

Correspondence from the Unseen
Prismatic Agri-environmental Governance in the Anthropocene

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ABSTRACT

Climate change is transforming agriculture and the governance frameworks responsible for it. Adaptation programs, efficiency measures, and technical interventions are offered as solutions, but across many settings they fail to address the conditions that farmers, ecosystems, and animals actually inhabit. This dissertation examines three such settings, drawing on political ontology's concept of the anthropo-not-seen to name what governance categories are structurally unable to perceive, and developing correspondence as the positive term for engaging what governance currently forecloses. Chapter 1 analyzes U.S. nutrient governance and practices and shows how metrological regimes, the arrangements through which environmental flows are turned into calculable variables, produce certain realities as governable while foreclosing others, including soil life as a living ecological community. Chapter 2 draws on ethnographic observations and interviews in Chile's Limarí Valley during the ongoing megadrought, where farmers describe a threshold crossing from chronic adversity into ontological breakdown, and where governance is present and active but cannot perceive the collapse of the configuration that made farming viable. Considering drought as a disaster in the making, the chapter extends the sociological concept of recreancy into slow-onset climate contexts and proposes *failure to correspond* as an analytical concept. Chapter 3 builds on ethnographic fieldwork at a farm animal sanctuary and argues that empathy, developed through bodily participation in care labor, produces knowledge about animal subjectivity that governance frameworks organized around animals as resources and emissions sources structurally cannot hold. The concluding chapter proposes prismatic governance as an orientation for agri-environmental governance in the Anthropocene, one that accepts ontological multiplicity and works with it. Under conditions where governance categories cannot perceive the situations communities, species, and ecosystems inhabit, the harms of climate change fall unevenly and the frameworks meant to address them reproduce the injustices they were supposed to resolve.

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GENERAL AUDIENCE ABSTRACT

Climate change is reshaping agriculture, and the institutions responsible for managing the relationship between farming and the environment are struggling to keep up. Programs and policies continue to be offered as solutions, but in many places they do not address the conditions farmers, ecosystems, and animals actually face. This dissertation studies three particular places where climate change is changing how agriculture is governed. In the United States, it examines how policy tools meant to reduce agricultural pollution measure some things carefully while missing others, including the living soil that farmers and scientists are learning to take seriously. In Chile's Limarí Valley, where a decade-long drought has transformed what farming can even mean, it follows farmers who describe a crisis that governance programs keep responding to as if it were a temporary problem. At a farm animal sanctuary, the third chapter describes the kind of knowledge that develops through daily care work with animals, and asks why this knowledge cannot enter the frameworks through which agricultural animals are governed. Across these three studies, the dissertation argues that governance often fails even when institutions are present and active, because the categories they work with cannot register what is actually happening on the ground. The concluding chapter proposes *prismatic governance* as a way of rethinking environmental policy, one that accepts that reality under climate change is more varied and more alive than current frameworks allow, and that institutions need new ways of perceiving what they are responsible for managing. When governance cannot see what is actually happening, the harms of climate change fall unevenly on some communities, species, and ecosystems more than others, and the policies meant to help often end up reinforcing the unfairness they were supposed to address.

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To our families as well, both those who are still with us and those who passed away while this dissertation was being written, thank you for being part of this journey, even from afar. Especially Mama, Co, y Oli.

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Preface

One of the draws of birdwatching for me is to allow myself to be amazed by nature. To see, acknowledge, and identify diversity in a species that has so many variations. Unlike practices aimed at killing or capturing birds, birdwatching emphasizes attention to the natural world and appreciates a world that flourished without and sometimes despite human intervention. Birdwatchers usually share their sparkbird, the bird that drew them into the practice. My path was different. Admiring birds sparked an ethics of veganism, a questioning of anthropocentric ways of relating to the world. Later I learned to enjoy birdwatching as a practice of attention and connection. It taught me to see the world as relational, to notice what I had been trained to overlook.

One of the most fun parts of birdwatching is observing different kinds of birds, and that usually means traveling to visit parts of the world very different from one another. Traveling entails class and material privileges that have allowed me to do it. It is also intertwined with a disposition to enjoy collectives of humans and nonhumans that I am not used to interacting with. This disposition, this enjoyment of difference, is challenged today by structural forces that treat such interactions as sources of contamination. White nationalism is one of them. Diversity is becoming a punishable word in academic writing.

Climate justice is social justice because the effects of climate change fall differently on different people, following existing inequalities. Multispecies justice is social justice because the systems of oppression that produce both are interlocked.

When I think about the time leading to this dissertation it usually starts with a specific memory. It is my first visit to campus seeing military recruits in uniform running through the grounds. For someone with experience in Latin American and European universities, this felt like a glitch, something that should not be there, something that worked against what a university is supposed to be. That image has stayed with me and contextualizes why sociological practice feels so different in the United States to me. Bourdieu thought of sociology as a combat sport. In my experience, the sociology I encountered seemed to think about itself as the referee. I felt nudges and atmospheres that pointed towards neutrality, or what Burawoy (2025) identifies as the fear

of being identified as nonneutral. A sociological practice that cannot, or is afraid to, condemn genocide or denounce the rise of fascism.

Fear is something I understand. I have experienced it even while enjoying the benefits of my privileges. I have stayed silent, and many of my peers too, because I fear the power of the state in the United States, its military connections with academic work, and its control apparatus. I can write this now because I see the end of some of the contradictions. The ending of my formal relation with the institutions of this country. The relative certainty that I can finish my PhD and hopefully feel safer somewhere else in the world.

Writing this section of this dissertation is my way of being witness. This work is the product of someone living through what is happening right now. It is also funded for four years by the same government that facilitates genocide and kills and incarcerates immigrants. I hold these things together because they cannot be separated. The privilege and the uncomfortableness. The source of my material reproduction and the violence it also supports. The silence I kept and the speech I try to leave here as source of context.

I initially thought of titling this dissertation "Dispatches from the Anthropocene." I wanted to emphasize the particular nature of the observer. Each chapter would show my way of seeing, the analytical perspectives I use that are connected to who I am and where I stand. Dispatches are sent from somewhere, by someone, to someone else. After thinking, reading and talking about it, I moved from dispatches to correspondences because the word can hold that same meaning while encompassing others. Correspondence is exchange. Letters sent and received. It is also response. The ways we respond to each other, respond collectively to something happening in the world. And it is understanding. The capacity to place oneself in the position of another and grasp why they might respond in some particular way.

I expect this dissertation contributes a style of sociology aware of its context of production. I also expect it to be able to denounce genocide and the rise of white nationalism while speaking about the environment, the climate, and technology. While probably being an act of limited impact, at least it refuses the calls for neutrality, honoring a specific tradition of what sociology should aspire to be.

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I. Chapter 1: Introduction

1. Context

The goal of this dissertation is to describe and analyze the governance of agriculture in the context of the Anthropocene. According to geologists and earth scientists, humanity has entered a new geological epoch, the Anthropocene, where the human species has become a critical force in shaping the general function and structure of Earth systems (Steffen et al., 2011). One of the most salient consequences of human activity that contributes to the Anthropocene is climate change. Climatic change and variability are increasingly impacting agriculture and food systems. Contemporary farming practices, like the use of pesticides and synthetic fertilizer, removal of native forests, and monocrops, are one of the main causes of increasing global temperatures, contributing to at least one-fifth of global greenhouse gas (GHG) emissions through land-use changes, enteric fermentation, and the management and application of synthetic fertilizer (Crippa et al., 2021; Nabuurs et al., 2022) .

The Intergovernmental Panel on Climate Change (IPCC) is one of the global institutions involved in supplying information to characterize and address the causes of climate change. The IPCC has identified that agricultural and ecological droughts are more likely to happen under scenarios of global temperature increases of 1.5° or 2.0° Celsius (Allan et al., 2023) and that food insecurity and biodiversity loss are likely outcomes of this new climate scenario (Pörtner et al., 2022). In this context, the expectation is that evidence-based agri-environmental policy and governance can help steer agricultural practices toward more sustainable farming practices and outcomes. As Leach and colleagues (2007) describe it, governance “addresses the multiple political processes and relationships through which state and non-state actors do, and might, engage”. Agri-environmental governance uses this approach to consider how multiple actors in farming settings engage with problems derived from adaptation to climate change, biodiversity loss, greenhouse gas emissions, and the management of sources of pollution (Alblas, 2023; Forney, 2016; Forney et al., 2018). Agri-environmental governance is a complex endeavor built upon economic, social, material, and historical considerations (Forney et al., 2018). Advances in science and technology affect this governance approach, like the availability of new data-collection and analysis tools, as

well as by exogenous factors like climatic change and extreme weather events. This type of governance also must deal with the consequences of the increased expansion and intensification of agriculture that has stressed many bio-physical ecosystems, from soil and water to broader ecological systems (Buttel, 2006). Thus, the connections between climate change and agricultural expansion have driven governance to the forefront.

The concept of the Anthropocene has been influential in conversations about the negative cumulative effects that human activities have on nature but has also been critiqued by its usage of the category of Anthropos, as it might avoid placing responsibilities on specific industrial activities of specific nations. In this regard, social scientists and philosophers have discussed the pertinence of using the 'human species' as an explanatory category because the responsibility of anthropogenic climate change can be traced to the economic activities of industrialized nations and not to all humans (Chakrabarty, 2009; Haraway, 2015). Donna Haraway's and colleagues (2016) response to some of the problems with the category of the Anthropocene is to use a different conceptual category, the Plantationocene. The Plantationocene identifies a particular way of organizing the production of goods at a global scale without care for its environmental consequences as the continuation of plantation logic of production. These critiques might show that the concept is still generative as a conceptual site, where tensions between species-level framing and differentiated responsibility can be held together and analyzed. As an organizing concept (Chagnon et al., 2022), the Anthropocene provides shared terrain where these tensions and the many conceptual variations they have produced can do analytical work across the empirical contexts this dissertation explores.

Environmental conflicts in the Anthropocene often appear hard to resolve because they involve what Marisol de la Cadena terms 'ontological disagreements,' conflicts between fundamentally different ways of constituting human-earth relations. De la Cadena's concept of the Anthropo-not-seen (de la Cadena, 2019) extends this argument. The concept shows how ontology drives the enactment of state power and supports the modern/colonial ideas behind resource extraction. De la Cadena considers the disagreements between indigenous ways of understanding the world, one that sees nature as spiritually connected to humans, that are at odds with economic activities that reduce nature to resources. For instance, conflicts over mining in

indigenous territories involve ontological disagreements about what kinds of beings mountains are and what kinds of relations are possible with them, which go beyond competing economic interests or cultural values. The political challenge of mediating between these different ontological positions, and the asymmetrical power relations that prevent productive engagement between different ways of world-making, means that the ontological clash helps to both contest and reinforce the ontological definitions that are the root of the Anthropocene (de la Cadena, 2019). De la Cadena is influenced by her preoccupation with ontological disagreements and informed by political ecology and environmental justice movements that have condemned the extractive nature of the states in Latin America (Acosta, 2013; Gudynas, 2016).

The ontological turn and environmental justice research and activism are key for the development of de la Cadena's concept, which provides sociology with enhanced analytical tools for understanding environmental conflicts that traditional frameworks struggle to explain. While Anthropology, Political Ecology and Science and Technology Studies have found the ontological turn as influential for creative new research strategies (Burman, 2017; B. Gill, 2016; Pickering, 2017), for sociology a deep engagement with ontology has proven to be a complicated affair. One of the reasons that might explain why sociology has trouble questioning its ontological foundations is that interrogating the divide between nature and society could shake the main pillars that sustain it as a scientific discipline (Pickering, 2000). Sociology has had trouble with a deep commitment to question the social/nature divide and its support for enlightenment-era ideas of science and humans, even when confronted by new research from environmental sociology and other disciplines (Goldman & A. Schurman, 2000). Opening up to a relational ontology, a feature of the ontological turn, means considering a world that is not pre-filled by social and non-social beings, but one that understands the world as co-constituted by interactions between humans and nonhumans that together create and recreate the social and natural world. While the threat of ontological explorations could mean that sociology is inherently flawed to explain the world, a more positive perspective sees that embracing a flat ontology is already present in many sociological work even if it is not overtly admitted (Breslau, 2000), and it might help the discipline and subdisciplines of sociology to develop new research agendas and heuristic models (Fletcher, 2024). This framework helps analyze why some environmental policies succeed

while others fail based on their ability to accommodate different ontological positions, and how power operates through the institutionalization of particular ways of constituting human-earth relations. Sociology's contribution to the ontological turn should be especially relevant since it is able to connect locally contingent associations of humans and nonhumans with structural classifications or social markers like class and power (Breslau, 2000).

Justice, as conceptualized by environmental justice and critical environmental justice researchers, relates to the normative idea that the inequalities that drive the causes and effects of socioenvironmental harms must be addressed (Harlan et al., 2015; McCauley & Heffron, 2018; Pellow, 2025). Justice considers distributional and procedural components. The procedural aspect is particularly relevant for an engagement with governance. Nevertheless, claims for both procedural and distributional components rest on the idea that the state is the place where they will be acknowledged and solved. Critical Environmental Justice embraces a hesitancy and rejection to place the state as the place of solution for injustices because the state is a space that has contributed to the enactment and maintenance of environmental inequalities (Pellow, 2016, 2025). In this sense, CEJ has similarities with the Latin American literature related to extractivism. Looking to contest development agendas that rely on the extraction of natural resources, extractivism scholars work in tandem with environmental justice advocates to show the inequalities that stem from extractive industries that are backed by the nation state. Interestingly, similar connections have been made by US-based sociologists (Malin et al., 2019) that connect environmental justice with extractivism, but do not engage with the Latin American 'school' of extractivism and are less critical of the role of the state. A deeper engagement between Latin American scholarship and environmental justice facilitates conceptions of justice that are able to reject productive models that are intrinsically destructive and recognizes the ontological difference present in nonhegemonic modes of living (Álvarez & Coolsaet, 2020). CEJ is also ontologically receptive to species as a category that is crucial for justice-based approaches, placing it next to more traditional concerns for sociological analyses like race and class. Additionally, a consideration of justice in the context of climate change allows for the contestation and expansion of the ways climate governance has been traditionally understood, expanding

beyond the ideas of mitigation and adaptation into new strategies like decoupling and restitution (Ciplet, 2025).

2. Positionality

The methodology I follow in this dissertation represents both a continuation of and departure from traditional ethnographic approaches. Thinking through the politics of positionality, what Kwame Harrison calls ethnographic comportment (Harrison, 2018), and the role of reflexivity in ethnographic practice has meant that I have approached this dissertation through ethnographic intentionality, which is different from Wolcott's ethnographic intent. Wolcott's emphasis on culture as the anchor of ethnography (Wolcott, 1987) is at odds with the ontological position described in the previous section. I will return to this issue when discussing the consequences of the ontological turn on ethnography from a sociological perspective. Individually, each of the chapters that compose this project, from interviews, to observations, to participant observation and informal conversations, is different and varies greatly in the level of immersion that I was able to achieve. But it is when they are placed together in a document like this, in conversation with each other but also in conversation with my thinking and writing, that I can make an initial claim to an ethnographic intentionality. New developments in the field of ethnographic or observational-based research have also provided relevant insights for research related to the Anthropocene and in conversation with the ontological turn.

With ethnographic intentionality, my goal is to situate my research in relation to previous work and maintain an informed approach that is also able to distance itself from the traditional style that defines most typical ethnographic work. Harrison provides a historically informed conceptualization of ethnography as an evolving methodology that is defined by practices like participant-observation and fieldnote writing, the use of culture as a critical explanatory variable, contextualization, empathetic engagement, and ethnographic comportment (Harrison, 2018, p. 33). My writing and methodological approach is informed but also at odds with that definition. I borrow insights from scholars that have emphasized materiality (Gullion, 2018; Law, 2004) and the challenge of research when the phenomena under study exceed the boundaries of a single site or community (Burawoy, 2000; A. Tsing, 2005; A. L. Tsing et al., 2024) to support my

understanding of ethnographic work that can be useful for the analysis of environmental concerns in the Anthropocene.

In relation to the topic of scales in the Anthropocene, my aim is to contribute to what Mathews (2020) has called 'Anthropocene ethnographies', a set of research that describes the situated impacts of new climate problems. These studies engage with speculative climate futures (Zalasiewicz, 2009), the long lasting effects of materials (Liboiron, 2016), the extinction of species (Rose, 2011), and an engagement with multispecies relations (A. L. Tsing, 2015). More recent studies have focused on ethnographic accounts of the Plantationocene, engaging directly with the structures and consequences of agricultural production in the face of the climate crisis (Carney, 2021; Chao, 2022; Ofstehage, 2024). Understanding climate change effects requires methods capable of attending to specificity, and ethnography offers this capacity through sustained presence in particular places with particular people. This kind of engagement produces knowledge that global perspectives cannot generate on their own, fostering perception of qualitative shifts and attending to how people articulate their situations, what categories they use, and where they mark thresholds.

Two researchers have been particularly influential in adapting ethnography to global scales. People like the late Michael Burawoy, when thinking about how to do ethnography in a globalized work, have had to think about how their approach continues and differs from previous ethnographic research (Burawoy, 2000). Burawoy and his students grounded their analysis in the affordances that sociological theory provides to work with the extended case method in order to follow and explain how certain types of globalization happen and are maintained. From a different perspective, Anna Tsing has also discussed the problem with doing ethnography in relation to global scales. Her solution is to acknowledge how her approach could be different from traditional ethnography but considers it 'deeply ethnographic in the sense of drawing from the learning experiences of the ethnographer' (A. Tsing, 2005, p. xi). In later work, the author mostly references analytical work in the Anthropocene through the idea of field observation instead of ethnography. Tsing et al. considers that to perform good research in the Anthropocene, stories are critical for our understanding of its origins and consequences (A. L. Tsing et al., 2024). Additionally, Tsing and colleagues consider that the observations from Environmental Justice

scholarship are critical to contemporary Anthropocene studies, a methodological affinity with my theory and positionality in this dissertation.

My writing is informed, more directly in some chapters than others, by my experiences. By my drives and thoughts through South Dakota, Vermont, and Virginia, exploring new topics, lands, and people. By my memories, previous knowledge, and family relations in the Limari Valley in Chile, one of the sites explored in this dissertation. And by the affordances of my body and the normative resonance with others who think of animals as more than resources and food, which is present when shoveling manure at a farm sanctuary to support a good life for rescued animals. My research is also informed by a political and racialized body during an aggressive enlargement of the immigration industrial complex in the United States (Ebert et al., 2020; L. L. Martin, 2024), that now includes a direct attack on international students. And as a migrant body in the US at this moment, one that traces its ancestry to Palestine, like many other Chileans, is a body at risk. A body that is told by the police state not to voice critiques at a government that incarcerates and disappears migrants and international students from the street and materially supports the genocide of the Palestinian people.

