I sell a quality product, offer a product that is risk-free. A product that does not cause harm. I work with a product that I am sure will not hurt you from my hand. I think that the farmer who is aware of this…will work to have more health and quality of life.

Participants therefore noted that in transitioning to agroecological farming, occupational health was improved as a result of: a) low or no use of agrochemicals; and b) farm-level diversification, where farmers ultimately transitioned entirely away from tobacco production and toward diversified crop, livestock, and/or agroforestry systems.

In addition to occupational health, participants describe significant mental health benefits associated with agroecology. Farmers reported feeling an increase in mental health and reduced stress, particularly as a result of increased satisfaction with the kind of work they perform. Much of this stems from a perception of having increased autonomy over their lives – by virtue of having more control over their own labor – and in being able to nurture a connection with the land. This is summarized by Marcio in his recounting of why he began to practice agroecology:

> Marcio: For the sake of health, because I think I am healthier. I get to do the math with my own life. I like being autonomous, I think I have to avoid exploitative relationships of labor … And for the sake of psychophysical health, I feel better … I need contact with the land because I think it is the best way to work with the body. I think it makes you wake up to very simple questions that are essential in life.

Similarly, "neo-rural" farming couple Ana and Eduardo shared many of these sentiments. While living and working in a city abroad, they had begun to experience some negative health issues as a result of stress:

> Ana: The urban way of living – we started to question ourselves. Is it worth it? Is it worth having all these 'comforts' and running after your mental and physical health? Then we started to question ourselves about the way of life we are leading, whether it is worth sacrificing and maintaining that way of life. I had to go to a psychotherapist because my level of stress and anxiety was way up due to the pressure of work, and I took care of basically everything on my own there. There came a time when I couldn't take it because my head couldn't take it, and my body was also weakened…I already had rhinitis and sinusitis and a lot of things.
>
> Eduardo: We arrived at that old adage that if we want to change the world, we have to change ourselves. This was also part of our reflections. It's all wrong in this world, capitalism doesn't work well. Well, there are a lot of negatives, and you realize that you are part of it all – you are also a tool for capitalism. So, what do you do? Say, 'no – the time has come!'

Ana and Eduardo's description of their day-to-day experiences during this phase aligns with what some mental health and well-being scholars have called "languishing," or a state of mental and emotional distress that impairs a person's ability to function, which can be accompanied by existential questioning about the purpose of life (Keyes 2004). Their description also draws attention to the ways in which class – understood not as socioeconomic status but rather in the Marxian sense, as the relationship people have to productive assets (e.g., land, capital) and their access to political economic opportunities – shapes people's experiences of stress and anxiety. This is an area which is receiving increased attention from critical public health scholars who

take a "social determination" approach to understanding health, highlighting the ways in which systems of exploitation – such as capitalism and colonialism – inhibit well-being (Breilh 2015; Prins et al. 2015; Spiegel, Breilh, and Yassi 2015).

For Ana and Eduardo, the dissatisfaction with their urban lifestyle triggered a lifestyle change, prompting them to move home to rural Brazil with their young son. They explained how from their perspective,

> Ana: Agroecology – it aims at…the well-being of people, at all levels.
>
> Eduardo: Social, religious, spiritual, whatever. We are human beings, so what are the essences of that? It is to live well, happiness. And what does happiness mean? Is it an economic state? We will fight for that. That's what a lot of people who have left the tobacco plantations did. They used to work as servants to a single company, then they left the tobacco plantation and now they have their own cows, and they are producing, and they have their own hours, and they eat well. And the family is extremely healthy and happy, and you see their faces and smile. It's not that bitter thing – working in tobacco, alone and sick. So, this is what we see constantly in agroecology, this joy.
>
> Ana: It's people's well-being too – it's health, it's a lighter but calmer way of life. It's hard in relation to the work you have, but it's much more rewarding. The result you have is much better.

In contrast to "languishing," the conditions described here by Ana and Eduardo are associated with "flourishing," or satisfaction with life that enables healthy and generative relationships with self and society (Emmons 2004; Keyes 2004; Prins et al. 2015; VanderWeele 2017, 2019). They describe how agroecology can promote happiness or joy thanks to improvements to mental health and quality of life; self-determination and autonomy; and the feeling of carrying out challenging but rewarding work that provides a sense of purpose and meaning.

Repeatedly, the nature of the work – as challenging but highly creative and rewarding – emerged in interviews. One young farming couple, Larissa and Diego, described with pride how a local university recognized them with a prize for "technology, entrepreneurship, and innovation" due to their success in transforming the degraded farmland (from prior cattle production) that they were renting into an agroecological farm. Another farmer who was in the process of transitioning to agroecology reflected on the creativity and critical thinking skills necessary for solving ecological problems:

> Lucas: The recovery power of nature is fantastic. When in doubt, not knowing what to do, I look at the forest and ask myself: What would happen there? … In agroecology you look for the cause of the problem, and seek to eliminate these problems through ecological practices.

In sum, agroecological actors describe how agroecology contributes to physical well-being by improving aspects of occupational and community health, particularly due to the non-use of

pesticides, as well as mental health, by supporting a sense of autonomy and creativity, and reducing stress.