As the cases of Rumeyna Ozturk and Mahmoud Khalil showed, among many others, speaking against genocide means placing the gaze of the police-immigration complex onto oneself. Speaking against the erasure of Palestinians as an international student in the US means that you are an enemy of the state. And academia, and Sociology in particular, under precepts of neutrality (Burawoy, 2025; Ziadah, 2025) are affected by a chilling effect that contributes to the erasure of research agendas and critical voices. As an international student with Palestinian heritage and from Latin America, the current deployment of immigration-related policing, which includes incarcerating those who speak against genocide, and profiling based on language and 'Hispanic' looks and names (Anderson, 2025), is part of the context that envelopes my research and writing experience. It creates an aura or feeling of danger and fear in daily life, in some of the fieldwork I have done, and in relation to my writing. The shield of privilege that academia delivered to international students, turning us into the 'good kind of immigrant', has started to crack.

At first sight these two things might not be necessarily connected. How does the enhanced persecution of immigrants' bodies relate to a dissertation focused on agri-environmental governance in the Anthropocene? Can this be more than a timid reference to reflexivity and positionality? As positionality, standpoints, and reflexivity have gained prominence, the use of personal grounding in social science writing has also been critiqued due to the lack of connection between individual stories and the outputs of the research, a way of paying lip service to social categories without reflecting on how subjectivity informs science (Pillow, 2003). A reflexive engagement with positionality explores what connects one's context and story with our exploration of issues, how they are analyzed and written about. Under a general perspective, anchoring my research in my experience and contexts provides me with an avenue to place at the forefront of my work ideas related to positionality and situated knowledges (Haraway, 1988). More specifically, I see that my positionality informs my research in three ways. First, a focus on inequalities derived from governance and the deployment of state power. Second, an affinity with silences and erasures at epistemic and public levels. Third, the reference of a sometimes-connected world that operates at multiple scales in certain places and bodies. As an international student, as someone who has lived in different locations, under different cultures or assemblages, I care about multi-sited, interconnected worlds that are both local and global.

As I previously mentioned, in my goal of maintaining an ethnographic intentionality, I must reconcile the ontological politics as understood under the Anthro-not-seen and the emphasis on culture from traditional ethnography. An engagement with relational ontology has affected how researchers think about methodologies and methods. John Law (2004) and Jessica Gullion (2018), writing about the topic almost 15 years apart from a sociological and multidisciplinary perspective develop arguments related to the influence of the ontological turn and ontological politics in how qualitative methods are approached by scholars and researchers. John Law uses the experience of laboratory ethnographies in the field of science studies to move toward the concept of a messy reality that requires flexibility and creativity in research. While acknowledging the value of rigorous and standardized methodological approaches, he also sees the value of embracing variations or new methods that are attuned to the positionality of the researcher and the varied, complex, and messy nature of reality. Drawing from ethnographic research performed

in laboratory settings, Law emphasizes how the entanglement of material and immaterial, human and non-human, is a critical component of reality that should guide methodological decision-making. Gullion also turns her attention to the role of matter and non-humans after her ethnographic work in subfield of environmental sociology. She links her interest on thinking differently about method directly to the issue of the climate crisis. For Gullion, methodological innovations are needed “To engage complex systems and entanglements in an ethical manner. To begin to address the crises of the Anthropocene.” (Gullion, 2018, p. 3). Methodologically, a turn to relational ontology generally implies replacing some of the metaphors that are traditional for social sciences. Instead of structures and agents, relational ontology leads researchers to think about the world as assemblages, facilitating the ‘flattening’ between varied and diverse components of life that avoids the anthropocentric hierarchies of standard social science research. Acknowledging the tradition of ethnographic research and embracing the innovations and variations that practical engagement and new theories about how the world operates have produced, I hope to enact ethnographic comportment while reflecting and respecting my own methodological intuition and intentionality in writing about my fieldwork and analysis.

3. Structure of the dissertation and its main components

This research contributes to environmental sociology discussions by extending the discipline's foundational concern with social construction into the realm of ontological politics. Sociology has been preoccupied with how social processes construct our understanding of reality. Ontological politics investigates how social processes construct reality itself. This theoretical move engages with new developments in environmental sociology and other disciplines that have demonstrated how 'nature' is socially constructed, and increasingly recognized that these constructions have profound material consequences. The concept of the Anthro-not-seen offers sociology a framework for analyzing how modern institutional arrangements constitute the worlds within which climate governance operates, shaping human-environment relations at the ontological level. By examining climate policy through this lens, the research shows how sociological insights about power, inequality, and institutional reproduction operate at the ontological level, how

certain ways of being-in-the-world are systematically foreclosed while others are reproduced through specific governance mechanisms.

The dissertation considers this main driving research question:

How agri-environmental governance categories shape what can be perceived and addressed in the context of climate change, and what they foreclose.

Each chapter engages a specific dimension of this question.

Chapter 1: Metrological Regimes and Epistemic Justice in U.S. Climate Agriculture

How are calculative practices and metrological regimes affecting farming and agri-environmental governance in the United States?

This chapter examines how metrological regimes in U.S. agricultural climate governance operate through formulas and standardized measurements to calculate nutrient losses and greenhouse gas emissions. In this account of agricultural practices and governance, metrological regimes stand as the constellation of formulas, technologies, and models that are used to guide action. While these regimes work under the idea and practices of augmenting precision and accountability in climate mitigation efforts, they risk excluding non-quantifiable knowledge forms like "soil health". Soil health turns into a relational concept that considers complex interactions between soil, plants, microorganisms, and farming practices. Through the lens of epistemic justice, the analysis shows how privileging calculable metrics creates limits to the deployment of new governance arrangements where farmers' experiential knowledge about soil is muted through policy frameworks. The chapter demonstrates how farmers, academics, and policymakers attempt to translate their relational understanding of soil into discrete, measurable units to gain policy recognition, a process that fundamentally alters and diminishes the alternative position that soil health mobilizes. This attempted translation in relation to the existence of historical and complex metrological regimes serves as an example of ontological politics, what de la Cadena calls the Anthro-not-seen, where governance systems rooted in nature/culture divisions conflict with forms of knowledge that emerge from being-with the natural world, not from calculating about it. The difficulty of synthesizing relational knowledge with metrological

demands creates systemic blind spots in climate governance, foreclosing alternatives that might otherwise reshape agri-environmental policy.

The chapter draws on 32 semi-structured interviews with farmers across South Dakota, Vermont, and Virginia conducted between 2022 and 2023 as part of an NSF-funded living laboratory project, one interview with a modeling expert, and documentary analysis of simulation tools and policy materials from Vermont's agri-environmental governance infrastructure. Table 1 summarizes the fieldwork details for this and the other empirical chapters.

Chapter 2: Correspondence Failure and Recreancy in Chile's Megadrought

How do farmers in Chile's Limarí Valley experience and articulate the effects of the megadrought, and how does governance respond to their situation?

This chapter analyzes how governance fails to correspond with the conditions farmers actually face during Chile's megadrought. The research draws on ethnographic interviews and observations with farmers in the Limarí Valley who describe a threshold crossing from constant adversity to ontological breakdown. Using a political ontology framework, the chapter shows that governance is present in the valley through extension programs and technical assistance, but these responses assume a reality of manageable drought requiring adaptation while farmers inhabit a reality where the assemblage that made farming possible has collapsed. This mismatch can be understood as a form of recreancy specific to slow-onset crises. Governance fails because of the inability of the state to correspond with actual conditions. The analysis shows how correspondence failure operates in two dimensions. First there is a categorical mismatch between governance frameworks and farmer experience. Secondly there is a distributional mismatch where the same responses correspond with some farmers and not others depending on their capital, water access, and market position. Only farmers with resources can extract value from partial correspondence, while others face both ontological breakdown and governance that does not fit their situation. The chapter extends recreancy theory to slow-onset climate crises and demonstrates the value of political ontology, a framework developed through Global South scholarship, for analyzing environmental governance failures.

The fieldwork consisted of two weeks of ethnographic engagement in the Limarí Valley during July 2024, and considered 15 semi-structured interviews with farmers and agricultural professionals, direct observation, attendance at an extension workshop, and informal conversations, all conducted in Spanish.

Chapter 3: Lessons for governance from practices of ontological refusal, care and correspondence in Farm Animal Sanctuaries

What can farm sanctuary practices reveal about the limits of agri-environmental governance in relation to animals?

Farm sanctuaries are among the few spaces where people develop the capacity to relate to farmed animals as individuals, learning their needs, personalities, and preferences through sustained physical proximity. This chapter draws on ethnographic fieldwork at one such site to examine how daily care practices cultivate empathy and what that cultivation shows about the limits of agri-environmental governance. It shows a contrast with traditional climate governance of animal agriculture, which operates through calculative frameworks that stabilize animals as hazards and resources, rendering them governable through metrics of emissions, efficiency, and risk. These frameworks foreclose the possibility of relating to animals as beings capable of response. Even frameworks explicitly designed to integrate human and animal health, such as One Health, remain instrumental, attending to animals primarily because their health affects human health. This stabilization is an ontological choice, one that closes off certain interventions before they can be imagined. Sanctuaries might work as sites of ontological refusal, where daily care practices enact animals differently, as individuals with histories, personalities, and needs, against the grain of their reduction to calculable units of production. Drawing on ethnographic fieldwork at a US farm sanctuary and participant observation at a regional One Health workshop, the chapter develops the concepts of correspondence and embodied empathy to analyze what sanctuary workers cultivate through care labor and what this cultivation reveals about the structural limits of current governance. The chapter argues that agri-environmental governance lacks the capacity for empathy, and that this lack constrains what governance can see and do. The

arrangements that exclude multispecies flourishing are contingent, and seeing them as political choices with ontological stakes is a precondition for contesting them.

Fieldwork spanned June through August 2025 and consisted of 10 volunteer shifts totaling approximately 50 hours of participant observation at a farm sanctuary in the northeastern United States, where I engaged in feeding, cleaning, and daily care labor alongside the sanctuary operator, complemented by observational attendance at a five-hour regional One Health workshop.

Together, the three chapters show how governance might support both climate mitigation and socially just alternatives to dominant agricultural logics. With qualitative-based fieldwork and data, and driven by an ethnographic intentionality, I show situated challenges produced by the expansion of agriculture in two different locations of the world and explore the meaning and possibilities of prefigurative climate politics that can provide alternatives to the hegemonic ways that agri-environmental governance is performed. In the concluding chapter, I provide a synthesis of the insights from the interviews and observations to propose a new conceptual framework that builds on political ontology insights. I coin the term ‘prismatic governance’ as an approach to agri-environmental governance in the Anthropocene that is oriented towards emphasizing empathy, correspondence, and respect toward ontological multiplicity to achieve more effective responses in the face of the climate crisis.

	Ch. 1: Metrological Regimes (U.S.)	Ch. 2: Megadrought (Chile)	Ch. 3: Farm Sanctuary (U.S.)
Time in field	Interviews Oct 2022–Oct 2023, across three states, as part of NSF-funded living laboratory project	Two weeks, July 2024, Limarí Valley, Coquimbo Region	June–August 2025; 10 shifts, ~50 hours on-site, plus one 5-hour workshop
Sample / roles	32 farmers (18 SD, 9 VT, 4 VA); 1 modeling expert	15 participants: owner-operators (small to large-scale), corporate farm manager, technical advisor, 2 former farmers	1 sanctuary operator; 66–67 animals; veterinarians and professionals at One Health workshop
Instruments	Semi-structured interviews; documentary analysis (simulation model manual, state policy documents, program materials)	Semi-structured interviews (in Spanish); direct observation; attendance at extension workshop; informal conversations	Participant observation through care labor; field notes; observational attendance at One Health workshop
Coding / analysis	Open coding; conventional content analysis across interviews and documents	Thematic analysis with open coding; iterative secondary coding	Iterative-inductive analysis; narrative organization; categories emerged through writing

Table 1: Summary of methods by chapter

4. Concepts Developed in This Dissertation

Correspondence describes the degree to which governance meets the situation as experienced by those it is supposed to serve. Correspondence fails when governance categories do not fit the conditions that affected communities inhabit, either because those categories assume a different reality (categorical mismatch) or because the same governance response lands differently across groups depending on their capital, access, and position (distributional mismatch). The concept draws on and extends Tim Ingold's work on attending and responding within the world, applied here to the institutional domain of agri-environmental governance.

Ontological breakdown refers to a threshold crossing where the assemblage that sustained a way of life collapses, and the situation cannot be understood as an intensification of existing adversity anymore. In this dissertation, the concept captures the experience of farmers in Chile's Limarí Valley whose farming configuration has been destroyed by the megadrought. Governance that treats breakdown as manageable difficulty fails to correspond with what is actually happening. The categories of adaptation and technical assistance presuppose a world that does not exist for those affected.

Prismatic governance is proposed as an orientation toward agri-environmental governance in the Anthropocene that accepts ontological multiplicity and works with it instead of reducing complex situations to single governance categories. The prism metaphor describes governance that refracts what appears as a single problem into its multiple dimensions and realities, making visible the spectrum of experiences, knowledges, and relations that current frameworks flatten. Prismatic governance is oriented by three capacities: reflexivity about governance tools and the realities they foreclose, attention to how governance responses land differently across

social fields, and the cultivation of relational practices that bring governance into contact with beings and knowledges it currently excludes.

II. Chapter 2

1. Introduction

Contemporary agriculture is increasingly organized around calculation, both in terms of how farming is practiced and how it is governed. At the farm level, technological trajectories such as Precision Agriculture and Digital Agriculture, which have seen significant adoption in recent decades (Lowenberg-DeBoer & Erickson, 2019), rely on sensor technologies, algorithmic recommendations, and computational models to guide farming decisions. These technologies look to support specific farming practices, such as variable-rate application of fertilizer instead of blanket application, through new models, valuations, and calculative possibilities. Recent upgrades in sensor technologies and artificial intelligence applications, such as machine learning, are greatly influencing how farming practices are enacted today (Linaza et al., 2021). At the policy level, agricultural governance increasingly depends on quantitative infrastructure to address environmental concerns, emissions inventories, biogeochemical models, and metrics for measuring sustainability outcomes. This shared dependence on calculative infrastructure, which includes the models, algorithms, and numerical parameters through which both farming and its governance now operate, makes agriculture a revealing case for studying how measurement shapes what can be acted on..

Agriculture plays a key role in climate policy and politics, both as a contributor to climate change and as a source of vulnerability (IPCC, 2022). Food production is responsible for one-third of the total anthropogenic greenhouse gas emissions emitted globally, and researchers have identified the constant application of synthetic fertilizer as one of the main culprits (Menegat et al., 2022). At the same time, Precision Agriculture technologies promise to address environmental concerns through more targeted interventions. The assumption that precision agriculture and environmental sustainability are intrinsically connected has become widespread, though recent

reviews suggest the empirical evidence supporting this connection remains more limited than often acknowledged (Ruder et al., 2026).

Academics and international organizations are concerned about the interactions between food security, which is connected to farming productivity, and the social and environmental sustainability of farming (Gardezi et al., 2022). There is a need to accommodate the growing demand for food while simultaneously limiting the impact of agricultural practices on the environment. Governments at local, national, and international levels are interested in promoting environmentally friendlier farming practices and hope that new precision agriculture technologies can contribute to sustainable agriculture. Implementing sustainable agriculture practices will depend on how much farmers are willing to modify their management practices, especially how they are currently using fertilizers to improve agronomic outcomes (e.g. yield) and ecosystem services (e.g. nutrient cycling).

Due to the increasing importance of synthetic fertilizers in contemporary food systems, restricting their use becomes a complex governance issue. Policymakers, crop advisors, and farmers are seeking to balance climate concerns and achieve food security goals, while promoting economic activities that support sustainable farming. Despite advances in mathematical formulas in plant and environmental sciences that purport to prescribe fertilizer use to maximize crop yield, farmers are unsure whether following these formulas and applying nitrogen to only nutrient-deficient parts of the field will necessarily increase overall crop yield. In the U.S., many crops are harvested once a year, and risking lower yields becomes a situation that farmers are unwilling to endure. When regulatory attempts to limit agricultural carbon emissions have been attempted, such as in the case of the Netherlands and their proposals to reduce national herd size due to its climate impact, farmers and producers have responded by protesting these kinds of interventions, including public manifestations of discontent and tractor blockades (van der Ploeg, 2020). The case of the Netherlands, and many other contemporary climate-oriented regulations in Europe, show the contested nature of promoting sustainable agricultural practices that align with how farmers perceive and enact how farming should be done.

The interaction between technology, policy, and farmers' expectations and values will shape the possibilities of adjusting how agriculture is enacted in the face of increasing global emissions. This chapter examines metrological regimes in U.S. agricultural nutrient governance, attending particularly to how these regimes are constituted through diverse institutional alignments and what possibilities they foreclose. Drawing on political ontology scholarship (de la Cadena, 2019), I show how metrological regimes produce systematic exclusions. My main argument is that new data-based technologies and environmental governance in agriculture rest on and reinforce existing metrological regimes, the context-specific networks that mobilize institutional actors and farm-level practices into stable calculative arrangements. Across the settings studied here, these regimes share a structural pattern, in which farmers, formulas, advisors, universities, and markets are assembled into the calculative practices that make farming governable. They also vary in their specific configurations. Vermont's Payment for Phosphorus Program offers a particularly visible case in which the full institutional elaboration of a metrological regime, with its regulatory mandate, modeling infrastructure, and enforcement capacity, can be examined in detail. These regimes have a dual function. They produce agricultural reality, making certain forms of farming real and governable, and they foreclose alternatives that fall outside their calculative reach, such as soil biodiversity as a governable ecological process.

The previous argument does not mean that all calculative infrastructure is equally problematic, but that understanding which configurations close off which realities might enable asking how governance infrastructure could be reconfigured to identify and reduce these exclusions. Attending to regime heterogeneity fosters political ontology analysis of governance transformation. If regimes are heterogeneously constituted, they are potentially reconfigurable, and we can specify which institutional configurations would need to shift to expand what can be governed.

Empirically, I ground this argument in interactions with farmers, their decision-making practices, and the policies aimed at regulating them, to interrogate the calculative support that shapes contemporary farming assemblages. I use data collected in the process of setting up a living laboratory for the development of sustainable technologies in agriculture in the U.S. states of Vermont, Virginia, and South Dakota. These cases reveal regime variation and its consequences,

and the analysis focuses particularly on the limits encountered when Vermont attempted to incorporate soil biodiversity into payment programs.

Researchers have studied the politics of measurements around carbon emissions and carbon markets (Blok, 2011; Bryant, 2016; Ehrenstein, 2018; Lohmann, 2005; D. MacKenzie, 2009) and sociological scholarship has shown increasing preoccupation with issues of measurement and calculation more broadly (Adkins & Lury, 2011; Çalışkan & Callon, 2009; Callon, 2021; Miller, 2004). Farming practices and their calculative underpinnings, however, have received comparatively limited attention from a metrological perspective, which creates a gap that this analysis addresses. Under this context, I explore how institutions and farmers come together with calculative and physical technologies to stabilize a particular way of enacting environmentally conscious agriculture.

2. Metrological regimes in the context of farming assemblages

2.1 Governing and doing farming in a world of data

Contemporary agriculture is shaped by the proliferation of data-based technologies at the farm level and the expansion of governance frameworks aimed at regulating farming's environmental impacts. Recent scholarly literature focused on the relations between technology and agriculture has engaged productively with the uncertain consequences that data-based systems, machine learning algorithms, and data-intensive tools could have on farmers and the food system more generally. Researchers have analyzed the potential effects of big data on the relations between technology developers, large farmers, and small farms and its consequences for just and balanced food systems (Bronson, 2022; Duncan et al., 2022). The effects of new technologies on farmers' identities, knowledge, and practices have also drawn the attention of social scientists who are interested in the potential impacts of rapid technological acceleration (Gardezi & Stock, 2021; Klerkx et al., 2019; Stock & Gardezi, 2021). Social scientists have provided insights from academic spaces like Science and Technology Studies (Gugganig et al., 2023), Sociology (Carolan, 2017), and Innovation Studies (Hebinck et al., 2021) to increase our knowledge of how farms and farmers manage the increased complexity and uncertainty of their operations.

In a comprehensive review of social science literature on digital agriculture, Klerkx et al. (2019) identify five thematic clusters that organize social science engagement with these technologies, which range from questions of adoption and adaptation to concerns about power, ethics, and the transformation of agricultural knowledge systems. This work shows constant engagement with the social and institutional dimensions of agricultural digitalization. However, the calculative and metrological dimensions that cut across these clusters, connecting questions of adoption with governance and linking farmer decision-making with policy frameworks, have received comparatively less attention.

Contemporary publications related to the integration of new data-based technologies into agricultural practices in the U.S. have described some of the new interactions they create when involved in farming assemblages. Carolan (2022) describes the interactions of data collection, usage, and governance in agriculture, reflecting on the connections, or chains, that make data-based farming assemblages a relatively stable configuration. Carolan's description provides continuity with description-based work of agri-environmental governance as an assemblage (Forney et al., 2018) but underplays the role of measurements and calculations in the assemblage's constitutive entities. To bridge the technology-human divide, Velden and colleagues (2024) use the metaphor of the Cyborg-farmer to provide a more integrative approach to the assemblage consideration, referring to the embodiment of practices and technologies as the main demonstration of an assemblage's particular configuration. Velden et al. work describes the interactions between embodied knowledges and technologies in farming settings without providing details about the ways these integrations happen in decision-making situations, which necessarily involve the usage of calculative methods, technologies, and practices.

While this scholarship illuminates how technologies reshape farming practices at the farm level, a parallel body of work examines how governance frameworks attempt to regulate these practices toward environmental ends. Approaches to governance that follow Foucauldian notions of governmentality have contributed with detailed descriptions of how policies and metrics work to regulate and control individuals and nature. By understanding regulations as political technologies, researchers have provided a new avenue to follow how governance is deployed in practice (Tironi & Barandiarán, 2014), one that investigates governance instruments as applied

knowledge that shapes what counts as a legitimate problem, a credible expert, and a permissible solution. Current conceptions of agri-environmental governance in agricultural settings describe the concept of governance as polysemic and contested in nature, providing varied sets of possible materialization like Payment for Ecosystem Schemes (PES), governmental and activist-based normative positions, and farm-level decision-making support systems (Forney et al., 2018). Miller (2004) gives special attention to calculative practices and management accounting as technologies of governance. Defining what counts, its value and the scientific legitimacy of the evidence used to develop norms and standards are critical components of how technologies of governance are created and deployed. Calculative technologies of governance act at an institutional level through policies and programs and at the micro level through management accounting practices. Other scholars have analyzed the effects of new data-based technologies on government-related environmental governance, and how new measures, calculations, and algorithms shape modern efforts to regulate agriculture and farm management practices (Ghosh, 2023; Loconto et al., 2024; Loconto & Rajão, 2020; van der Velden et al., 2025; Wolf & Ghosh, 2020).

In the case of institutional governance of farming, market-based programs have emerged as one of the dominant strategies to support governmental intervention in policy arenas since the 80s, based on the idea that nature provides a service when it supports human activities in some way, and this service can be valued (Maechler & Boisvert, 2024). Countries and international organizations have extended this conceptual apparatus into policies that aim to incentivize the protection of those services by people close to them and that act as technologies of governance. Policy mechanisms such as PES seek to correct the problem of externalities from human use of natural capital by internalizing these values into markets (Redford & Adams, 2009). PES seeks to create incentives for farm managers whereby beneficiaries can compensate farm managers to maintain the services that bring them utility. PES schemes are deployed with the hope that they can encourage sustainable actions by rewarding efficient use of resources (Rodríguez-Ortega et al., 2018). PES programs are not alone as Agri-governance calculative technologies, but their constitution makes them an ideal site for analysis of calculative practices at the institutional and farm-management levels.

From the perspective advanced in this chapter, academic efforts to understand the effects of new and emerging data-based technologies in agriculture will benefit from an integrative approach that is capable of merging both farm-level and government-level practices as they are shaped and co-constituted by calculations and metrology within a multi-level environmental governance regime. Metrology is the science of measurement, and on the farm, relates to ways in which farmers' management practices interact with the new technological and policy imperatives of contemporary agriculture. Caring about calculations and measurements from a relational perspective requires the integration of literature that can treat symmetrically the constitution of knowledge, the material technologies involved in the process, and the technologies of governance that are attempting to manage them. I acknowledge and extend research that recognizes the contingent and situated arrangements of practices and governance as assemblages that include humans, more-than-humans, and the knowledges and technologies that affect their action (Ortiz-Przychodzka et al., 2023). In the next section, I describe the main components of a theory of calculative action in farming assemblages. I argue that metrological regimes are an underrepresented aspect of the contingent formation of data-based farming assemblages. I propose a conception of metrological regimes that takes a symmetrical approach to action and structure.

2.2 Calculative agencies and metrological regimes in farming

Critical and reflexive approaches to the construction of measurements are deeply connected with environmental governance. The concept of critical metrology, as developed by Cooper (Cooper, 2015), has influenced a set of academic literature concerned with the effect of varied types of calculations and measurements relevant to environmental governance. Most of these efforts have focused on the constitution of metrics related to carbon markets and their effects, from technology-mediated measurement of carbon in forests (Stanley, 2024), to atmospheric CO2 removal modeling (Wilson, 2024), and the performative effect of global warming metrics (Cusworth et al., 2023), among others. Cooper (2015) developed the concept of critical metrology as a specific theoretical lens for the analysis of environmental governance by building upon the

work of sociology and science and technology studies scholars, who were concerned about the effects of measurement practices in scientific fields (Latour, 1987; Shapin, 1995) and the economy (Callon, 1998b). Cooper also builds on the work of Barry and his concept of metrological regimes, defined as “a zone in which measurement has come to take relatively standardized forms.” (Barry, 2002, p. 281), to show the political dimensions of how carbon emissions are measured and how carbon markets are constructed.

Acting in contemporary settings that require market-based or management-oriented interactions calls for the coordination of human and non-human actors, the networks of objects, models, and nature. In this context, agents act through calculative practices and networks that are shaped by theories, formulas, and other types of scientific knowledge. Formulas are performative, they shape and facilitate action based on their constitution and description of the world. Through the theory of economic knowledge as performative, Michel Callon (1998b, 1998a, 2007, 2021), Donald Mackenzie (D. MacKenzie, 2017, 2022; D. MacKenzie & Millo, 2003), and other scholars from the field of cultural economics and science and technology studies (Amin & Thrift, 2004) have provided new insights into how economic agencies are constructed, and what are the required arrangements that make action possible. Probably one of the most representative examples of how models interact with economic activities is the body of work describing the way the Black-Scholes formula has participated, in a performative way, in the creation of financial markets it was supposed to represent in theory (D. MacKenzie & Millo, 2003). Scholars in this tradition argue that the rational economic human that many economic theories take for granted is not an illusion. Homo economicus is constructed and shaped by theories and calculative devices that help people act rationally and with consideration of market structures.

Many of the initial critiques of the performativity of economic knowledge were aimed at the lack of consideration for the real-world politics of action. In the field of agri-environmental governance, scholars have taken special care of not missing the political component of performativity. Wolf and Gosh (2020) describe the process of enlisting corn productions’ nitrous oxide emissions into carbon accounting and the varied technopolitical compromises required in the creation of measurement protocols that have limited performative or prescriptive possibilities. Cusworth and colleagues (2023) have analyzed the performative nature of global

warming metrics in relation to the political nature of its stabilization, and how by itself the performative act becomes a site of political contestation. Stanley (2024) has explored the interactions between new technologies and calculative practices of carbon, noticing that their performative role is intentionally and politically shaped to increase the final number of potential carbon sequestration. Building on this body of work, this analysis identifies calculations in farming practice aimed at facilitating the rational and scientific management of the farm as a business, situated within normative and political orientations. Systematic control of inputs and outputs provides the foundation for a profitable operation, but an increasingly complex system of calculation and measurement is required for modern-day farmers to act as managers and as business owners.

Critical metrological analysis has demonstrated how standardized measurement flattens environmental complexity in the service of governance and markets. Cooper's (2015) work on carbon offsetting shows how commensuration necessarily simplifies heterogeneous emission sources, temporal dynamics, and geographic contexts. Similar dynamics appear across environmental governance, where biodiversity indicators (Turnhout et al., 2014), ecosystem service valuations (Robertson, 2012), and pollution metrics (Lansing, 2012) all achieve governability through standardization that eliminates complexity. Attention to the effects of standardization opens the possibility of examining how metrological regimes are constituted in the first place. Barry (2002) defines regimes as 'zones in which measurement has come to take relatively standardized forms,' but this definition leaves open the processes through which standardization occurs, the actors involved, the purposes served, and the alignments that stabilize particular configurations. While standardization has proven to be a defining feature of metrological analysis, the heterogeneity also present in these regimes has received less attention.

2.3. Political Ontology and Governance Foreclosure

Political ontology scholarship examines how governance practices constitute what counts as real, attending to how organized practices enact particular realities while producing foreclosure of others (Blaser, 2009, 2024; Mol, 1999). In environmental governance, this means examining which realities correspond with policy instruments, regulatory frameworks, and institutional

capacities, becoming governable, and which remain structurally ungovernable despite their material existence and importance. Mol's (2002) work on ontological politics shows how medical practices enact different versions of disease through different diagnostic and treatment arrangements. Her concept of enactment is critical because it emphasizes that ontologies are performed through specific material-semiotic practices. Institutional arrangements, in this view, do ontological work, enacting certain realities as governable while other possible realities remain unenacted and structurally outside governance capacity. Law (2004) extends this insight toward questions of method and infrastructure, arguing that the models, metrics, and calculative devices through which governance operates are constitutive. They participate in making certain realities more real and others less so.

Mario Blaser's (2009, 2013) political ontology framework extends this analysis by examining conflicts between different ontological projects, particularly where modernist ontologies (assuming one nature, multiple cultures) encounter ontologies grounded in other premises (multiple natures, relational worlds). In this framing, ontological conflicts are intrinsically connected to political conflicts, involving which worlds get to exist and which relations and entities can participate in what governance calls nature or environment. De la Cadena's (2015) ethnography of Andean communities develops the concept of *anthropo-not-seen*, defines as entities and practices that exceed modern nature/culture divisions, remaining unseeable within frameworks that assume a singular ontological perspective. De la Cadena argues that these entities and ways of life exist, participate in territorial relations, and matter profoundly to those who correspond with them. Her position is that there is a structural foreclosure where dominant institutional arrangements cannot engage with earth beings as the kinds of entities they are, explained in part because infrastructure does not exist to govern through such engagement.

Recent scholarship has applied these frameworks to environmental and agricultural governance. Walker DePuy and colleagues (2022) examine the ontological underpinnings of land, water, and biodiversity governance, showing how modernist assumptions embedded in policy instruments actively shape the world by making certain aspects and relationships visible while rendering others invisible. Hokkanen (2024) develops the concept of soil extractivism to describe how industrial agricultural governance in the European Union enacts non-relational understandings of

soil, treating it as inert substrate instead of living community and thereby erasing multispecies relations from governance capacity. In a similar vein, Rickard and Ludwig (2025) demonstrate how participatory water governance in Brazil systematically enacts certain river ontologies through its classification instruments while foreclosing Indigenous and community-based relations to water. These analyses suggest that exclusion operates through the absence of infrastructure that would make alternative engagements possible.

Using the case of agriculture in the U.S., in the remaining sections of the chapter, I will explore the constitution of metrology regimes aimed at the promotion of agri-environmental governance. The constitution of metrology regimes (Cooper, 2015) refers to the organization of a specific set of relations that are mutually shaped by how humans and more-than-humans are measured and the practices or performances involved in its (re) enactment. My contribution is to demonstrate that regime heterogeneity plays a critical role in ontological politics. If different configurations afford different possibilities, regime design becomes a political question about which realities governance could correspond with. In the discussion section, I use this framework to analyze the constitution of calculative practices and technologies of governance in U.S. agricultural nutrient management, attending particularly to how current configurations make certain realities, such as soil biodiversity, structurally ungovernable despite their recognized importance for sustainable agriculture.

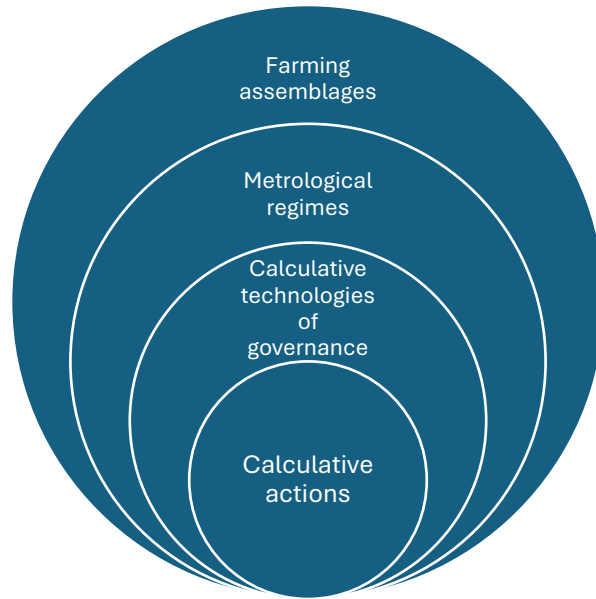


Figure 1. Heterogenous constitution of metrological regimes in farming assemblages. Source: Created by the Author

3. Method

3.1 Project Overview and study sites

The data used and analyzed for the purposes of this chapter was collected for a US National Science Foundation (NSF) funded project. The project uses a living laboratory approach to develop and test decision support tools that could help farmers make more sustainable choices in their farm management practices. Prior to recruiting the living lab participants and data collection activities, internal review board (IRB) approval (IRB-2103006-EXP) was secured. The data collection process is a part of the continued setup of the living laboratories, which involved regular meetings of an interdisciplinary research team of computer scientists, agricultural researchers, extensionists, and social scientists. Methods include collection of data through observant participation while recruiting farmers to the project, while visiting their farms and interacting with their fields, and by participating in technology-development meetings of innovative decision-support tools.

Me and other colleagues who are part of the project, conducted a set of semi-structured interviews with farmers during 2022 and 2023. During this time, the team conducted 32 Interviews with farmers from Vermont, Virginia, and South Dakota. The productive profile of these states allowed us to generate information from diverse sets of farming contexts. According to the information from the 2017 Agricultural Census (USDA, 2022a) Farms in South Dakota are 1,443 acres on average, significantly larger than the average farm sizes in Virginia (180 acres) and Vermont (175 acres). The main non-animal agricultural products also vary among the states. South Dakota focuses on row crops, primarily corn and soybeans. Virginia also produces soybeans along with a broader mix of vegetables and fruit. Vermont's non-animal production centers on apples and maple products, which are harvested from sugarbushes rather than cultivated in the annual-crop sense. This range across states captures variation not only in scale but in the kind of cultivation practice and the temporal rhythm of production. The percentage of farmland in total land area differs substantially across the three states. In South Dakota, 89% of the total land area is dedicated to farming, while Virginia and Vermont have lower percentages at 31% and 20%, respectively.

The South Dakota farmers interviewed owned mostly large farms on average and grew mostly corn and soy. In Vermont, a state characterized by its many dairy operations, farmers had smaller operations. In Virginia, farmers planted a diverse array of crops, like vegetables and corn.

3.2 Data collection (tools and approach)

The interview protocol was directed at gathering farmer's accounts of their decision-making processes when managing fertilizer usage on their farms. Farmers were selected through their voluntary involvement in an experimental program aimed at developing new and appropriate decision-support tools for farm management purposes. The program involved payment for the participants' time, formalized through contracts that included their availability for data-collection purposes. The interviewees had decision-making power and were generally the owners of the farm or direct family members. Finally, I conducted one semi-structured interview with a modeler working at the intersection of environmental policymaking and farming practices in Vermont. The modeler is a researcher and consultant who develops and adapts computational simulation tools

(in this case, the physics-based APEX model discussed in later sections) for use in agri-environmental policy and farm-level decision support. The interviews were transcribed by the research team using a standardized protocol, which included an internal meeting to decide on a common structure that facilitated understanding of the final product.

In terms of secondary data, I analyzed publicly available documentation of a physics-based simulation model (Steglich et al., 2023) and reviewed policy documents of agri-environmental governance from the state of Vermont. Vermont was selected as the case study for agri-environmental governance due to its support of payment-based schemes that require baseline calculations, measurements, and simulations of farming operations. In this sense, the state of Vermont provides a particular set of governance technologies that allowed us to explore the interaction between farm-level action and government-level calculative technologies of governance. The data collection approach and the different types of information used are summarized in table 2.

Type	Details	Information
Interviews	18 Interviews with South Dakota Farmers	Interviews conducted between February and March 2023, in person
	9 Interviews with Vermont Farmers	Interviews conducted between October and December 2022, in person
	4 Interviews with Virginia Farmers	Interviews conducted during June 2023, in person
	1 Interview with modelling expert	Interview conducted in October 2023, via Zoom
Documents	APEX User’s Manual Version 1501	User's manual that details the formulas used in a specific agricultural modeling tool (Steglich et al., 2023)

Payment for ecosystem services and soil health working group Final report	Public documentation published by the state of Vermont in 2023 (Vermont Agency of Agriculture, Food and Markets, 2023)
Vermont Pay For Phosphorus Program Communication material	Public documentation published by the state of Vermont in 2023

Table 2. Summary of types of data and collection method

3.3 Analytical Approach

I analyzed the interviews using an open-coding approach (Stemler, 2001) aimed at identifying recurrent themes relevant to this research that emerged while reflexively reading them. These themes were then grouped into analytical categories represented in the discussion section of this chapter. The thematic coding and the experiences in the Vermont living lab were the main drivers for the selection of the documents I reviewed. The documents were used as informational sources, providing details about the inner workings of the models and the goals of policies, and as artifacts or materials used in the governance of agriculture.