5.3.2 Environmental Well-Being

Environmental well-being can be understood as "the relationship between human actions (such as agricultural practices) and the state of nature, such as the health of ecosystems, soil, water and air" (Wolff 2021, p. 46). All participants perceived agroecological practices as contributing to environmental well-being by leveraging and promoting ecological processes for food production, which allows for reducing or eliminating agrochemical inputs and associated pollution. A quote from a farmer practicing collective agriculture at an agrarian reform settlement epitomizes this:

> Thiago: Since we arrived here, we haven't put any poisons on the earth. We have always worked with the principles of agroecology and organic agriculture. So even though we have traces of poison on the land [from prior land managers], we have always managed to produce here … from the moment you can put high loads of biomass in the soil, it accelerates the microbiological activity of the soil. Even with some remnants of pesticide poison, the plant develops well. It is biodiversity that is fundamental, and which provides biological control. For example, we're starting to plant more because we're seeing that we need more insects, we need more dragonflies. The dragonfly is a magnificent predator of insect pests.

Participants repeatedly referenced how agroecology entails working *with* nature by living in harmony with non-human actors (for example, insects and their natural predators); enhancing

diversity in production, particularly through promoting a mix of annuals, perennials, and livestock, and through spatial and temporal diversification practices, such as crop rotation and intercropping; setting aside natural areas, in particular for native forests and endangered species; protecting water sources using practices like riparian buffers; practicing good nutrient management and cycling; protecting the soil with soil cover; and planting flower strips that provide habitat for pollinators and natural pest enemies. Use of these practices contributed to participants describing agroecology as being a "life-promoting" strategy:

> Sebastião: And talking more about what agroecology is – a farm that has life … Because there has to be life. There has to be an environment for you to live with animals, with people … when you arrive at a property where everything is killed with poison, what environment does it have?

Connection to life, including non-human actors, is also central to cultural-spiritual well-being, which is explored next.

5.3.3 Cultural-Spiritual Well-Being

Cultural-spiritual well-being refers to having the freedom to express cultural and spiritual practices, including ceremonial practices, and the ability to access nature, including lands that are of cultural or spiritual significance (Wolff 2021). Interestingly, a recent review of the Portuguese language literature indicated "a clear lack of and need for publications around the cultural-spiritual impacts of agroecology and food sovereignty on well-being," finding no studies that discussed cultural-spiritual wellbeing (Wolff 2021, p. 66). Our interview data show that cultural-

spiritual well-being is a crucial dimension of well-being for agroecological actors (65%). Some quotes that typify this include:

> Antonia: For me, agroecology is everything. From spirituality, health, food, well-being, and living with others. It all revolves around that. It changes a lot [in your life]. Because you are what you eat, in your health. You give more value to nature, which is a wonderful work of God.

And,

> Geraldo: We do this [agroecology] for life. Out of respect to the human being and everything that is here, that was created by God or a star … out of respect for that.

Central to agroecological actors' notions of cultural-spiritual well-being is the appreciation or valorization (*valorização)* of nature and people – the giving of esteem. The values to which they typically referred include respect, care, interconnectedness or holism, and a recognition of shared or collective commitments or obligations to one another and to more-than-human life forms. As one farmer said,

> Edson: For me [agroecology] is a concept of life … Respect for nature, sustainability … Also thinking about preserving, not just extracting. So now we see it as a consortium, a partnership with nature. If you leave nature there, it brings you results … So it is adding value by protecting, respecting, and, consequently, producing quality food … It is a

> living concept. It goes far beyond producing something at no cost. But to respect life, you know. Because it is directly related to human life, not just nature.

In fact, beyond being a method for producing food, many participants view agroecology *as a vehicle* for cultivating this sense of respect and interconnection, which they describe as the most profound aim of agroecology. This is summarized by one farmer, who said:

> Maria: *Agroecology is not a way of working, of producing. But a way of living.* It is the idea of respect for nature, and appreciation and such. A way of life. Not killing, not destroying, not to be destroyed. Pesticides destroy this connection and this experience with the environment…We are in this environment. We are the environment. This respect, this care for life – for the whole, right. (Emphasis added)

Two farmers at an agrarian settlement stated:

> Thiago: Nature is cyclical, and agroecology must also involve culture and the social environment…I think culture is what will condition it most. Now there are things that are principles, the collective knowledge, the collective land, collective work, respect – respect to gender, respect for the child to the elderly – these values that we have as humans, the [capitalist system] every day makes us bury them more and more. *I think that agroecology is rescuing these values. And within that, producing food. Producing food is not the central point, it is the final output. At the end of all this harmonious work*

is this re-socialization with nature; we find a sustainable way of producing food, but it was only possible because we readjusted this way of seeing the world. (Emphasis added)

Gustavo: Agroecology involves producing food in harmony with nature, without degrading it. It will be possible anywhere in the world, you just have to find out what is the way to do this in each place, right? That's conceptually. But I would say that in addition, in practice, you have a model of life, in addition to a mode of production, *it is not simply a way of producing things but of producing life and the collective management of everything* … We plant and harvest life in here. *For me, that is agroecology, it is the management and collective production in support of the vision to produce and reproduce life.* (Emphasis added)