I used a conventional content analysis approach (Hsieh & Shannon, 2005) to organize and interpret the information from the interviews and the documentation, orienting my interest in data related to decision-making processes and the calculations and formulas involved in the process. The analysis of the documents was also guided by the initial results of the thematic coding, engaging in conversations between official documentation that supports calculation practices and the information provided by the farmers. Finally, insights from academic literature were used to interpret the results in consideration of the main objectives of this research.

4. Results

The three contexts examined demonstrate constitutive heterogeneity in agricultural metrological regimes. All involve nitrogen calculations, university extension services, and farmer decision-

making, yet they differ in terms of regulatory intensity. They also diverge in their institutional alignments, the configurations where state requirements, farmer needs, and university capacity either coincide or remain in tension. This variation derives from how regimes are built, who participates in their construction, what motivations align across institutional boundaries, and what infrastructures support particular forms of calculation. Understanding this heterogeneity plays a critical role in diagnosing where and how certain realities are closed off.

4.1 The basic calculations

The interviews show that formulas, mathematics, and calculations are important for farmers. These calculations are the backbone of their decision-making process and a guideline for the performance of their practices. Farmers from Vermont and South Dakota identify the supporting role of formulas to the way they manage their farms.

“Picking the right equation for the right field, because there's a list of equation-based stuff that you can pull but is it relative to Vermont? On my field, on my farm.” Farmer #6, Vermont

“Then, with the nitrogen, we do a lot of math. We'll do the math based on what a corn plant will require in order to produce a bushel, but then, we will start backing out what kind of credits we have, either from our soil samples or split application or things along that line” Farmer #9, South Dakota

Formulas matter beyond theoretical considerations. They are incorporated in everyday practices and recognized at a discursive level. The awareness of formulas in daily life grounds the study of calculative practices in agriculture in lived experience, supporting the construction of metrological regimes that draw on this ability to measure and manage through numbers.

A foundational part of rational input management in contemporary farms involves deciding and using an adequate amount of fertilizer. Nitrogen is a critical component of many management decisions and farmers rely on the formula of the nitrogen response curve to guide their choices. Figure 2 shows the details of the formula used to identify the optimal amount of fertilizer usage

that will provide the maximum yield of whichever crop is being modeled. The usage of the response curve aligns with the usage of synthetic fertilizer in farming operations, which in conjunction facilitates the rational management of inputs.

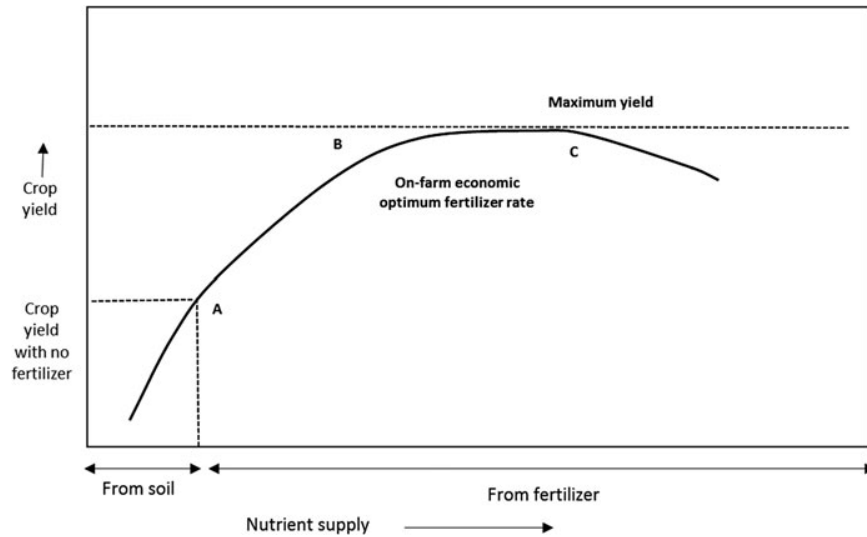


Figure 2. The Nitrogen response curve. Source (Noor et al., 2020)

Results from the interviews with farmers identified the curve as one of the components involved in their calculation processes:

“With those two nutrients specifically [Nitrogen and Potassium], it’s either if you have enough, you can achieve good yields, but adding a little bit more, you don’t necessarily see a yield response where nitrogen, you can create a pretty nice curve” Farmer #9, South Dakota

The creation and stabilization (Akrich, 1992) of this form of calculation is built upon the relations between farmers and universities. Universities train agronomy students and diffuse this technology of calculation, while at the same time publishing university guidelines that help with updating and maintaining its relevance. University guidelines contain updated information about input calculations. They are published online and diffused via agricultural extension offices. They

provide a stable source of recommendations that farmers can use to manage their inputs. As a Vermont farmer puts it:

“we're looking at existing soil type, how we apply crops, how much fertilizer nutrients we use and then using that yield data to work on next year. Pretty simple, actually. Then university-based recommendations of what we'd actually put down” Farmer #6, Vermont

These university-farmer relations constitute a stable alignment, one in which farmers need management tools to reduce uncertainty and optimize inputs, universities provide standardized knowledge in the form of formulas and recommendations, and this mutual utility reinforces the regime. The result is path dependency. Research funding flows to calculable problems, extension efforts foster calculative techniques, and farmer expertise develops within these frameworks. Against this backdrop, alternatives that might serve other purposes, or that do not satisfy both parties, become systematically harder to develop. Unlike Nitrogen, Potassium’s effect on soil health and crop yield is not modeled as easily. The characteristics of the fertilizer require a different configuration of the metrological regime that will be discussed in further sections.

In a more technologically advanced context certain farmers rely on precision technologies that are aimed at the creation and collection of precise data points on their farm, in the form of grids or zones, that provide new calculative possibilities for the management of inputs like fertilizers and pesticides. The combination of information from soil sampling, historical yield data, remote-sensed satellite imagery, and equipment-integrated sensors gives farmers and their crop advisors a virtual representation of the past, present, and future conditions of their fields. Crop advisors function as intermediaries who translate soil test results, yield maps, and model outputs into specific fertilizer and input prescriptions. These probabilistic conditions can then be used to adjust farm management practices, such as side-dressing nitrogen fertilizer to achieve specific and measurable agronomic goals. This is how a South Dakota farmer explains it:

“I mean if we have good soil tests we know what area of the field needs what. With the multibin dry fertilizer spreader we can, you're splitting up the P and the K and some others, and that's the bigger deal.” Farmer #13, South Dakota

Although it may seem that farmers participating in the living lab exhibit a high degree of trust and rely solely on formulas and model outcomes for their management decisions, overflow still happens. As in other socio-technological contexts, the complexities of managing highly uncertain biogeochemical and market conditions require continuous adjustments and experimentation by farmers, who often deviate from established formulas and model predictions. Resource availability, data uncertainty, and trust affect the implementation of formula-based nutrient management. Experience and knowledge of the land where farmers operate every year are integrated into these adjustments, providing modifications to model outcomes based on what they judge necessary for their own goals.

“sometimes we would make some small changes say, look, that's that may be what it either you got to tweak the formula or create a different zone or let's just manually change it” Farmer #18, Virginia

Some farmers calculated fertilizer rates themselves instead of seeking consultation from a professional crop advisor. These farmers were able to deal with the uncertainty of agricultural management by having a more direct approach to the interactions between data-driven calculations and recommendations made by models and software.

“We run into years where we have under five in nitrogen. If we had put on another 10 pounds that would cost \$70 an acre, we could have netted \$20 an acre. Then, there's years where we hit it right, and I guess that's the risk I have chosen to take by creating my own prescription maps.

Maybe a co-op or a consultant don't get that aggressive. We are going to calculate that maximum economic return, and we are going to add another 20 lbs.” Farmer #9, South Dakota

Formulas and technologies are assembled with farmers and nature to make their operations controllable and manageable.

Calculative technologies of governance

Calculation tools are relational and encompass universities, technology companies, consultants, and governance technologies wielded by the state. The Nutrient Management Plan (NMP) is an organizational instrument aimed at the calculation and management of the nutrient balance,

deficit, or surplus using farm-level data, typically derived from soil, water, manure, and plant testing (Beegle et al., 2000). Nutrient Management Plans are a farm-level management technology that has been framed by the U.S. government as critical part of the promotion of 'Climate-Smart Agriculture' (USDA, 2022b). To comply with the NMP, farmers in some U.S. states are required to report yearly information with regards to the nutrient balance of their farms, such as the type, source, and amount of fertilizer used and the weather and soil conditions at the time of application. In the case of the state of Vermont, these NMPs are part of the regulatory apparatus that provides oversight to certified small farm operations, medium farm operations, and large farm operations to limit water pollution from fertilizer runoff.

The scientific management of nutrients, via models and calculations, is what enforces and validates the NMP. The importance of the NMP is highlighted by a farmer in Vermont in this quote:

“By state law, we have to have a nutrient management plan for certain size farms. And I've done that and I find that having a good record of what we're doing in a year's time over the years makes a difference. Knowing that I meet the water quality standards, I meet my nutritional requirements and all of that's changing.” Farmer #5, Vermont

NMPs provide organized information that helps with decision-making and compels the farmer to interact with an expert advisor and to document their practices to comply with environmental regulations. NMPs are also a complex set of data and spreadsheets that have the potential to be too complicated to help with actual on-farm decisions.

In conjunction with mandated reporting through the NMP, the state of Vermont and diverse stakeholders have promoted the use of a Payment for Ecosystem Services (PES) scheme to nudge and incentivize farmers into more sustainable management practices. The PES program, called Payment for Phosphorus Program (PPP) rests on the ability of an adjusted model to provide accurate data regarding nutrient runoff from farming operations. The PPP scheme models the potential reduction of phosphorus loss by the implementation of specific management practices and provides payments based on the calculations of the model. The program is described as an alternative approach to environmental governance, moving away from practice-based incentives into schemes that care about measurable reductions in fertilizer application and runoff.

The PPP scheme rests on the Farm Phosphorus Reduction Planner (FarmPREP), which constitutes a comprehensive modeling framework designed to quantify and mitigate phosphorus losses from agricultural fields. The model integrates agronomic parameters which includes field boundaries, soil test data, crop rotations, tillage practices, as well as manure and fertilizer application rates, alongside conservation measures, facilitating the creation of a baseline P loss metric (Vermont Agency of Agriculture, Food & Markets, n.d.). Figure 3 reproduces one of the case studies used by the state of Vermont in their official communications of the program.

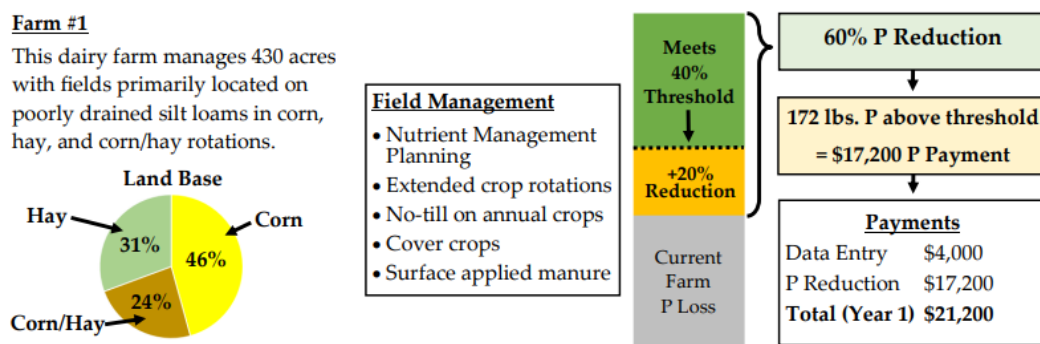


Figure 3. Case study of Vermont's PES scheme. (Vermont Agency of Agriculture, Food & Markets, n.d.)

Vermont's specific regulatory configuration illustrates how institutional alignments shape metrological regimes in ways that foster particular forms of environmental governance. The Lake Champlain Basin faces eutrophication from agricultural phosphorus, which led EPA to establish Total Maximum Daily Load targets under the Clean Water Act. When Vermont's initial 2002 TMDL was challenged in court for lacking adequate scientific background (Osherenko, 2014), the state responded by developing more sophisticated modeling infrastructure derived from APEX-based FarmPREP. This arrangement created what might be called dual utility, a configuration in which the same calculative infrastructure serves both farmer management needs and state regulatory legitimacy, with each reinforcing the other's investment in the regime. The Payment for Phosphorus Program emerged within this alignment, serving both compliance demonstration and farm optimization, reinforcing the regime's stability and defines a specific governance structure with specific limits of participation and inclusion (Carcamo et al., 2025). This configuration gives

phosphorus governance a particular infrastructural intensity, one intrinsically connected to regulatory mandate, modeling capacity, and payment mechanisms, that other environmental concerns lack.

In Vermont, a critical component of the PPP is the FarmPREP that helps to integrate the required data and generates the base line of the program. FarmPREP is based on the Agricultural Policy/Environmental eXtender (APEX) Model. The APEX model uses a range of variables for agricultural and environmental management at the farm-scale. These include methods for managing water such as irrigation and drainage, landscape alterations buffer strips, nutrient management through fertilization and manure handling, and agricultural practices that consider crop rotation and tillage (Steglich et al., 2023). As a physics-based model, APEX is constructed following particular formulations that are expected to predict the behavior of farming components based on specific algorithms and relations. Apex contains a series of equations that represent real-world physical dynamics between plants, soil, and nutrients and is built on a knowledge basis from previously published models from the 80s, such as the Environmental Policy Integrated Climate (EPIC) model and the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model. Discussing the historical roots of the modeling tools used to analyze and manage agriculture in the U.S. goes beyond the scope of this chapter, but it is a systematic knowledge base that has been legitimized by scientific and institutional means. The APEX is part of the technological components of the living lab project, aimed at testing its relevance as a decision-support tool in varied conditions of data availability and farm sizes. The role of the model in both calculative practices in governance and farm-level practices makes it an interesting artifact to consider in relation to the constitution of contemporary and future metrological regimes.

FarmPREP constitutes the main calculative device behind the PPP. A modeler that works regularly with the system described the work behind the adjustments, simulations, and scenario development of the software.

“We've developed through another project an optimization algorithm for Farm Prep so that you can say, OK well, I want to reduce my phosphorus loss by 30% and the model will spin off

thousands of simulations and come back with like your top 10 best options for reducing your phosphorus.” (Modelling consultant)

The model is not adjusted to the farming context of Vermont only by modelers and consultants. For it to be successful, the model needs the concerted effort of consultancy companies, researchers, extensionists, and the state of Vermont to function as a practical management technology.

“we developed farm Prep so that essentially we can walk users through a user interface through easily setting up an apex model specific to their farm fields. So we worked with crop consultants and farmers to establish, you know, a bunch of common practices involved in Vermont.”

(Modelling consultant)

The validation of practices is critical for the implementation of the payment system. People from the agency of agriculture go to the fields and check in situ that the practices being reported by the farmers are real. The interaction between verification and data creation is essential for the model to be seen as proving legitimate calculative actions by the state government.

“the agency of Ag they do have some field staff. They go out and they say, OK, well, you said you have a buffer on this field. Yes. OK. You have a buffer on that field that's verified. And the agency of Ag. reviews all those results and stuff too, as well as the inputs to make sure that they're reasonable and that kind of thing. And then, yeah, based at the end of the year on farmers reductions from the baseline, they essentially get a payout.” (Modelling consultant)

A technology of governance, such as the PPP, provides the required stabilization for models to perform their goals. By visiting farmers, implementing payments based on practices, and adjusting the model to the biophysical characteristics of agricultural production in Vermont, the necessary work required for the model to work in practice is met. At the same time, the basic calculative structure of modern agriculture and the formulas and calculations that support on-farm decision-making also needs to be in place for models to perform.

Nevertheless, APEX by itself does not provide a calculative environment that facilitates action. APEX is built on knowledge that escapes the average farmer's comprehension, and even experts and scientists fail to run the model in appropriate ways. For example, researchers have faced problems when running the model based on site-specific sets of data, finding that the functions that model crop growth behave in counterintuitive ways (Mason et al., 2021; Nelson et al., 2018). The cases show a shared pattern in how metrological regimes are organized. Governance-level and farm-level calculative practices work as two connected halves of the same regime, linked through the performative use of shared technologies. Figure 4 shows this pattern and places the specific technologies and policy instruments from the three cases within it.

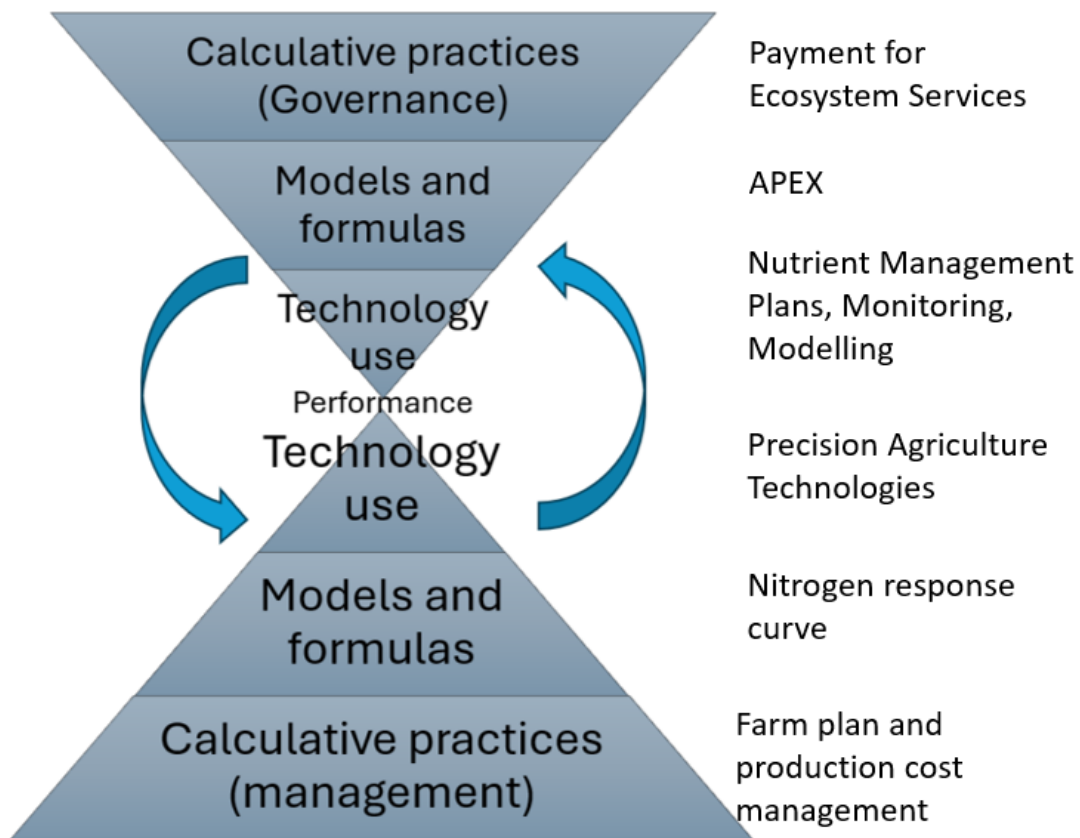


Figure 4. The structure of a metrological regime in agricultural governance. Own elaboration.

4.2 When current arrangements meet realities they cannot govern

The metrological regime that nudges and incentivizes farmers to become better environmental stewards, built through the alignment of farmer management needs with university knowledge production and regulatory and market structures, encounters realities it cannot govern. The interviews and observations, together with policy documents, show possibilities for new calculative practices and governance arrangements while also illuminating why such alternatives remain difficult to assemble.

One of the main threads of unmet expectations of calculations has to do with soil health, which reveals encounters with what current configurations cannot accommodate. Farmers are interested in gathering new information about the soil condition of their farms to inform their own management practices, yet their questions often exceed what quantification within current regimes can provide.

“Right now my biggest agronomic question is the quantification of what's going on in the soil. What's really there? What I'm doing? What is it doing? What are the microbes doing? What's happening? Somebody test and tell me how we can quantify what's going on with soil.” Farmer

#14, South Dakota

In the previous quote, the farmer asks for quantification, yet the questions themselves suggest an interest in relational processes that current metrological regimes struggle to render calculable. The regime corresponds with soil-as-nutrient-substrate, defined here as N-P-K ratios, pH levels, and organic matter percentages. It does not correspond with soil-as-living-community (de la Bellacasa, 2015), comprised by microbial relations, ecological processes, and multispecies flourishing.

“when you follow soil health practices, you don't know how much you can cut rates [fertilizer application rate] and still survive. So it's kind of a self-discovery along the way.” Farmer #11,

South Dakota

This is a form of ontological uncertainty, in which the category of optimization does not apply straightforwardly. Measurements and calculations about soil health could enable farmers to make more suitable agronomic decisions, working through the uncertainty of caring about the total biodiversity of their farms, promoting living roots, and planting cover crops.

Concerns about assembling metrological regimes that simply go beyond maximizing crop yield and instead focus on improving soil health are also echoed by state actors. In the state of Vermont, the Payment for Ecosystem Services and Soil Health Working Group recently submitted its report to the State’s Senate Committee on Agriculture and the House Agriculture, Food Resiliency, and Forestry Committee. The working group asked how the PPP schemes incentivized farmers to focus on soil health and what outcomes the program delivered between 2019 and 2023. Their report, over 400 pages long, details the institutional and technical requirements to include soil health as a calculable component of natural capital. The report makes a point of paying calculative attention to biodiversity and its benefits for farming ecosystems:

“The Working Group identified biodiversity is a key ecosystem service provided by farms in Vermont. Microorganisms and fauna in soil participate in several ecosystem functions, including the formation of soil structure, carbon and nutrient cycling, decomposition of plant and animal matter. For these reasons, biodiversity is generally regarded as a supporting ecosystem that regulates other ecosystem functions” (Vermont Agency of Agriculture, Food and Markets, 2023, p. 25)

Yet the attention from the state of Vermont toward soil health is not necessarily aligned with the calculative prosthetics required for a successful metrological regime. Today, technoscience is not aligned with the diverse normative interests of farming stakeholders, due to the complexity of integrating new understandings of value and values that are a part of agri-environmental governance. In this regard, the report from the soil health working group states that “the technical contractors also investigated potential options for valuing soil biodiversity but found that none were feasible within the scope of their study” (Vermont Agency of Agriculture, Food and Markets, 2023, p. 16). This infeasibility reflects infrastructural absence. Ecological science has sophisticated methods for assessing microbial communities, yet the organized relations required to make biodiversity governable do not exist.

Phosphorus governance reveals how configuration determines governability. Phosphorus has regulatory mandates derived from TMDL requirements, court-tested calculative legitimacy, institutional capacity in the form of trained personnel and established protocols, and

enforcement mechanisms like compliance verification and payment structures. Soil biodiversity has none of this infrastructure because no equivalent alignment has formed.

This contrast has a long history. Phosphorus became governable through cumulative alignment built over decades, with Clean Water Act mandates fostering EPA enforcement, which fostered state modeling capacity, university research programs, and farmer compliance infrastructure. Each element reinforces others, creating a stable regime.

Soil biodiversity lacks this cumulative development, and no regulatory driver creates institutional investment, leaving biodiversity in infrastructural absence despite scientific and farmer recognition of its importance.

Finally, a few farmers we interviewed showed interest in acquiring knowledge and data that would allow them to modify critical parts of their practices dependent on dominant and structural components of the agri-food industrial complex.

“How can I get away from synthetic fertilizer?” Farmer #13, South Dakota

“why do we try and grow non-native crops? Some of them might work fine. Some of them might not.” Farmer #6, Vermont

These questions challenge fundamental premises of current metrological configurations. The regime is built around optimizing synthetic inputs, with nitrogen response curves assuming nitrogen application, university recommendations guiding application rates, and regulatory compliance measuring synthetic nutrient management. Questions about eliminating synthetic inputs or growing native crops challenge the regime's ontological ground. Current configurations cannot answer these questions, and this limitation derives from infrastructural foreclosure, not from deliberate prevention. The organized relations that make industrial agriculture governable, like research programs, extension services, market structures, regulatory frameworks, and calculative technologies, do not exist for radically different agricultural ontologies. Some farmers expressed limited interest in different ways of management, but these interests remain disconnected from the dominant metrological regime. These new potential measurements and calculations will only emerge if the appropriate actors, knowledge, and technologies work

together to establish their potential interactions and benefits. Integrating measurement technologies with calculative practices and alternative value systems has proven challenging for projects related to agroecology and precision agriculture (Sullivan, 2023), which makes understanding ontological foreclosure important for future research.

5. Discussion

While carbon measurement and capture remains a pressing issue for global environmental governance, our approach moves the metrological concern from the details and problems of carbon measurement to the constitution of calculative action and decision-making. This effort brings together critical metrology scholarship and the literature on agri-environmental governance in farming assemblages. Extending the concept of metrological regimes enables a connection between calculations at the levels of practice and governance, clarifies their integration, and facilitates the analysis of alternatives grounded in diverse forms of valuation (Maechler & Boisvert, 2024).

The description of the constitution and the interactions between calculative practices and calculative technologies of governance shows that metrological regimes are stabilized through the performative effects of specific formulas, algorithms, material technologies, and models. They are participants in farming activities and contribute to their stability, while at the same time providing measurements and data that guide them. The performative effects contribute to the reproduction of normative propositions of the agri-environmental governance assemblage of what farming should be, valuing efficiency, production at large scales, and the ability to capitalize on natural processes.

The results show that the capacity to calculate is distributed and appropriated by farmers and governmental institutions in different conditions, some of them voluntarily and some of them under regulatory coercion. The varied forms of calculation presented here show that calculative agencies become increasingly distributed across farmers, models, advisors, and regulatory

agencies, and relational in the sense that the capacity to calculate holds only through the specific connections among them..

5.1 Calculative action in agricultural metrological regimes

Following the argument advanced by Peter Miller, I agree that social sciences have lost the original preoccupation with calculative practices shown by some of its most notable figures (2004, p. 181). Adkins and Lury have also argued in favor of maintaining the relevance of measurement and value in sociological inquiry (Adkins & Lury, 2011). Max Weber's concerns about understanding rational action and placing bookkeeping as a critical component of the capitalist enterprise figure as some of the initial insights provided by social scientists about the inner workings of economic activities. Building on this classical tradition, the results characterize calculative action in agriculture along two main dimensions.

First, calculative action in agriculture is performative and embedded in situated assemblages. Adkins and Lury (2011) argue that instead of thinking about performativity in terms of causal effects, analysts should collapse the categorical distinctions between what is measured and how. The ways of calculating and the actions they produce are co-produced with measurement, meaning that the lines dividing the prescriptions of how something is measured and what is measured are no longer analytically useful. In these cases, the formulas, models, and algorithms that shape the metrological regime are in constant conversation with their participants. Institutions, government agencies, private companies, technologies, environmental conditions, and farmers are all shaped by and shape the process of measurement. These measurements are a constitutive part of how farmers act. Calculative action happens in the contexts of farming assemblages that are situated by their specific metrological regime, performed under context-specific normative settings.

Second, calculative action can be oriented toward control and management, toward valuation, or toward both simultaneously. Orientation toward management and control facilitates resource allocation, integration of data, and dealing with uncertainty. Orientation toward valuation is connected to the ontological presupposition that natural capital exists, that it can be measured, and that it can be used by market-based interactions and technologies of governance. As Haraway

puts it, 'control is not always a bad term' (Franklin, 2017), especially in agriculture. This entails that the normative underpinning of calculative practices is not inherently aligned with neoliberal, or capitalist-based technologies. They can be decoupled from normative assumptions rooted in ethics of efficiency and from attempts to value natural capital. Decoupling these two orientations of calculative action could provide the development of technologies that can move beyond 'valuation-centrism' (Maechler & Boisvert, 2024) and foster the development of more diverse agri-environmental governance assemblages.

5.2 The Politics of Regime Configuration: Methodological Contributions

Three dimensions of this heterogeneity are analytically consequential across the cases presented here. They relate to the configuration of actors involved in regime construction, the alignment of motivations across institutional boundaries, and the depth of institutional investment sustaining the regime.

First, actor configurations differ across contexts. Vermont's regime assembles regulatory authority, university modelers, and farmers under compliance requirements, but South Dakota's is built around farmers, agronomists, and input suppliers coordinating through markets with minimal regulatory presence. The same calculative object, nitrogen, becomes governable through different organized relations, and what governance can accomplish with it differs across these contexts. These situated connections and organizations echo both ontological and organizational matters in the performative constitution of agri-environmental governance (D. A. MacKenzie, 2009; D. MacKenzie & Millo, 2003).

Second, motivational alignments are different. Vermont's phosphorus governance stabilized through the dual utility described earlier, where regulatory compliance and farm optimization reinforced one another. Soil biodiversity lacks any equivalent alignment that would drive institutional investment, and the infrastructure to support it does not exist.

Third, institutional intensity varies considerably. Phosphorus governance in Vermont accumulated decades of legal precedent, modeling refinement, and enforcement capacity. Soil biodiversity governance has no comparable institutional history, starting from near-zero institutional capacity.

This approach allows specifying how particular configurations foster governance of certain environmental flows while closing off others through infrastructural absence. This precision matters politically because it locates intervention sites. If certain environmental realities became governable through specific alignments of regulatory mandate, modeling capacity, and farmer compliance infrastructure, then currently ungovernable realities would require building equivalent alignments.

Moving from critiquing standardization's effects to examining regimes' constitutive alignments also reveals why transformation is difficult. Regime stability derives from serving multiple purposes simultaneously, a dynamic observed across studies of how calculative infrastructures become embedded in the practices they coordinate (Callon, 1998b). Farmers need management tools, states need regulatory legitimacy, universities need research relevance, markets need predictability. Alternatives lacking such multi-purpose utility face structural barriers to stabilization. Methodologically, this suggests studying environmental governance through attention to configuration diversity, analyzing why certain configurations stabilize while others remain impossible and what institutional work would enable alternatives.

5.3 Ontological Foreclosure Through Infrastructural Alignment

The cases reveal that what gets excluded is a configuration-specific outcome of how institutional arrangements determine ontological affordances. Understanding this specificity is prerequisite for imagining governance transformation.

5.3.1 Realities Beyond Current Configurations

The encounters described in the previous section, in which farmers posed questions about soil life (the living microbial and invertebrate communities in the soil and the relational ecological processes they sustain) that governance could not answer, and Vermont policymakers found biodiversity metrics infeasible, reveal a pattern that political ontology scholarship helps interpret. These encounters are instances of ontological mismatch between what governance infrastructure can correspond with and what farmers and policymakers seek to engage. Ecological science possesses sophisticated methods for assessing microbial communities and functional diversity,

yet the organized relations that would translate these assessments into governance action have not been built.

Current configurations enact soil-as-nutrient-substrate, which involves discrete stocks of nitrogen, phosphorus, and potassium alongside measurable pH levels and optimizable input-output relations. Soil-as-living-community, which involves relational processes, ecological dynamics, and multispecies flourishing, exceeds these configurations. The Vermont working group's finding that biodiversity valuation was not feasible within the scope of their study reflects this mismatch. The institutional alignments required to make biodiversity governable do not exist.

The dominant configuration enables certain forms of governance, like nutrient management plans, application rate regulations, and payment schemes for measured reductions, while excluding others. Soil microbial communities involve relational processes and ecological dynamics that resist measurement in ways that translate straightforwardly into payment schemes or regulatory compliance. Rendering soil life governable within current configurations would require transforming it by extracting discrete measures from relational processes, reducing living communities to calculable biomass, and optimizing what resists optimization logic.

Following political ontology scholarship (de la Cadena, 2015; Mol, 1999; Blaser, 2013), this can be understood as infrastructural foreclosure of certain ontological possibilities. Realities that exist, participate in practices, and matter profoundly nevertheless remain structurally unseeable within dominant frameworks. These realities are neither hidden nor mysterious. Farmers correspond with soil life. Ecological science studies soil life. Governance cannot engage with soil life as the kind of entity it is because the relevant infrastructure, such as regulatory frameworks, measurement protocols, and enforcement systems, corresponds only with calculable substrates.

The mismatch extends beyond what governance can measure to what knowledge it can act on. Farmer knowledge about soil health and soil life is epistemologically legitimate and scientifically validated. Yet certain knowledge forms can ground governance while others cannot, based on infrastructural alignment and not on epistemic quality. Farmer observations about soil life, community monitoring of environmental conditions, and questions about agricultural transformation all exist and matter. They remain ungovernable within current configurations

because infrastructure exists for translating discrete measurements into governance action but not for translating relational processes, lived experiences, or transformative visions. This structural asymmetry constitutes an infrastructural dimension of epistemic politics (Temper & Del Bene, 2016).

5.3.2 How Configurations Produce and Sustain Exclusion

The cases examined here show how specific configurations produce specific exclusions through cumulative institutional alignment. When regulatory mandates drive institutional investment, states must demonstrate compliance, which creates demand for modeling capacity and that universities develop. Farmers participate because doing so serves both management optimization and payment access that monitoring systems verify and enforcement mechanisms legitimate. Each element reinforces others, creating stable regimes with strong institutional momentum.

The contrast between phosphorus and soil biodiversity illuminates how these mechanisms operate. Phosphorus governance accumulated infrastructure through a specific historical sequence, starting with Clean Water Act mandates that created regulatory pressure, the Lake Champlain TMDL that established legal requirements, court challenges that drove investment in modeling capacity, and the resulting infrastructure that created dual utility stabilizing farmer participation. Soil biodiversity has no equivalent history. The alignment-building forces that created phosphorus governance have no counterpart for biodiversity.

Different alignments afford different ontological possibilities. The exclusion emerges from alignment patterns, not from explicit decisions to privilege certain environmental realities over others. Decades of investment in certain infrastructures, driven by regulatory requirements and legal precedents as well as scientific traditions and market demands, created path dependencies. But the same stability that makes governance effective makes it resistant to alternatives that some farmers are already imagining. Some farmers articulated desires that challenge current regimes' ontological foundations, asking how they might move away from synthetic fertilizers or questioning the predominance of non-native crops. These questions are not answerable within existing configurations because the regime was built to govern industrial input-intensive agriculture. Agriculture without synthetic inputs, or agriculture organized around native species,

remains outside regime capacity because the infrastructural absence runs deep. No research programs, extension services, or payment schemes exist for radically different agricultural ontologies.

5.4 Implications for Governance Transformation

The question then becomes which institutional configurations would need to shift for governance to correspond with currently foreclosed realities. The analysis suggests three implications for governance transformation. First, making new realities governable requires building equivalent infrastructure to what currently exists for established objects of governance. Developing metrics alone is insufficient. Governance requires regulatory drivers, institutional capacity with trained personnel and established protocols, enforcement mechanisms, and reasons for farmers to participate.

Second, strategic alignment-building offers a pathway for transformation. Regimes stabilize through serving multiple purposes simultaneously, and alternatives need equivalent multi-purpose utility to overcome path dependency. This suggests seeking alignments where new governance serves farmer interests through improved outcomes and market access, state interests through regulatory legitimacy, and scientific interests through research funding. Transformation becomes possible through coalition-building that creates new forms of dual utility. Single-purpose initiatives offering only environmental or only farmer benefits are unlikely to stabilize.

Third, regime reconfiguration constitutes a political strategy that acknowledges the deep embedding of metrological regimes in contemporary governance while insisting they can be transformed through institutional work. This might involve engaging existing infrastructure while redirecting it, building parallel infrastructure for currently ungovernable realities, or reconfiguring alignments to change what existing measurements can support.

Decisions about which institutional alignments to build and which measurements to standardize are simultaneously decisions about which agricultural worlds can exist as governable realities. Alternatives rooted in diverse ontological definitions of farming and nature, such as knowledge that relates to spiritual connections with soil (Lal, 2024), the definition of nature as sentient

beings (De la Cadena, 2010), or factor in other culturally appropriate considerations to measurement and calculative processes that aim to foster more sustainable agriculture (Pereira et al., 2020) might find space through productive tensions and conversations with dominant frameworks. Understanding how such tensions unfold, and what institutional conditions allow them to become productive rather than be resolved through exclusion, is a direction for further work.

6. Conclusion

In this chapter, I have described the constitutive parts of metrological regimes in contemporary agriculture in the United States. This contribution is particularly relevant as new data-based technologies and machine learning algorithms become increasingly important for decision-making.

As I have shown, attending to constitutive differences in metrological regimes allows us to specify which institutional configurations generate which ontological exclusions and through which mechanisms these operate. This precision helps move from critique toward intervention. Regimes built through specific alignments might be reconfigured.

If certain environmental realities became governable through cumulative alignment of regulatory mandates, university modeling, and farmer compliance infrastructure, then currently ungovernable realities would require building equivalent alignments. Transformation demands strategic alignment-building that creates dual utility for currently excluded realities and redirects institutional investment toward alternative infrastructures.