These sentiments were echoed by yet another farmer, Beatriz:

Beatriz: For me, *agroecology is the background – in everything that you are going to do you will have this lens of agroecology, of integration; with a real and true connection, in relationships with people, in the manner that you consume, in how you interact with the world, how you relate to animals, with plants, with others*. I think that agroecology is this – it is almost spiritual, it's all of it. It is as if you are in relationship with everything, with every decision. Say I'm going to the city to buy shoes; I want to know where they came from, what materials it contains, what kind of labor was employed in that. The way I want people to look at food and look back at everything involved – I also need to practice that in everything else. (Emphasis added)

This attunement to the social relations that sustain society – and to the wider political-economic systems that shape these relations – speak to the next dimension of well-being, social-political-economic well-being.

5.3.4 Social-Political-Economic Well-Being

Seventy-three percent of participants described the importance of the social-political-economic dimensions of well-being, which have to do with having healthy and supportive relationships; the ability to exercise political voice and participate in political processes; and financial independence and security (Wolff 2021). Due to the networked nature of agroecology, especially through programs like participatory guarantee systems (where peer-to-peer learning and agroecological certification are built into membership within the network), agroecological actors describe feeling connected to and supported by their community in a way that goes beyond other modes of food production, including third-party organic certification. As one NGO leader said when describing Rede Ecovida, an agroecological network that also created one of the first participatory guarantee systems in the world,

> Miguel: Rede Ecovida understands that agroecology is not simply a technical model, it implies social organization. And to have social organization, the citizen has to interact. You have to be leaving the house, interacting with other farmers, organizing with other farmers. This is necessary.

Participants also very strongly recognized the role of agroecology in reconnecting the city and country, a sentiment that is often chanted at various agroecological events: *Comida de verdade no campo e na cidade* (real food in the country and city)! One farmer involved with a community-supported agriculture (CSA) initiative describes her CSA members as "co-farmers." She says,

> Beatriz: We didn't want to produce organic food to offer to people. This is not our goal. We want to provide healthy food, but the goal is to bring people closer to reality, you know? To build agroecology like this so that people understand rural issues, the production process. Then there is the agroecological food. But that is not the goal – it's the social construction itself. And then bring the farmers and co-farmers [CSA members] here … they have to make a little commitment to the farmer, come and visit the farm, things like that. And then we do the production planning with them in the cost spreadsheet, like we will earn this much, production will cost this much, and we will need all people to share this amount, hence the monthly fee. So it's a process of social construction.

Participants also articulate a sense of social and political solidarity with other movements, in particular those pushing for racial and gender justice. Henrique, a long-time policy advocate who is involved with a national agroecology association, reflected that,

> Henrique: With great force the agroecological movement embraces traditional peoples, *quilombolas* (Afro-Brazilians), Indigenous peoples, and the territorial rights of these

> populations…All policies related to the defense and demarcation of territories of traditional and Indigenous peoples have to do with the understanding of agroecology. Another strong understanding is the recognition of women. So also knowing that it is not enough to talk about family farming, but we also need to understand that within families and in the economies of agrifood systems there is a specific contribution of women that needs to be recognized by the State. And at the same time women suffer from a structurally patriarchal culture that excludes women, who are important for building more democratic agrifood systems with agroecological principles. So affirmative and inclusive actions are needed to strengthen women's movements.

Underpinning these goals of solidarity and alliance-building across social groups and spatial scales is a commitment to collaboration and partnership, instead of competition. For example, two agroecological farmers, Leticia and Natalia, began their journey by visiting another farmer, Geraldo, known as a reference point for agroecology in the region. As fairly new farmers, they emphasized how important it was to them that Geraldo "saw us as a companion, not as competition. That was really cool." This sense of cooperation and interdependence actually serves to bolster farmers' perceptions of autonomy, self-determination, and resourcefulness, as they aim to rely on one another and to work with natural inputs and processes (i.e., native seeds and species, mulches, organic fertilizers), instead of relying on agribusiness and the private sector. As Geraldo stated,

> Geraldo: I respect nature through her cultivation. And for me, the person who plows the land – they do not cultivate the land, they destroy the land…I didn't lime, I didn't use

> fertilizer, I only used leaves, grasses, and manure and so it went, recuperating…I don't want to add lime. I am against mining – dig a cave, destroy an entire hill, throw garbage on the land of others. And I don't buy inputs. Basalt, which is rock dust, several organic farmers use this product, but I see the other side. As soon as the consumption of basalt increases a lot, Bunge is watching; VALE is keeping an eye on it; Yara Fertilizer is watching; Manna is watching. And what happens? They start to uproot mountains; they start to make a dam to get the minerals, and it starts causing a problem. That's why we do things like we do here.