By making the metrological regime that supports calculative action more transparent, I aim to reveal the intermediary processes between data collection and its outputs. This transparency helps show that lock-ins can be decoupled and that constructing more diverse agricultural practices requires attending to the interactions between knowledge, formulas, and action. Transformation requires engaging with how regimes are built, with the actors involved, the motivations that create alignment, and the existing infrastructure. Generic calls for 'alternative ways of knowing' lack the specificity that political transformation requires. Examining regime heterogeneity provides that specificity, showing where foreclosure happens and what would need to change.

Making new realities governable requires recognizing infrastructural requirements, especially the organized relations that connect regulation, research, markets, and practice. Alternatives need multi-purpose utility to overcome path dependency, which suggests coalition-building across farmer, state, scientific, and market interests as a viable pathway. And because calculative

infrastructure is deeply embedded in contemporary governance, regime reconfiguration seems more promising than wholesale rejection.

The political contestation of sustainability transitions in agriculture, elevated in awareness by the recent wave of farmers' demonstrations against climate-oriented regulations in European countries, is likely to continue contributing data related to contradictory values and the valuations derived from agri-environmental governance. The rapid expansion of data-driven environmental technologies, including AI-enabled monitoring, automated sensing, and precision modeling, makes these questions increasingly urgent. More calculation will not resolve the fundamental challenge that governance must learn to correspond with realities that exceed calculation. Multiplying the descriptions of metrological regimes in different contexts could provide policymakers and regulators with insights that foster better alignments between the values of sustainable agriculture and the calculative practices of farmers.

The ontological politics of agricultural governance is ultimately a question of institutional design, about which configurations we will build and which realities we will enable governance to engage. This analysis suggests that the reality agriculture inhabits is multiple. Yet this multiplicity is held together and made stable through heterogeneous institutions. The challenge for governance is learning to correspond with this multiplicity, finding ways to engage diverse agricultural ontologies through institutional arrangements capable of holding difference without forcing commensuration.

A note on metrological regime reconfiguration: Practical Directions

This chapter has shown that metrological regimes are heterogeneously constituted, and that this heterogeneity matters because regimes are the connective tissue between farm-level management practices and governance enactment. Formulas, models, and calculations organize how what a farmer does in a field relates to what a state agency monitors, pays for, or enforces. Because these regimes are heterogeneous, they contain joints where reconfiguration is possible. The direction of reconfiguration matters. A relational understanding of soil, one that engages with microbial communities, ecological processes, and multispecies interactions, offers a stronger foundation for agri-environmental governance than one limited to nutrient stocks and input-output optimization. Building governance capacity for this understanding requires institutional development along three dimensions, oriented toward modularity, meaning regimes designed to hold ecological complexity and to be reorganized as understanding develops.

First, a regulatory driver would need to create institutional demand for engaging with soil life as an ecological reality. Current conservation compliance frameworks tend to operate through practice-based requirements or single-metric outcomes, channeling institutional investment toward standardized measurement that produces foreclosure. A regulatory anchor for soil biodiversity, whether through farm bill provisions, state-level soil health legislation, or reconfigured conservation compliance, should instead require demonstration of ecological functioning across multiple dimensions of soil health. This orientation would push institutional development, from its inception, toward engagement with complexity.

Second, practical biodiversity indicators should be developed through participatory processes that include the farmers who correspond with soil life daily. Farmers in this study were already asking relational questions about microbial activity, nutrient cycling, and the interactions between soil health practices and their operations. These questions suggest that indicators developed in conversation with farmers could capture dimensions of soil life that purely laboratory-based or model-driven metrics might miss. Biological soil health assessments, functional diversity indices, or composite indicators that integrate multiple dimensions could provide entry points, particularly if designed to support farm management decisions alongside governance needs.

Third, institutional capacity should be designed for modularity and reconfigurability. Phosphorus governance is stable precisely because it locks in a single model, a single verification protocol, and a single payment logic. A metrological regime oriented toward soil biodiversity would need to accommodate local ecological variation, integrate new scientific and

farmer knowledge as it emerges, and support adaptive management. Building extension programs around soil ecology, advisory networks capable of interpreting biological indicators in context, and payment logic that rewards ecological outcomes would constitute the institutional architecture of a reconfigured regime. In this sense, designing regimes for reconfigurability accepts that governance becomes harder when it cannot rely on the simplicity of standardization.

III. Chapter 3

1. Introduction

I drove into the Limarí Valley on a bright winter morning. The sun was bright and clear the way it is in places close to the desert where clouds stop at the coastal mountains and rarely make it through. I had prepared for fieldwork by watching videos online about the place I grew up in but was currently far away. I saw videos depicting reservoirs at historical lows and footage of cracked earth and dry riverbeds. I expected to encounter many of the dry and brown patches of soil in the mountains that are typical of the area. Instead, I found green hills, the valley lush after it had finally rained for the first time in a long time.

It was funny in a way, arriving to study drought and finding the land looking like this. During my first days back in the region, family and friends shared videos with me of people celebrating the rain, filming rivers and canals flowing, some of them even crying. The rain brought a sense of hope and happiness with it.

But the farmers I interviewed in the weeks that followed were cautious. They knew this latest rain was not a solution to what the last ten years had done to their economic lives. The landscape and what farmers described did not match. This difference or mismatch is a constant of what I encountered. The valley can perform a mirage of its former self while the structural conditions of breakdown remain unchanged. The farmers had their own language for this.

"There's a saying here in Ovalle: Ovalle strangles but doesn't kill." (Ovalle ahorca, pero no mata.)
(Participant #1, mid-size farmer)

This *dicho* (saying), shared by a farmer in the Limarí Valley, carries with it a collective understanding of what farming in this semi-arid Chilean territory has always been. Farming has been difficult, sometimes to the point of asphyxiation, but survivable. The saying contains decades of accumulated experience with drought, market crashes, and debt cycles. These hardships could be managed because the configuration that held farming together, from dams and knowledge to seasonal rhythms and credit, always bounced back after a crisis. When I asked

whether the current drought might be different the farmer paused and said: "I think for many people the saying won't hold" (Yo creo que para muchos no va a servir el dicho).

This statement from a farmer in the Limarí Valley marks the threshold this chapter explores. The speaker describes a qualitative shift, what I see as a crossing from chronic adversity into something else. The image of strangulation captures a history of difficulty because farming in this semi-arid Chilean valley has always required navigating water scarcity, market volatility, and debt pressure. The configuration which allowed farmers to keep living despite chronic strangulation has broken down.

The Limarí Valley sits in Chile's Norte Chico region, where agriculture has always been conditional on managing aridity. Dams built in the 1960s and 1970s created an engineered correspondence between water availability and agricultural demand, enabling the expansion of irrigated farming (Vicuna et al., 2014). Neoliberal reforms in the 1980s privatized water rights and oriented production toward export markets (Bauer, 2004). Farmers developed expertise for working within this configuration through accumulated knowledge, territorial practices, and the adaptive resources that dam infrastructures provided. Beginning around 2010, what researchers have termed a megadrought (Garreaud et al., 2020), began depleting the reservoirs that had made this agricultural configuration viable. The Paloma reservoir, one of Chile's largest and the backbone of Limarí agriculture, reached historic lows. The infrastructure designed to buffer multi-year drought cycles cannot close the gap between water supply and demand.

This chapter argues that farmers in the Limarí experience ontological breakdown, understood as the collapse of the sociomaterial conditions that allowed farming to be possible and knowable in this territory. The megadrought collapsed the arrangements between water, infrastructure, and agriculture that had made intensive farming viable in a semi-arid region.

The chapter examines how governance responds to ontological breakdown. Extension centers operate in the Limarí valley, programs promote drought-resistant crops, technical advice is available. Nevertheless, farmers describe these responses as fundamentally mismatched with their situation. The analysis builds on political ontology to understand why this mismatch occurs and what it reveals about climate governance of slow-onset phenomena.

Political ontology is a theoretical framework developed primarily through Latin American scholarship engaging with situations where governance interventions failed because they assumed a reality that affected communities did not inhabit (Blaser, 2009; De la Cadena, 2010; Escobar, 2017). I argue that ontological breakdown works similarly in climate governance of slow onset phenomena. Farmers experience and articulate ontological breakdown, but the categories governance relies on cannot perceive or respond to it because those categories assume continued viability even when breakdown signals that farming as a viable activity has collapsed.

This chapter makes two contributions. First, it argues that the megadrought has changed reality in the valley, producing an ontological difference between governance and the farmers it serves that explains why institutions fail to respond in the ways farmers expect. . Second, it proposes failure to correspond as an analytical concept for governance that is present but cannot respond to the situation it is supposed to address. The concept extends recreancy from sudden technological disasters to slow-onset crises, and from absence or negligence to categorical mismatch.

The chapter proceeds as follows. The theoretical framework reviews literature on recreancy, political ontology, and slow-onset crisis. The context section provides background on the Limarí Valley. The methods section describes the ethnographic approach. The findings present ontological breakdown across four dimensions. The discussion develops implications for recreancy theory and political ecology. The conclusion ends by reflecting on what correspondence would require.

2. Theoretical framework

Recreancy and Institutional Failure

Recreancy, a concept introduced by William Freudenburg (1993, 2000), describes the failure of experts or specialized organizations to properly carry out responsibilities entrusted to them by the broader community. Freudenburg developed the concept through an engagement with Weber's analysis of rationalization and the division of labor. His argument was that risk perception scholarship had focused on the characteristics of individual perceivers, asking why people

appeared irrational about risk, when the more productive question concerned the institutional conditions under which risk is managed. As the division of labor grows more complex, individuals depend on specialized institutions to manage risks they cannot evaluate themselves. Trust in these institutions is rational given the structure of modern societies, but the same division of labor that makes such trust necessary also creates the conditions under which it can be violated. He tested this empirically in communities selected as potential nuclear waste sites, finding that recreancy variables explained roughly three times as much variance in public concern as ideological and sociodemographic variables combined. The implication was that public concern about risk was not irrational anxiety but a reasonable response to the possibility that trusted institutions might not be doing their jobs.

Other empirical applications of recreancy have focused primarily on technological disasters with clear temporal boundaries. The Exxon Valdez oil spill became a paradigmatic case (L. A. Ritchie et al., 2013), followed by studies of the BP Deepwater Horizon spill (Cope et al., 2016), hydraulic fracturing and unconventional oil and gas development (León-Corwin et al., 2025; L. A. Ritchie et al., 2021), and water crises (Straub et al., 2025). These cases involve identifiable institutional failures that produced visible harm, and recreancy in this literature operates primarily as absence, incompetence, or negligence when institutions were expected to act.

Recent scholarship has expanded recreancy's dimensions. Ritchie (2024) identifies fiduciary concerns, institutional competence, denial, and blame attribution as key components of recreancy. She also distinguishes between public perceptions of recreancy and actual recreant behaviors assessed through institutional analysis. The two dimensions do not always align because the relationship between institutional failure and public perception of that failure is shaped by the specific conditions under which failure occurs. Straub et al. (2025) push the concept further by questioning the causal direction that most recreancy research assumes. The standard model treats disaster as producing perceptions of recreancy, following a sequence from trust to failure to perceived betrayal to psychosocial impact. Studying the chronic water crisis in Jackson, Mississippi, where decades of infrastructure neglect preceded the 2022 flood, the authors ask what happens when the public already expects institutional failure before a discrete disaster occurs. Their concept of routinized recreancy describes a situation where institutional failure has

become normalized through repeated experience, producing a condition where the expectations is that institutions will fail. The authors build on Michael Edelstein's work on normative recreancy (2013), arguing that recreancy can function as a pre-existing cultural condition rather than a post-disaster perception, which means the sense of betrayal that characterizes classic recreancy may not always be present.

From a broader perspective, and to further promote new research in the field of recreancy, Ritchie (2024) identifies an underdeveloped connection between recreancy and Giddens's (1991) concept of ontological security, a gap that this chapter builds from. For Giddens, ontological security describes the basic trust that the social and natural world will continue to operate as expected, a confidence based on practical consciousness, the tacit, routinized acceptance that maintains everyday life. Giddens argues that ontological security depends on what he calls a protective cocoon, built through routinized practices that push existential anxiety away from the individual by providing stable frameworks for daily action. This cocoon depends on institutions behaving as expected due to the fact that in modern societies trust in abstract systems extends the basic trust that individuals first develop through early social relations .

Recreancy weakens the trust on which ontological security depends. When institutions fail to carry out their responsibilities, the protective cocoon that routine maintains begins to dissolve. Giddens theorized this dissolution primarily through sudden crises that pierce the protective cocoon, revealing the contingency that routine had bracketed. Chronic and slow-onset crises produce a different mechanism where the cocoon degrades over time. Routines that once sustained a sense of stability stop working, and what people could previously take for granted about their daily lives comes apart slowly rather than all at once.

This chapter addresses two open areas in the recreancy literature. First, recreancy has not been fully developed for crises where harm accumulates gradually and where the temporal markers that organize the standard recreancy sequence, trust, failure, and perceived betrayal, may not hold. Second, the connection between recreancy and ontological security that Ritchie identifies needs empirical development in cases where ontological security collapses at the scale of an

entire livelihood configuration, where what breaks down is not trust in a specific institution but the conditions that made an entire way of making a living possible.

Political Ontology and the Anthro-not-seen

Political ontology emerged from Latin American scholarship engaging with indigenous movements, extractive conflicts, and the limits of liberal governance frameworks. The approach developed through attention to situations where governance brought categories that did not match the reality of affected communities.

Political ontology's core claim is that different groups may enact different worlds through their practices, categories, and relations. Apparent disagreement about facts or policies may reflect ontological difference, conflicts between incommensurable worlds not within a shared one (Blaser, 2009). Blaser's (2009, 2013, 2024) work on ontological conflicts shows how governance interventions fail when they assume a world that locals do not share. A wildlife management program assumes animals are a natural resource subject to bureaucratic allocation. Indigenous communities may relate to the same animals through kinship, reciprocity, or spiritual connection. The program addresses a world that does not exist for those it targets, and failure follows from ontological mismatch rather than implementation problems.

De la Cadena's (2019) concept of the anthro-not-seen describes entities and relations that exist but are not legible within modern governance categories. Governance frameworks carry ontological commitments, assuming that actors are rational economic agents, that problems are technical and quantifiable, and that relations are organized through property and contract. Anything outside these categories becomes invisible. It exists but cannot be seen or responded to within the categorical infrastructure governance relies on. Political ontology offers analytical tools for understanding governance failures that other frameworks miss. The framework has been developed primarily through Global South scholarship and case studies, speaking back to Northern governance frameworks that assume universal categories and singular reality (Escobar, 2011, 2017)

Political ontology has primarily analyzed situations where ontological difference is durable, where it pre-dates the governance intervention and persists independently of it. In De la Cadena's case,

indigenous communities enacted the mountain as an earth-being before the state arrived with its extractive categories, and they continue to do so regardless of whether governance recognizes it. Whether political ontology's tools apply to situations where the difference is not pre-existing but produced by the collapse of a shared configuration is a question this chapter considers empirically.

Slow Violence, Extractivism, and the Capitalocene

Rob Nixon's (2011) concept of slow violence describes violence that occurs gradually, dispersed across time and space, difficult to represent and mobilize around because it lacks the dramatic quality that captures attention and generates response. Harm accumulates incrementally, thresholds are crossed without clear markers, and causation disperses across years and decades. Gill et al. (2026), working in a social production of disaster approach, examine the case of a flood in Jackson, Mississippi as an episode in a longer history of slow violence produced by infrastructural neglect, institutionalized racism, and chronic infrastructural harm. Their analysis demonstrates how slow violence connects chronic conditions with acute events. The Limarí case engages slow violence in a structurally distinct configuration that is particular to agricultural activities in the global south in the context of a Megadrought.

The Limarí Valley represents what might be called an agro-extractivist configuration, including infrastructure, policies, and practices organized around intensive agriculture for export markets in a semi-arid region (Krähmer, 2025; Veltmeyer & Ezquerro-Cañete, 2023). Dam infrastructure enabled the expansion of irrigated agriculture, integrating the valley into export markets. Neoliberal water reforms commodified water and oriented production toward global markets (Bauer, 2004). Export agriculture expanded despite chronic water scarcity. This configuration extracted value from the territory while externalizing costs across time. Social-ecological resilience in the valley has been shaped by the interplay between water markets and climate stress (Urquiza & Billi, 2020), but the megadrought has exceeded the adaptive capacity these arrangements provided.

In relation to Capitalocene conditions (Moore, 2016), extractivist configurations organize governance around the continuation of the productive model. The neoliberal restructuring of the

1980s transferred risk to individual producers while maintaining collective infrastructure that obscured the transfer.

These three bodies of scholarship play different roles in the analysis that follows. Political ontology supplies the core analytical framework. It provides the tools for understanding how governance categories shape what becomes visible and actionable, and why ontological difference can make certain situations invisible to responsible institutions. Recreancy theory provides the scholarly conversation this analysis contributes to. Failure to correspond, the concept I develop through the findings, is proposed as an extension of recreancy into slow-onset contexts where the standard sequence of trust, failure, and perceived betrayal does not hold. The Capitalocene and slow violence literatures frame the structural conditions, including the extractivist configuration, the neoliberal transfer of risk, and the temporal dispersion of harm, under which governance failure in the Limarí operates. The findings and discussion develop how these frameworks connect.

3. Context: The Limarí Valley and the Making of an Extractivist Configuration

The Limarí Valley lies in Chile's Norte Chico region, a semi-arid zone between the hyperarid Atacama Desert to the north and the Mediterranean climate of central Chile to the south. Agriculture has depended on careful water management for as long as people have farmed here. Rainfall is limited and variable, concentrated in winter months with significant year-to-year fluctuation. Before major infrastructure development, farming was small-scale and dependent on seasonal river flows, constrained by what the climate would reliably provide.

The construction of the Paloma dam system in the 1960s and 1970s restructured the valley's hydrology. The Paloma reservoir, one of Chile's largest, was designed to buffer multi-year drought cycles, storing water during wet years for release during dry ones (Vicuna et al., 2014). This infrastructure created an engineered equilibrium between water availability and agricultural demand. The dams enabled expansion and intensification of irrigated agriculture, integrating the valley into national and international markets. Agriculture in the Limarí became dependent on this engineered system, displacing rainfall as the organizing variable.

Image 1 provides details about the geographical location of the region and its water stress levels, as calculated by the World Resources Institute in its water risk atlas. Water stress is defined as the proportion of total water demand in relation to the available renewable surface and groundwater availability (Kuzma et al., 2023).

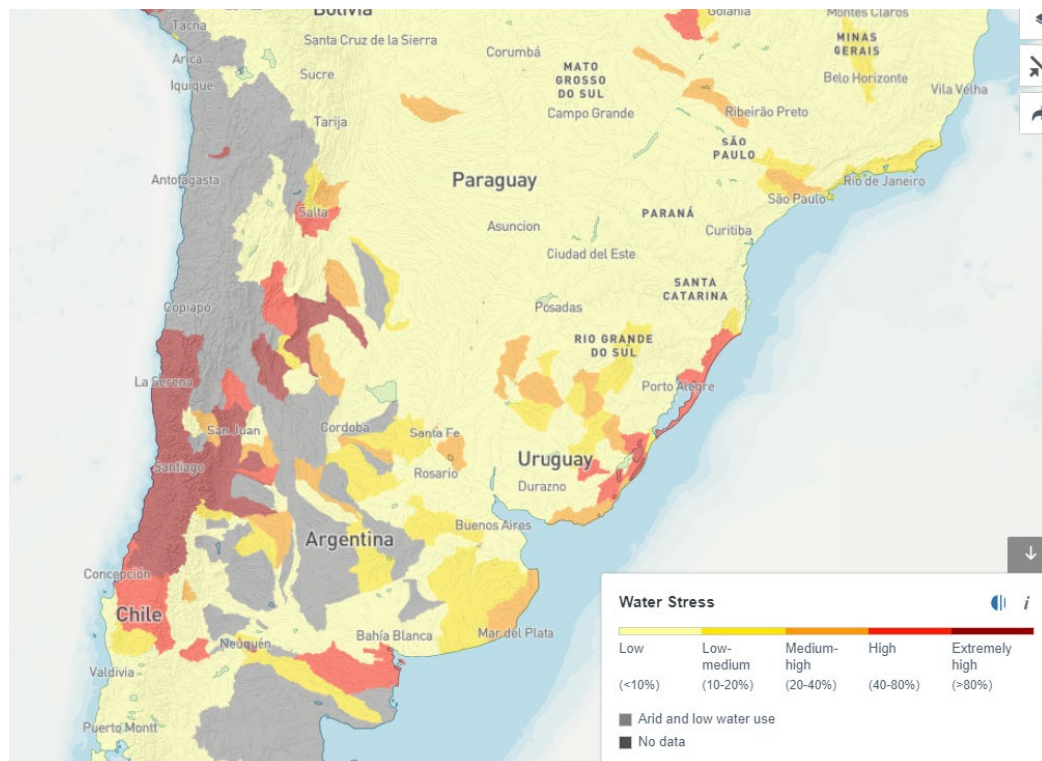


Image 1. Geographical location and water stress of the site study. Source: (*Aqueduct Water Risk Atlas*, n.d.)

Agriculture is one of the economic sectors most affected by the megadrought in Chile. The sector contributes almost 7% of national GDP through agri-food activities and ranks third in export-related activities after mining and industry. Despite worsening environmental conditions, total cultivated land increased by 13,000 hectares between 1999 and 2021, almost doubling the area used for agricultural purposes.

The Pinochet-era reforms of the 1980s deepened the extractivist character of this configuration. The 1981 Water Code privatized water rights, separating them from land ownership and making them tradeable commodities subject to market allocation (Bauer, 2004). Agricultural policy oriented production toward export markets, with grapes, avocados, and citrus for international

consumption. The valley became integrated into global commodity chains, with production decisions responding to distant market demands over local conditions or needs (Budds, 2004). Investment, water demand, and exposure to market volatility all increased.

Beginning around 2010, drought of unprecedented duration and intensity began accumulating in the region. The megadrought differs from previous dry periods in both severity and persistence (Garreaud et al., 2020). More than a decade of below-normal precipitation has depleted the reservoirs designed to buffer inter-annual variability. The Paloma reservoir has reached historic lows, dropping to levels where the infrastructure that created engineered correspondence cannot function as designed. The system that made intensive agriculture viable in a semi-arid region lacks the water to sustain it.

Two weeks before the fieldwork for this study began, the local scientific institution, CEAZA (Center for Advanced Studies in Arid Zones), published a report on reservoir levels in the Coquimbo Region following rainfall on June 13–14, 2024. The report gave quantitative content to what the introduction of this chapter describes as a mismatch between landscape and structural conditions. The June rainfall had turned the valley green, which is what I encountered when I arrived for fieldwork expecting to find the dry brown landscape I had seen in videos and satellite imagery. But the reservoir data made the gap between the visible landscape and the structural deficit calculable. La Paloma, the backbone of Limarí agriculture with a designed capacity of 750 million cubic meters, rose from 1% to 3%. Cogotí went from 0% to 7%, and Recoleta from 2% to 5% (Ceaza, 2024). Image 2 shows satellite imagery of these reservoirs and their capacity levels before and after the June rainfall. The reservoir data grounds what I experienced and what farmers described throughout the interviews that followed.

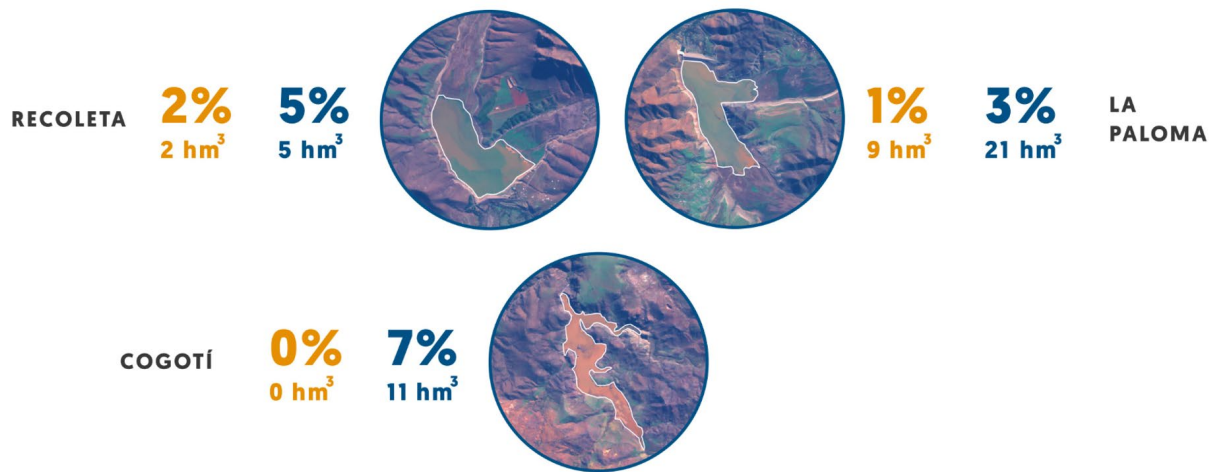


Image 2. Reservoir capacity levels in the Limarí Province before (orange) and after (blue) June 2024 rainfall in percentage levels and cubic meters. Source: CEAZA (2024)

4. Method

This chapter draws on ethnographic fieldwork (Ballesteros & Winthereik, 2021; Burawoy, 2000; Harrison, 2018) conducted in the Limarí Valley for two weeks during July 2024. The study was designed to understand farmer adaptation to drought conditions. I conducted semi-structured interviews with 15 farmers and agricultural professionals, accompanied by direct observation of the valley landscape, attendance at an agricultural extension workshop, and informal conversations with residents. The interviews constitute the primary analytical material. Observational data serves as contextual grounding and, in specific instances noted in the findings, direct evidence of the dynamics farmers describe.

I employed purposive sampling (Patton, 2014) to capture variation in farm size, crop type, water access, and market position. Participants included owner-operators ranging from small-scale (under five hectares) to large commercial operations (several hundred hectares), a farm manager for a corporate agricultural enterprise, a technical advisor with thirty-five years of experience in

the valley, and two former farmers who had recently exited agriculture. All interviews were conducted in Spanish, recorded with participant consent, and transcribed for analysis

The interview protocol addressed three main domains. I asked about adaptation strategies, what farmers had done in response to drought, what had worked, and what had failed. I explored experiences of drought, how farmers described their situation, the affective dimensions of living with megadrought, their sense of change over time. And I examined governance and support, including farmers' experiences with available programs, perceptions of fit between support and need, and accounts of what help looked like and whether it helped. The protocol considered the potential role of recreancy by asking interviewees if they would place blame in any person or institution for the extended drought and its consequences. Thus, it deals mainly with what Ritchie (2024) identifies as the perceptual dimension of recreancy. A full assessment of actual recreant behaviour would require institutional analysis, policy review, and expert evaluation of governance mandates and their execution, which goes beyond the scope of this research.

I employed thematic analysis of interview transcripts following established qualitative approaches (Hsieh & Shannon, 2005). Initial coding focused on adaptation strategies, drought experiences, and governance perceptions using an open-coding approach (Stemler, 2001). Through iterative engagement with the data, a secondary coding scheme emerged around threshold crossing, categorical mismatch, and differentiated experiences of breakdown.

In terms of positionality, The Limarí Valley is where my hometown sits. I grew up in this region and returned to study adaptation in a place where I kept hearing that things were dire. This shapes my access, my familiarity with the region and existing relationships, and my perspective, my emotional investment in the place and its people. I address this through reflexive attention to how my position shapes what I see and how I interpret it. This is a constant thread of my analysis and the overall structure of the chapter. The initial vignette is grounded in my observation, but also in my experience as a resident of the valley and as someone with stakes on the survival of the people who live there.

Fieldwork period	Two weeks, July 2024
Location	Limarí Valley, Coquimbo Region, Chile
Participants	15 (farmers and agricultural professionals)
Sampling	Purposive, capturing variation in farm size, crop type, water access, and market position
Data collection	Semi-structured interviews (primary), direct observation, attendance at extension workshop, informal conversations
Language	All interviews conducted in Spanish
Ethics	Recorded with informed consent, participants anonymized by number, local cultural norms observed throughout. IRB approved (Protocol #24-637)
Analysis	Thematic analysis with open coding (Hsieh & Shannon, 2005; Stemler, 2001), followed by iterative secondary coding

Table 3. Study design and participant overview

5. Results

The two weeks I spent during the fieldwork stage of this chapter felt somewhat easy when compared to other experiences. I had family and friends ready to receive me, a set of potential contacts and interviews already lined up thanks to the help of people connected to the agricultural landscape of the region. There was no need for that stage of getting to know the space and the people. It was just going back home.

Of course I did not take this lightly. I tried to make the familiar strange, as many people might advise in this situation. To pay attention to things I had not noticed while living there. But this was not hard either. While living in this place, I had never really looked at what was being grown, how dry the place was, how you could see the cordillera with snow on top of it after it had rained. The roads were not just tools to get from one place to another anymore. I found myself enjoying the landscape, noticing what types of birds were around, learning where geographically the rivers naturally took water and what places in the valley needed the dams to grow crops. The small hawks (aguiluchos) and the Chilean mockingbird (Tenca), that were previously almost invisible when I lived there, were flying or perched everywhere I looked now. I also came back with more knowledge about agriculture than I had accumulated in all my years living there, which definitely shaped the way the conversations flowed and the things I was noticing.

It was also an experience filled with contrasts. I had expected to see a site of emergency but the landscapes were green. I remember vividly stopping on one of the trips because the view looked so ready-made, an ideal scene of a green valley, almost like something for television. Maybe I was trying to capture how fleeting the moment was. I knew from experience and research that this latest rain was not enough to overcome the historic megadrought. But what people told me over those two weeks was anchored less in the landscape and more in the lived experience of farming practices, adaptation failures, and the material conditions the green hills obscured.

5.1 From Chronic Adversity to Ontological Breakdown

Across interviews, farmers marked the threshold between chronic adversity and ontological breakdown through explicit rejection of cyclical thinking. Participant #5, a farmer in his sixties

with roughly seventy hectares who was actively preparing to exit agriculture, described the cognitive transition as follows: "At the beginning you'd say, no, these are cycles. Even the meteorologists said we were in the eight-year cycle and then it would reverse. Sure, it rained once, but we went back to the same thing. A cycle on top of a cycle. That idea didn't hold up for us."

Participant #8, a medium farmer who had reduced his operation from fifty hectares to twelve, put it more briefly: "No, it's already a permanent thing. We've been in drought for twenty years and it's not something that will pass, it's not cyclical." Participant #2, one of the most experienced farmers in the sample, grounded the shift in material infrastructure: "There had never been a drought this long. In the sixties I lived through that drought and it was shorter. But the reservoirs that were designed for interannual accumulation have stopped working." All three reject cyclical thinking from different positions within the valley's agriculture.

Participant #14, a farmer since 1974 and a member of the canal board directorate, traced the threshold through infrastructure data that made the collapse measurable. "With the Paloma reservoir, in the first years, the 80s and part of the 90s through 2000, they were very good decades. The distribution from Paloma was 240 million cubic meters and these last seasons we were distributing barely 50 million." At the valley level, cultivated area had dropped from roughly 50,000 hectares to what he estimated at 15,000. His own production of avocados had fallen from 300,000 kilos to 20,000. These numbers give material content to what the other farmers articulate experientially. The configuration did not weaken gradually but contracted past the point where it could function.

Not all farmers recognized this threshold. Participant #9, a technical advisor and small farmer with rainfall data going back to 1961, maintained the cyclical framing even when pressed. "It's cyclical... these are conditions... I don't know, maybe through the years, cyclical, I don't know." His position as a technician with historical records gave him an interpretive framework, cycles and precedents, that buffered against the threshold recognition other farmers expressed. The threshold is real but not universally perceived, and what determines whether a farmer crosses it epistemically may relate to interpretive framework as much as to material conditions.

The threshold also registers in the disorientation of knowledge that has stopped working. Participant #12, a technical advisor with thirty-five years of experience across dozens of farms in the valley, described a precise inversion of established knowledge: 'Because before, the hotter it got, the better the grapes finished. But there came a point when in very hot years that stopped happening. And that's when we realised that the plants, on most of the days when they're stressed, were going backward more than forward. They were regressing.' The old rule did not become slightly inaccurate. It reversed. The conditions that knowledge assumed had changed qualitatively. Ontological breakdown registers here in the domain of knowledge. Practices that worked for thirty-five years stop producing reliable outcomes.

Participant #7, a small farmer with five hectares who had recently been forced to stop producing, described the same dynamic at a more foundational level: "We never thought that part would fail on us. The most essential part, water." Participant #7 experienced the failure of a basic assumption, that water, the condition of possibility for everything else, would be there. The ontological dimension here is that farming stopped working as a practice, not because one thing failed but because water, knowledge, seasonal rhythms, and debt all broke down together.

Participant #1, the retired farmer whose "ahorca pero no mata" saying opens this chapter, traced this convergence through comparison with the 1997 drought: "We have no water, we've eaten through our capital, and we're in debt. Very different from when I went through '97. We ended an enormous drought too, we all went to zero, but it rained and I could set up ten hectares of export grapes. Today I couldn't even buy the seedlings for that." The 1997 drought was severe, but the configuration could be rebuilt afterward, since rain replenished the reservoir, capital was available, and the productive system could be reassembled. The current situation is ontological breakdown, not intensified adversity, because the capacity for reassembly has been lost.

Participant #6, a second-generation farmer who had studied agronomy and agricultural administration, described the convergence with a phrase several farmers used independently. "It was like a perfect storm. Because it was the drought problem, the mining problem, the cost of electricity, which is a very important cost in agricultural production today, and on top of that, imports of agrochemical products and everything else, costs rose on us 40, 50, 60%, in some cases

up to 100%. So all of that piled on top of the problem we already had." Where Participant #1 located the convergence in water, capital, and debt, Participant #6 added labour migration to the mining sector, energy costs, and import price inflation. In both accounts, farming depended on a configuration of relations that collapsed across several dimensions simultaneously.

Some farmers describe impossibility, not difficulty. They have already moved from looking for adaptation strategies to questioning whether farming remains possible at all.

Participant #5 described reaching a decision he had resisted: "Despite the love I have for it... the only thing I've ever worked in my life has been agriculture. And now I'm thinking of getting out." Participant #8, asked whether he would recommend farming to a young person, responded: "If the young man has money to invest, I'll sell him mine."

Participant #15, a water governance leader who had served as president of his Junta de Vigilancia for over twenty years, described the threshold from the other side of it. "Of the 130 hectares I had, I'm not working any of them. I closed the fields." The psychological toll registered in how he described others' decisions. "The drought really affects you, the psychological toll it takes. The young people are emigrating and the old are left." A second farmer present at the interview added that several agronomist sons in the valley do not work with their fathers anymore "because the fathers' future is uncertain."

5.2 Categorical Mismatch

The categorical mismatch was most visible when governance offered specific technical advice. Participant #8 described a visit from the Agriculture Minister: 'The minister said we should switch to citrus. Citrus needs ten thousand cubic meters of water. A grape consumes five, six thousand cubic meters a year. So citrus needs even more water. And here we don't even have the water for grapes.' The error was structural, not individual. Governance categories contained 'crop switching' as a drought response. They could not register that water availability had collapsed below the threshold for the proposed alternative.

In this same context, I was able to attend an extension workshop in the area aimed at providing technical support for farmers looking to diversify their operations. The valley has been historically

oriented toward grape production, both for international market and for the production of Pisco, a typical Chilean spirit. But market pressures and shifts in consumer preferences have meant that grape production is not good enough business for some farmers. Considering the market and environmental pressures, public interventions have been devised to give farmers the type of knowledge useful for changing what they grow to more profitable crops. Almonds, mandarins, and more recently cherries are the types of crops recommended for reconversion. The workshop was held at one of the largest farms in the valley, a well-capitalized operation that was partnering with INIA Intihuasi to test cherry varieties. About fifteen farmers attended, most of them used to these kinds of interventions, attentive and hoping for something that could help them get out of the drought-derived problems they faced. The extensionists presented data on chill units, rain patterns, and the agronomic requirements for cherry cultivation. The reasoning was technically informed since cherries use less water, might bloom earlier under new climatic conditions, and fetch high prices in Chinese markets. After the presentation, we walked into a test lot where cherry trees were planted. The extensionist climbed into a large hole in the ground to show us sensors measuring soil moisture and water levels.

The advice was precise. It also assumed capital for replanting, water security for multi-year tree establishment, and market access for a new crop. The farm hosting the workshop had these things. The farm manager who ran point for them was knowledgeable in both the business and agronomic sides. Most of the farmers in the room did not have this configuration. The workshop exemplified governance responding to drought with technical precision while missing the structural collapse that makes technical advice beside the point.

Participant #13, the most technologically advanced farmer in my sample, was also testing cherry varieties in partnership with a nursery company. He is the farmer this advice is designed for. For farmers with less resources, reconversion requires capital, multi-year water security, technical knowledge, and market connections that the megadrought has dismantled. The advice corresponds with the farmer who least needs it and fails to relate with those who most need governance support.