Another farmer said,

> Eduardo: Why are there so many poor people in the world? It's because someone is consuming a lot. Then it centralizes that power. In agroecology we don't see this, and neither can we – the more you concentrate, the worse things work. In agroecology you reach a certain level – I have a little money, I have a few assets, I can survive, and that's enough – I don't need any more. What am I going to create empires for? If you start creating empires within agroecology, then your philosophy has to change – it stops being agroecology … Agroecology as a concept is cooperative, not private. It is not a company that owns and that will rule everything. It is always that cooperative idea.

Related to this political commitment to cooperativism and non-hierarchical forms of economic organization is the idea of fairness and equity. Agroecological actors refer to the ways in which healthy food should be accessible to all, and how land, wealth, and other resources should be

fairly distributed. For example, in the realm of production, Leticia and Natalia highlighted the concentrated land ownership structure in Brazil and how large-scale agriculture – even if incorporating ecological management practices – creates issues from an equity standpoint:

> Leticia: I think there is no technical limit to producing sustainably. But ethically, there is. In the sense that, a property of 5000 hectares in the hands of one person means that there are a lot of people who do not have access to land. Technically, I'm not sure if it's possible to practice agroecology; maybe, but more likely organic. Because even though workers might have good working conditions, they wouldn't have autonomy in decision-making.

> Natalia: And they wouldn't be as able to participate in the social transition, because they'd be treated more as *executantes* (executors of employer-dictated tasks).

With respect to ensuring access to agroecological foods for consumers, Geraldo described his commitment to guaranteeing that the pesticide-free foods he produces are non-exclusive and available to as many people as possible:

> Geraldo: I work with solidarity prices. It's an affordable price. There are people who say 'no, you could charge $2000, $3000…' I charge a rate of $100–150 *reais* [for courses and lectures]. *Eu faço um trabalho justo* (I do fair work). That is my interest…and I don't agree with that organic producer who sells one kilo of carrots for $8 *reais*. Because then, as they say, he wants to 'gouge the eyes' of those who buy. I'm selling it for $4 *reais*. An

affordable price. In the conventional market, it's $3.50–3.90 *reais*. I sell directly to the consumer.

The notions of doing "fair work" and "not creating empires" map onto what many participants articulated as having "enough," or what they felt was sufficient, to feel economically secure. As Geraldo went on to say,

> Geraldo: I have no interest in getting rich. My interest is to have a simple life, one where I can live, having the necessary comforts. It is not in the interest of doing things for money…We need money, we can't deny it. But we do things with a bigger awareness.

Flavia, a farmer whose family previously worked with tobacco, said,

> Flavia: We have neighbors who ask us why we farm like this, why we don't produce tobacco. Because tobacco gives you money, right – you could be rich, they say, if you plant tobacco. We don't think about getting rich, we think about quality of life.

This was echoed by another farmer, whose family also previously worked with tobacco,

> Patricia: We worked for 10 years in tobacco and my husband was always sick, his sisters-in-law sick, his mother-in-law sick, we were stressed and sick and I wanted to get out of this life…And then my children started to be born. I didn't want the children to grow up around tobacco. And, to live you don't need so much – we didn't need so much for us to

> survive, right? I don't need a mansion or a new car for us to know how to live. I didn't want to expose the children like that in that job…I didn't want it at all. So we left tobacco behind and started to plant [organic] grapes.

Another farmer, Debora, relayed:

> Debora: Agroecological farmers don't have to cut [deforest] everything. We are aware that we do not need to deforest the entire hill to make a garden…We need to maintain what we have. What we have is enough to eat, and then some, from our small farm.

However, simultaneous to acknowledging what it meant to have "enough" for a good life, some farmers recognized the need to address self-exploitation and the right to a dignified livelihood (Blesh and Wittman 2015; Walsh-Dilley et al. 2016). As Beatriz noted,

> Beatriz: The biggest challenge, I think, is to make it possible for many people to consume [this] food, make it economically possible for them, and make it possible for many farmers to be able to produce food and work with agroecology and also be economically viable. I think that this is one of the biggest challenges for both those who produce and for those who consume – is it actually viable without us having to get used to being underpaid? Can the young person have a real opportunity for having a good, peaceful life? We are not talking about luxury; we are talking about dignity.

Agroecological actors also describe how political-economic forces, like neoliberalism, constrain well-being at a structural level. Many participants framed this as an abdication of the state's responsibilities (while recognizing that the state is also constrained by international political-economic forces, including trade rules and regulations and multinational corporate influence). As one farmer put it,

> Renato: The state has very straightforward commitments. It has to keep the population healthy. This is its fundamental role…It is not a matter of protectionism, it is a matter of public health policy, it is a matter of food security. But the neoliberal view is that the state has no duty to anything.

Since all of the interviews took place during and after the election of Jair Bolsonaro to the presidency, participants particularly emphasized how policies under the Bolsonaro administration would roll back protections to environmental and human rights and cause additional difficulties for small-scale and family farmers, agroecological and organic farmers, and traditional populations. Another NGO leader and prominent food and nutrition security policy advocate relayed,

> Luciana: They [the administration] are reducing the budget…the restructuring of ministries is in disarray…They're undertaking a total destruction of the role of INCRA [the Ministry in charge of agrarian reform], of FUNAI [the government body responsible for upholding Indigenous peoples' rights]…They have already said that they will stop the demarcation of Indigenous land, of *quilombos* [Afro-Brazilian communities]…not only

> have policies on food security and agroecology been reversed but there has also been a serious deconstruction of the environmental and land legislation, and with these barriers created by these changes in the law, you make it unfeasible to produce in an agroecological way. It makes life impossible for many people in the places where they are. Indigenous people are much more persecuted than before, as well as the *quilombolas*. It's very serious.

In summary, agroecological actors in southern Brazil emphasize the contributions of agroecology to physical well-being through improved occupational and mental health; environmental well-being through use of ecological management practices that work with, rather than against, nature; cultural and spiritual well-being by creating a sense of interconnectedness and respect for life; and socioeconomic and political well-being by providing actors with increased autonomy, access to social support networks, and a way to make a living that aligns with their values (such as fairness, solidarity, and cooperation). However, participants acknowledged the structural forces – neoliberal capitalism and vested political interests – that constrain well-being at the farm scale and beyond.

5.4 Discussion and Conclusion

While agroecology is often described as a science, practice, and social movement (Wezel et al. 2009), our findings show that, beyond this, agroecological actors in southern Brazil describe agroecology in terms of well-being: As a philosophy of living that provides a good quality of life, and even dignity and joy. They describe the stimulating and creative nature of their work, including the potential for learning new ways to address complex problems, lending evidence to

how agroecology can contribute to a "dignified life" (Antkowiak 2020) and lead to contributive justice by encouraging farmers and organizers to develop new capabilities, exercise self-determination, and care for their communities, while in turn being recognized and valued for these efforts (Timmermann and Félix 2015). In addition, while a recent review found few studies that "specifically examined the relationship between food sovereignty practices [such as agroecology] and mental health outcomes" and that "this area of investigation merits more attention" (Wolff 2021, p. 59-60), our interview data provide evidence for how agroecology can positively influence mental health through contributive justice.

Although agroecologists working in Latin America have increasingly articulated the distinct contributions to agroecological practice and thought from this region (Méndez et al. 2015; Rosset et al. 2020, 2021; da Silva 2014), the contributions of agroecology to well-being still seem to be relatively unexplored empirically (c.f. Wolff 2021; Dumont and Baret 2017). This is an area ripe for further engagement, as critiques of Western, reductionist, and biomedical approaches to understanding health and well-being in the context of socioecological crises are growing. Many of these critiques problematize the ways in which individualized biomedical approaches to health can lead to de-contextualized forms of biological determinism that downplay how environmental factors and social structures shape and mediate wellness (Dennis and Robin 2020; Spiegel et al. 2015). In particular, critical public health and social work scholars note the ways in which intersecting oppressive structures such as capitalism, colonialism, racism, and patriarchy fuel inequality and poverty (Butler 2019; Dennis and Robin 2020; Gonçalves et al. 2019; Prins et al. 2015), which in turn shape both people's subjective assessments of life satisfaction as well as material health and well-being outcomes (Pickett and Wilkinson 2015; Selita and Kovas 2019;

Wilkinson and Pickett 2011). Recent research even links social and economic policy that exacerbates inequality to the heritability and expression of traits that affect well-being, in what has been called the "Gene-Gini interplay" – shedding new light on how "inequality gets under people's skin" due to the social structures that condition wellness (Selita and Kovas 2019, p. 22).

As a result of this growing understanding of how social structures like capitalism (through alienation and individualism) and colonialism (through domination and creation of binaries and racial and ethnic hierarchies) increase inequality and reduce well-being, there is a renewed interest in understanding what it means to "live well" from various standpoints. For example, throughout a number of countries in what has been territorialized as Latin America, various post-development discourses have been mobilized under the "umbrella" of *Buen Vivir* (Good Living) (Gudynas 2011, p. 442). Drawing direct inspiration from the Kichwa philosophy of life, *Sumak Kawsay* (Viteri Gualinga 2002; Simbaña 2011; Kowii 2011), *Buen Vivir* and good living philosophies promote a "fullness of life in a community" as well as a set of principles, rights, and responsibilities that outline how to live in harmony with one another and with nature (Gudynas 2011; Huambachano 2015). Many Indigenous good living philosophies honor and uphold principles like reciprocity, solidarity, and the continuity of collective knowledge in an effort to maintain a sense of equilibrium and harmony with nature and with community (Huambachano 2015, 2020; Viteri Gualinga 2002; Kowii 2011). These same principles have found resonance among the agroecology community in Brazil, which has increasingly centered and expanded upon the contributions of Indigenous and traditional peoples in agroecology movements and practice.

In parallel, European philosophers often draw on Aristotelian notions of "flourishing," which – counter to trends in the field of positive psychology that emphasize focusing on an individual's strengths and improving one's mindset – recognize the crucial effect of a person's material circumstances on well-being. As social work and policy scholar Iain Ferguson (2007) notes,

> For Aristotle and even more so for Marx, the capacity for [flourishing] depends largely on the type of society in which you live. As Terry Eagleton has recently put it in his short treatise on The Meaning of Life: 'If happiness is a state of mind, then it is arguably dependent on one's material circumstances…Happiness or wellbeing is an institutional affair: it demands the kind of social and political conditions in which you are free to exercise your creative powers.'

In taking a Marxist and "normative humanist" approach to analyzing mental health and well-being, social psychologist and philosopher Erich Fromm distilled what he considered to be five characteristics that are necessary for human, and therefore societal, flourishing: Relatedness, transcendence, rootedness, a sense of identity, and a frame of orientation (Fromm 1955). Fromm describes the first pillar, relatedness, as the desire to connect with oneself, with others, and with nature through love, itself composed of emotions of "care, responsibility, respect and knowledge" (Fromm 1955, p. 31). In his words,

> The necessity to unite with other living beings, to be related to them, is an imperative need…There is only one passion which satisfies [one's] need to unite [oneself] with the world, and to acquire at the same time a sense of integrity and individuality, and this is

> love. Love is union with somebody, or something, outside oneself, under the condition of retaining the separateness and integrity of one's own self (Fromm 1955, p. 29-30).

Second, Fromm argues that humans need to create and be creative in order to feel a transcendent sense of purposefulness, fulfillment, and freedom, stating that "the satisfaction of the need to create leads to happiness" (Fromm 1955, p. 36). Fromm's third pillar for human flourishing is rootedness, which is constituted by the institutions and relationships that make us who we are and provide a sense of belonging or feeling at home – "the individual leans on them, feels rooted in them, has [their] sense of identity as a part of them, and not as an individual apart from them" (Fromm 1959, p. 39). Fromm's fourth characteristic necessary for human well-being is identity, where sense of self is cultivated through thinking, feeling, and "creative action." Here, Fromm argues that contemporary and unequal capitalist societies conflate the development of a relational notion of identity with forms of identity that are based on social status, leading to feelings of estrangement, alienation, and dissatisfaction. Lastly, Fromm notes that humans need a "frame of orientation," or a coherent worldview or "thought system" comprised of intellectual, feeling, and sensing elements that provide a spiritual or philosophical lens through which to see the world and interpret meaning and experience (Fromm 1955). With these five criteria for human flourishing – and counter to mainstream Western psychology, which had framed health and well-being in terms of an individual's conformity to late capitalist society – Fromm argued that health and well-being "cannot be defined in terms of the 'adjustment' of the individual to [their] society, but, on the contrary…must be defined in terms of the adjustment of society" to the needs of people (Fromm 1955, p. 70). This raises the question: What kinds of societies do we want to build to promote well-being?

For their part, agroecological actors in southern Brazil already articulate the ways in which agroecology, as a philosophy of living, can promote an alternative, harmonious, or adjusted society that is based in human and planetary needs. Their commitment to this way of life enables them to continue to practice agroecology even as the already modest policy supports for agroecology are being rolled back. They describe agroecology as contributing to well-being through improvements to mental and occupational health; by working with and respecting ecological processes; by providing the autonomy to undertake creative, challenging, and rewarding work in the context of social solidarity and collective organization; and through cultivating a sense of interdependence and connectedness with one another and with nature. These findings suggest that agroecology can provide a pathway to overcoming alienation, commodification, and exploitation, although broader political-economic conditions constrain this potential. Yet as social and ecological crises continue to accelerate and undermine human and environmental health and well-being, the capacity for agroecology to promote wellness from various ontological and epistemological positions warrants further attention. To what extent does agroecology enhance well-being in comparison to other forms of food provisioning? How might it open up avenues for valuing and enacting different ways of living and relating? In what ways can agroecology contribute to more liberatory futures?

Chapter 6: Conclusion

In light of the widespread agreement on the need to build viable alternatives to current, unsustainable models of agricultural development – alternatives that support food security and nutrition, improve the environment, provide dignified and equitable livelihoods, and enhance overall human well-being – this research project explored one proposed alternative: a transition to agroecology. By investigating a) the histories, paradigms, and actors that shape agri-environmental governance and the development of agroecology policy; b) the spatial distribution of agroecological indicators and the potential drivers of agroecological performance; c) the role of social movements in conditioning the relationship between farm size and agroecological practice use; and d) the ways in which agroecological actors define and describe agroecology, this project contributed empirical evidence toward understanding how to how to contextualize, assess, and facilitate the "scaling out" of agroecology.

6.1 Findings and Contributions

The specific contributions of this dissertation are as follows. Chapter 2 explored how a historical-relational-interactive framework could help to explain the histories, relationships, competing paradigms, and actors that have shaped agri-environmental policies in Brazil. I found that, historically and currently, the Brazilian state's agri-environmental institutions heavily favor the agrarian elite and agribusiness, which promote a Green Revolution-oriented agricultural development paradigm. However, social movements and civil society have managed to both create and take advantage of democratic openings to push for policies in line with an agroecology-oriented rural development paradigm, finding particular success during Brazil's "Golden Era" thanks to sympathetic political figures located within the state.

Key to getting agroecology-inspired policy institutionalized during the Golden Era were democratization processes that were simultaneously unfolding *outside of* (through movements to democratize land and the means of production) and *within* (through struggles to democratize access to public resources, knowledge, and policymaking spaces) the state. The agroecology movement's emphasis on democratization and decentralization of the state apparatus has emerged directly out of long-standing and legitimate concerns over how centralized state power has led to historical and ongoing inequities, repression, clientelism, and corruption – forces that largely stymied or watered-down more transformative approaches to development. In Brazil's current political climate of austerity and authoritarianism, the extent to which national agroecology policy gains will remain will likely depend on the degree to which social movements and civil society are able to both mobilize against anti-democratic rhetoric and organize alliances at local and international levels.

Chapter 3's contribution is the elaboration of an indicator-based approach (based on FAO's TAPE) to assessing agroecological bright spots using agricultural census data, which subsequently allowed us to identify potential drivers of agroecological performance. Based on the ecological, economic, social, and cultural indicators of agroecology included in the agricultural census, we created an agroecological index and mapped the results at the municipal level across Brazil to evaluate agroecological performance. We find that Brazil's North has the highest average regional score for agroecological performance and the Centre-West has the lowest average regional score, with the states of São Paulo and Paraná also having low average scores at the state level. Within these areas, we then identified municipal bright spots of

agroecological performance (municipalities doing better than expected compared to their context), which served as the basis for a literature review to identify and explain the potential factors that influenced better agroecological performance. The review pointed to the activities of grassroots farmer networks and NGOs; access to public policies, programs, and trainings; proximity to urban areas and markets; and maintenance of traditional and cultural agricultural practices as potential drivers of agroecological successes. This approach allowed us to use publicly available quantitative data to begin to characterize agroecological performance at the municipal level for all of Brazil, and can potentially serve as a model for indicator-based assessments of agroecology in other contexts.

In Chapter 4, I find that there is no effect of farm size on the use of agroecological practices among farmers embedded in the agroecology network Rede Ecovida. This stands in contrast to recent studies on the organic sector in the Global North, which have identified an effect of farm size on agroecological practice use. In this case, I suggest that the lack of a relationship between farm size and agroecological practice use can be attributed to the fact that Rede Ecovida acts as a "social carrier" for agroecology that promotes territorial autonomy. The construction of territorial autonomy – based on sustained collective social organization and leveraging of ecological processes in order to reduce dependency on external actors, markets, and inputs – may lead to environmental benefits on farms across the size spectrum. Indeed, in our study, farms that ranged from 0.03–295 ha used a broad suite of agroecological practices and management systems, and were likely able to do so thanks to their shared ideological commitments and increased access to agroecological knowledge and markets through Rede Ecovida. These

findings provide new insights on the relationship between farm size and agroecological practice use, the role of social movements in scaling out agroecology, and evolving theories of autonomy.

Lastly, given the integral role of social movements in advancing agroecological approaches, Chapter 5 focuses on understanding what agroecology means to these actors. Using ethnographic methods, I find that agroecological actors in southern Brazil frame agroecology as a way of life that can enhance various aspects of well-being, which stands in contrast to how agroecology is often defined or described in scientific literature and policy documents. I link these findings to philosophies for living well that circulate in Western and Indigenous discourses (Manson 2021) and raise questions about how agroecology can provide a counterpoint to individualistic conceptions of well-being by instead contributing to collective well-being as part of a "post-development" shift.

6.2 Limitations, Strengths, and Future Directions

There are a number of limitations to acknowledge in this project. First, there are some important data gaps, particularly for the indicator-based assessment of agroecology discussed in Chapter 3. While Brazil has one of the most thorough agricultural censuses in the world and tracks a range of indicators relevant to agroecology, data was still lacking, particularly on the social and cultural components of agroecology – despite the fact that the social and cultural components may act as important factors shaping agroecological performance. In addition, whether or not a farm or municipality is "agroecological" or is in practice performing well on a set of specific *agroecological* indicators (rather than organic indicators or perhaps those representative of another system) requires context-specific input from local actors. Lastly, this chapter only

provided a snapshot of agroecological performance, while future research could use time series data to further elicit potential determinants or drivers of agroecology.

Another limitation of this work is the lack of a counterfactual. Given that this project is informed by a community-engaged research approach, the focus was largely on understanding agroecological principles and processes in service of agroecological actors. For example, Chapter 4 looked at agroecological practice use across a range of farm sizes on farms seeking certification through the agroecology network Rede Ecovida. Future research could focus on providing a comparative assessment of agroecological practice use across farm sizes among Rede Ecovida farmers, farmers pursuing third-party organic certification, and non-organic farmers in Brazil, to provide further evidence on whether and how farm size and participatory networks influence agroecological practice use. Similarly, while Chapter 5 took an ethnographic approach to understanding what agroecology means to agroecological actors in southern Brazil, and did not *a priori* identify a focus on well-being, future research could comparatively assess farmer and worker well-being on agroecological farms and non-agroecological farms, thereby providing a counterfactual that would allow for more robust claims about the specific ways that agroecology can enhance well-being relative to other farming methods.

While recognizing these limitations, the overall strength of this dissertation is two-fold. First, the multi-scalar, interdisciplinary, and mixed methods analysis has enabled a more holistic understanding of the way that agroecological approaches unfold through policy, practices, power-building, and philosophies for living well. Second, this dissertation has identified the crucial role that agroecology movements play in scaling out agroecological approaches through

these different dimensions. Taken together, the chapters herein bolster the evidence for pursuing agroecology as an alternative rural development paradigm, and contribute insights relevant at the structural level that can help decision-makers build an enabling environment that better promotes transitions toward more sustainable, healthy, and just food systems. By respecting and working with farmers, workers, and practitioners who are already implementing creative and successful agroecological approaches to development tailored to their territorial contexts – even in a context of disempowerment – researchers and decision-makers can better support transformative agroecology.

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Appendix: Interview Guide

Part 1: Background

1. Farmer name
2. Farmer age
3. Owner-operator of the farm? Shared owner-operator responsibilities?
4. Farm location
5. For farming purposes, do you:
    - own land
    - rent land out
    - rent from anyone else
    - use common land
6. Farm size
    - Total area:
    - Total garden area:
    - Total productive area used for farming:
    - Total area certified:
7. In general, how would you describe the land?
8. Are you in transition or certified with an agroecology or organic program?
9. Income
    - Total farm income?
    - What is the main source of income?
        - Farming activities
        - On-farm value-added activities
        - Off-farm activities
10. How many people work here?
    - Family members:
        - On average, how many hours do you estimate each family member works per week on your farm? Off-farm?
    - Non-family members:
        - How many non-family workers do you hire and for how much time in a year?
        - For what purpose do you hire additional labor?
    - Do you have sufficient access to labor for your needs?
11. How would you describe your education level?
12. What's the story of this place/property?

Part 2: Production and management

13. Number of crop species grown:
    - How did you decide what to grow?
    - Where and how do you access seeds?
14. Number of livestock species raised:
    - (If applicable) Do you utilize rotational grazing practices?
15. Could you describe the types of management practices you use on your farm?
    - Biological control
    - Flowering borders
    - Mixed cropping (intercropping, relay cropping)
    - Crop rotation
    - Conservation tillage
    - Soil cover (cover cropping, mulching)
    - Locally-adapted varieties
    - Fallow fields
    - Agroforestry (alley cropping, hedgerows)
    - Integrated crops-livestock
    - On-farm nutrient/energy recycling
    - Riparian buffers…
16. How do you access your water?
17. Can you describe your input use for pest control and soil fertility?
18. What machinery, if any, do you use during production/processing?

Part 3: Access to markets and resources

19. Are you a member of other cooperatives? If so, which cooperatives, and for what purpose?
20. Are you or were you a participant in government-led family farm programming? (i.e., PNAE, PAA, PLANPO, etc.)
    - How beneficial were these programs to you, and why?
    - How easy were these government programs to access?
21. How would you describe your access to credit?
22. Have you accessed extension support for your farm?
    - If so…
        - Who provides/provided the support?
        - With what frequency?
        - Does or did this extension service provide support for agroecological production?

23. Do you participate in farmer-to-farmer meetings, field schools, or other learning exchanges?
    - If so…
        - Who provides/provided the support?
        - With what frequency?
        - Does or did this experience provide support for agroecological production?
24. Do you participate in other formalized education activities (short courses, academic workshops)?
    - If so…
        - Who provides/provided the support?
        - With what frequency?
        - Does or did this experience provide support for agroecological production?
25. What is your greatest expense, and what proportion of your expenditures goes to this expense?
26. Are markets for agroecological products easy to access for you?
27. What proportion of what you grow do you keep/sell to markets/sell to the government?

Part 4: Motivations

28. Do you consider yourself to be an agroecological farmer?
    - Why or why not? What does agroecological farming mean to you?
    - Who decided to start producing/living in this way and why?
29. What is an agroecological transition? What does it involve/look like? What would a global transition to agroecology look like and what would it take?
30. Would you be able to farm agroecologically if you expanded your farm?
    - Is it possible to be a large agroecological farmer? Why or why not?
31. *IF CERTIFIED*
    - Why did you decide to certify? What motivates you to use ecological/sustainable management practices?
    - Do you or did you encounter any problems with
        - Becoming certified?
        - Maintaining your certification?
    - What were the biggest barriers you experienced during the transition to agroecological farming?
    - What is your overall greatest challenge on your farm and why? What would help you overcome this challenge?
32. *IF NOT CERTIFIED*
    - Have you been certified in the past?

        - If so…
            - For how long?
            - Why did you give up certification?
    - Are you interested in…
        - Transitioning to agroecology?
        - Becoming certified?
    - What would motivate or help you to:
        - Transition toward agroecological management practices?
        - Become certified?
    - What is your greatest challenge on your farm and why? What would help you overcome this challenge?

Part 5: Wrap-up

33. Is there anything we haven't discussed but that you think is important and would like to share?
34. Who would you like the findings from this research project to be shared with?
35. How would you like the findings from this project to be shared with you?