As Participant #1 said: "This isn't fixed with ideas, it's fixed with water. Besides, it's a joke." Participant #3, a small farmer, responded to reconversion advice with a question: "How do I do it? With what money, with what water, with what time?" The mismatch extended to technology transfer. Participant #11, a manager for a large multi-field operation, described irrigation sensors these terms: "Why do I need a sensor if I can't even irrigate the minimum the sensor is going to tell me? I'd like to have that technology, but when the water doesn't reach, it makes no difference having a sensor. It's always reading empty, empty, empty." The sensor was designed to optimize irrigation, a technical solution to a management problem. When there is no water to manage, the technology produces correct but useless information. The governance category, efficiency, assumes a resource that the situation lacks.

Participant #12 named the gap between the governance category and the situation it was supposed to describe. "Working only 30-40% of the irrigated area is already a disaster. So yes, we should be in disaster, in a disaster zone, but it should have been declared a catastrophe a long time ago." The formal designation had not caught up with the material reality, even by the criteria governance itself uses to classify crisis. The mismatch is ontological. Governance categories like 'crop switching' and 'efficiency' assume a world of farmers with capital, water, and market access to act on technical advice. For most farmers in the valley that world no longer describes the conditions they are working in.

5.3 Temporal Mismatch

Farmers described programs that arrived after decisions had been made, advice that would have helped five years earlier, support calibrated to sudden episodes when the crisis has become chronic.

Participant #1 described temporal mismatch across three registers. Infrastructure arrived after need had passed: "They sent us a geomembrane. By the time it arrived the drought was basically ending, and I couldn't even test it because there was no water to put in it." Participant #15, who had spent twenty years as president of his local water governance association, described the pattern with a repetition that carried the weight of experience. "Always late in all governments, always late, always late. With short-term solutions, not definitive ones." He contrasted this with

the governance capacity that once existed. The reservoirs built in the 1930s through 1960s were products of state policy that transcended electoral cycles. That kind of policy was not present anymore, and the megadrought required exactly the long-term institutional commitment that the political system was unable to produce. Participant #8 had articulated this mismatch to a minister directly. "I told him what we needed was a drought delegate, but a permanent one. Not a person who comes to say 'I'm here' and then leaves. But someone who's permanent, because from here to here it's already desert, it's desert by climate." The demand for permanence registered the same gap. The crisis was chronic, the governance was sporadic, and every time it rained the crisis was declared over.

5.4 The Absence of Blame

In my fifteen interviews I asked farmers directly or indirectly about responsibility for their situation and the one facing the valley. No farmer expressed the sense of betrayal by institutions entrusted with managing risk that defines classic recreancy in the technological disaster literature. Participant #2, asked who was to blame, responded: "People, no. I think it's cycles." Participant #1 stance was disillusionment without expectations: "When you're a farmer in this country, you have to forget about the government." Participant #10 assessed state support flatly: "At the state level, zero. Zero." Participant #7, a small farmer who had recently stopped producing, turned the question inward: "We didn't do what we should have done. Nobody pointed us in the right direction, but then again, we could have sought it out."

But there was one partial exception. Participant #8 directed structural blame at the state, framing it as neglect by choice, not as betrayal of trust. 'The drought could be seen coming, it could have been prevented. Something could have been done. [...] I think a bad vision of what this zone is. This country is very centralist, they've focused on mining, which gives more, and this is an agricultural zone and they haven't been interested in agriculture. There hasn't been an agricultural policy like there was in the 80s, when CORFO did set up programs to improve irrigation.' The account identified foreseeability and past state capacity, and named a decision to direct resources elsewhere. But even here the affect was matter-of-fact, closer to structural critique than to the recreancy sequence of trusting, being failed, and experiencing betrayal.

Participant #11, a manager for a large corporate operation, offered the most direct admission of collective responsibility. "Yes, there is an overexploitation of the basin, that's purely the fault of humans. In the end we ourselves have contributed to this problem." His position as a corporate farm manager may have enabled this admission, since the company could absorb the acknowledgment that the model was unsustainable in a way that smaller farmers, whose livelihoods depended on that model, could not.

The absence and dilution of blame may stem from what Straub et al. (2025) call reluctant resignation, a response in which people stop trying to change their situation and accept that little can be done. The concept could provide an explanation for the difficulties of pinpointing responsibilities and adequate responses to the megadrought context. But the Limarí case provides a different perspective. For Straub et al., resignation builds up due to the taxing process of looking for appropriate institutional responses. In the Limarí, it comes from a sense that governance does not see what farmers are going through. Farmers are resigned to the fact that the institutions use categories that no longer match their situation.

5.5 Differentiated Breakdown

The threshold of ontological breakdown is real but differently positioned for different farmers. Some describe severe stress with continued viability. Others describe bankruptcy, land abandonment, and exit from farming. Where farmers stand relative to the threshold depends on structural factors like capital reserves, water access, crop type, and debt load, but also on interpretive frameworks that shape whether the threshold is perceived at all. The breakdown is ontological and uneven. The configuration has collapsed for some farmers while still holding for others in the same valley..

The threshold is not crossed uniformly. Participant #1, who had retired and leased his land, positioned himself explicitly as buffered: "I have a different perspective because I'm retired. The one who has to produce every year, who has to make a living from this, he sees it differently." Participant #13 described a different form of awareness from his relatively secure position: "There are others who don't know they're bankrupt. That's the critical thing. There are people who think they still have options and they actually don't." Participant #8, asked whether some farmers had

responded to the drought better than others, reframed the question. "Yes, but it's just a longer death. Yes, some have lasted a little longer, but they're also dying." Where Participant #13 observed differentiation from a position of relative security, Participant #8 insisted that the differentiation was temporal, not final.

Where the threshold falls for different farmers depends, in the first instance, on structural position. Participant #8 identified capital, not water, as the binding constraint: "More than water shortage, it's been financing. Because there were tools. The problem was that many people didn't have access to them. And the number one tool is financing." This inverts the expected narrative of a drought crisis. Water scarcity is real, but what determines who crosses the threshold is the financial capacity to respond to it, to drill deeper wells, switch to drip irrigation, survive years of reduced income, or replant with new varieties.

Water access makes this worse. Participant #1 described it: "I'd kept four water shares per hectare. The one who had twenty hectares and twenty shares is much worse off than me. That's all." Water share concentration, a product of prior investment decisions and market transactions, creates structural advantage that the drought amplifies. Participant #8 connected water access to market position: new high-value grape varieties are all late-season, requiring water past December. Farmers whose water runs out before then are locked into early-season varieties destined for the low-value raisin market. Market position is not a choice. It is an outcome of water access, which is an outcome of capital, which is an outcome of prior structural position. The drought does not create inequality. It reveals and accelerates it.

Participant #2 described this differentiation directly: "The small farmer who is supported by INDAP has had some support, because they give them seeds, they teach them some things. A more professional farmer, medium, like one might call it, with a hundred hectares, doesn't have access to INDAP and also doesn't have the resources of the big ones. There's a tier that nobody supports at all." The formal governance architecture sees two categories: small farmers eligible for INDAP and large operations presumed to be self-sufficient. The medium tier, too large for small-farmer programs and too small for corporate resilience, falls into a gap that governance categories do not contain. Correspondence, such as it exists, tracks the categories governance

already has. Farmers who do not fit those categories experience the megadrought compounded by governance that cannot see them.

For farmers without capital, even the attempt to respond to drought became a gamble. Participant #13 described what well-drilling looked like for those without his resources. "You can start drilling, spend the hard cash, practically go to the casino, because it's a lottery." When the rational decision tree had been exhausted only chance was left.

Participant #9, a small farmer and former extension worker, described the mechanism of water concentration from the other side. "The big businesses ended up with practically all the water, because the small producers started selling their water rights, and the big producers started planting beyond their canal quota. So they planted avocados, they planted citrus, and those are evergreen crops that need much more water." Large farmers had also drilled illegal wells, extracting groundwater "sometimes without DGA authorization because they have wells that are half-hidden." The formal equity of the water rights system, in which water is distributed proportionally by shares, masked a process of structural concentration that the drought then amplified.

5.6 Affective Dimensions: Living in the Anthro-not-seen

The anthro-not-seen is also present in an affective register. What governance cannot see is still lived, and the emotional texture of these interviews shows how. The emotional register of farmer accounts provides evidence of correspondence failure at the level of lived experience, similar to affective patterns that scholars have described as ecological grief (Cunsolo & Ellis, 2018). Solastalgia has been used in this field as a concept related to the distress people experience when their home environment is transformed around them (Galway et al., 2019), which is particularly relevant to contextualize some of the conversations with the participants of this study.

Farmers expressed frustration at responses that missed the point. This frustration carries a quality of absurdity, with programs that assume conditions only a handful have, advice disconnected from actual circumstances, and official response to a crisis that seems to miss the crisis.

Participant #5 described the cycle of performative response: "Politicians would arrive, 'what are we going to do, what are we going to do.' And then the first rain fell and everyone forgot. The brutal emergency became normal. In three days." Frustration here is directed at a response that shows concern but does not solve anything, and that disappears with the first rain because it was never designed for a crisis that does not end.

Participant #15 described a frustration rooted in the contrast between what farmers were doing and what the rest of the population was not. His water association had been distributing water in 18 sections, meaning each farm received water for three days out of every fifty. Meanwhile, "despite this terrible drought, nobody, there was no campaign saying shower shorter. Never a campaign. Nothing. I'd see a neighbour's nanny watering the sidewalks." Agricultural water was being rationed at survival levels while urban consumption continued unrestricted.

Several farmers described feeling unseen despite programs existing. Farmers feel abandoned because the state is present and still cannot perceive their actual situation. Participant #7 described feeling unseen in terms of guidance: "Nobody pointed us in the right direction. Nobody told us, 'do this, take this path.' Maybe they existed and we didn't access them, but nobody came and said 'there's this program, apply for it.'" This shows a gap in the architecture of correspondence, governance that is formally available but practically unreachable for those without the knowledge, connections, or institutional literacy to find it. Participant #1 described a similar feeling of abandonment: "When you're a farmer in this country, you have to forget about the government. We are the villains of the movie."

Participant #15 described feeling unseen despite being inside the governance architecture. He had served as president of his water association for twenty years, had pioneered soil moisture sensors in the valley, and had spent a decade advocating for structural water solutions. "That's why I quit. I'd been grinding for ten years, and it was affecting my daily life with my family. Nobody wants to take charge. The honest truth is nobody wants to take charge." The passage registers a different form of abandonment, that of someone who was once inside governance and now sees that there is no one to turn to, and no way to hand over the burden of farming.

Grief ran through many of these feelings. Farmers mourned a way of farming that used to make sense here, sharing the feeling of losing the knowledge and the relationship to the territory that came with it.

Participant #1 traced the affective dimension of prolonged crisis: "It's a process where you just keep falling, falling, falling. And when you keep falling, there comes a moment when you say, at least this thing has stopped. I can't go further down, so all that's left is to stay still where I am or start to improve. And then a moment comes when you say, at least this thing is over, and it almost becomes a relief. I'm speaking for myself." The rhythm of 'cayendo, cayendo, cayendo' in the original Spanish carries the slow violence of megadrought as lived experience.

Participant #7 described a different trajectory, from hope to disillusionment. In relation to the recent rains they shared: "I celebrated it with everything, man. I really celebrated it. It seemed like in that moment everything had changed, it had gone back to how it was before. Unfortunately one rain doesn't do it, the drought stays the same. In the end it didn't do anything . it just wet the ground." This can be understood as solastalgia. Together, these two passages show two sides of what farmers experience, the exhaustion of sustained decline and the disappointment of a recovery that turns out to be false.

Participant #15, in conversation with a fellow farmer who was also present at the interview, described what rain meant after years without it. "The Norte Chico used to be called the Green North. But we looked like Copiapó two months ago." The second farmer added, "it was all grey. The native trees, ancient ones, drying out." When it finally rained, "we get together with farmer friends, have a barbecue, everyone's in the air. From the most humble to... Everything changes. The switch. Totally." Participant #15 described telling his wife, "coins are falling," and concluded, "I think there's nothing more democratic than rain." The celebration of rain made visible what the megadrought had taken from the valley's social life, since it took the return of something ordinary for the loss to register as collective.

6. Discussion

The findings presented above describe ontological breakdown in the Limarí Valley and trace its multiple dimensions. In this section, I develop the theoretical implications of these findings. The main argument of this section is that the megadrought has changed reality in the valley, and that governance and some of the farmers it serves no longer share a world in which the categories of drought response still describe what is happening. This ontological difference is what explains the failure of institutions to respond in the way farmers expect. It is also why conceptual frameworks built to explain institutional failure in disasters, recreancy in particular, need to be extended to hold slow-onset situations where a shared configuration has collapsed unevenly. I develop this argument below, proposing failure to correspond as the specific form institutional failure takes when governance and the governed no longer share the conditions the concept of institutional failure assumes. The Limarí valley may be an early case of conditions that will appear elsewhere due to climate change, and the concept is intended to travel to other slow-onset climate governance settings where similar collapses are underway or likely to happen.

6.1 What Ontological Breakdown Reveals

Adaptation scholarship has increasingly acknowledged that incremental responses fail when the system itself has shifted (Wise et al., 2014). O'Brien (2012) argues that the adaptation literature mostly focuses on accommodating change when some situations require deliberate transformation. The Limarí case suggests that ontological breakdown marks where this distinction becomes unavoidable. When the configuration has collapsed, the category of adaptation becomes inadequate. The situation requires recognition that something has ended, not adjustment to changed conditions.

Farmers and the state share the same material conditions, the same water, territory, and infrastructure. But they do not inhabit the same configuration of relations to those conditions. Recent work in political ontology has argued that different configurations of relations are produced through practice within shared conditions of existence, meaning they can overlap materially while remaining distinct from each other (Escobar et al., 2024). In the Limarí, the extractivist configuration, enacted through capital, export markets, and water as tradeable

commodity, continues to be performed by governance. The farming configuration, enacted through practical relations between water, land, knowledge, seasonal rhythms, and generational continuity, is unraveling. These are two ontological configurations sharing the same territory. The anthropo-not-seen here is the death of the farming historic reality, which governance categories cannot perceive because they belong to the extractivist configuration, within which farming appears as a manageable variable rather than as a distinct assemblage of relations that can cease to exist. Failure to correspond, as I propose it, describes the specific mechanism through which ontological breakdown falls into the anthropo-not-seen in slow-onset climate governance. The invisibility operates through the categorical incapacity of governance to register that a shared configuration has collapsed, and not through the exclusion of non-modern entities that organizes many interventions in the field of political ontology studies. This invisibility does not operate only between governance and farmers. As one interviewee observed, some farmers have materially crossed the threshold but do not know it. They continue to inhabit the categories of the old configuration, planning next season and expecting recovery, reading the drought as cyclical. Their breakdown is real but not yet perceived. The anthropo-not-seen, in this case, extends to the governed themselves. The same categorical assumptions that prevent governance from perceiving breakdown also prevent some farmers from recognizing that the frame within which they are making decisions has already come apart.

The imperceptibility of breakdown is a feature of the situation itself. The state offers reconversion workshops because its categories assume viability. Some farmers plan next season because their categories assume the same thing. The mechanisms differ, since the state operates through institutional frameworks while farmers operate through dispositional optimism and cyclical thinking, but both end up unable to perceive that breakdown has happened. And the capacity to perceive breakdown is itself shaped by structural position, since those with capital and education have the interpretive resources to read bankruptcy in others. The perception of ending is differentiated by the same inequalities that produce the ending.

This shared world is ending and neither party has categories adequate to perceive the ending from within it. Extinction studies provides a useful parallel here. Van Dooren (2014) describes extinction as the unravelling of a cross-generational assemblage of relations, and Rose (2012)

identifies functional extinction as the condition where the relations sustaining a way of life have been severed while the entity still appears to exist. The farming configuration in the Limarí has unravelled in this sense, but some farmers continue to move through its forms. The agronomist sons who will not farm in the valley are the clearest sign that this way of farming has no next generation. Garlick and Symons (2020) describe "geographies after extinction" as places where former ways of living have disappeared and the landscape shows no trace of what ended. The Limarí Valley, green after rain while the structural conditions of collapse remain unchanged, is this kind of geography. Slow-onset climate crisis may produce this condition in other contexts where governance and the governed share categories that assume the continuation of something that has already collapsed.

This is similar to James C. Scott's (2020) analysis of how state governance imposes legibility through simplification, rendering invisible what does not fit its categories. In the Limarí, drought is legible. Ontological breakdown is not. When it comes to acting in the space of the Capitalocene, this inability to perceive breakdown is structural. Governance cannot see that the model is finished because seeing it would require abandoning the extractivist logic that organizes governance itself. The risk transfer that neoliberal reforms enacted in the 1980s remains operative. Individual farmers bear the consequences while the infrastructure of dams and water boards maintains an appearance of collective management. The export boom appeared to validate this arrangement. The megadrought showed that risks remained collective, including shared water, climate, and market exposure, but the capacity to respond collectively had been dismantled. Farmers experience this as individual failure because the neoliberal ontology has been internalized.

6.2 Failure to Correspond

Failure to correspond names governance that cannot recognize or address the ontological situation of those it is supposed to serve. The term draws on two senses of *correspond*. The first is etymological: *con* (together) and *respondere* (to respond), suggesting governance that answers the reality it encounters. The second is relational. Ingold (2017) proposes *correspondence* as a different picture of social life from the one mainstream social science and governance

conventionally work with. In the conventional picture, social life is made of discrete units with their own interests that meet across the gaps between them, and institutions respond by treating those units as classifiable cases to which rules and programs can be applied. Ingold argues that this picture misses what holds social life together. For Ingold, human lives are constituted through the relational work of attending and responding to each other as conditions change. Correspondence is his term for this relational angle that characterizes how we live. With *failure to correspond*, I bring Ingold's apparatus into the context of ontological breakdown. The discrete picture on which governance operates misses the relational conditions that make reality hold together, and it also misses how those conditions degrade. Governance in the Limarí continues to treat farmers as classifiable cases, but the relational conditions that made those cases legible, the reservoirs, the rainfall, the capital, the generational continuity, have come apart.

Failure to correspond as an idea extends recreancy in two directions. First, it moves the concept from sudden technological disasters to slow-onset crises where there are no clear temporal markers separating before from after. The temporal mismatch described in the findings, where governance responds in episodes to a crisis that does not end, is one consequence of this shift. The findings show that in slow-onset contexts, the standard recreancy sequence of trust, failure, and perceived betrayal does not hold. Farmers do not describe betrayal because the conditions for it were never present in the way the technological disaster literature assumes. The neoliberal framework individualized risk, making institutional responsibility diffuse. Farmers describe something closer to the routinized recreancy that Straub et al. (2025) identify in Jackson, Mississippi, where citizens come to expect institutional failure as a baseline condition. But the Limarí moves this into a different plane. Farmers do not simply expect failure. They inhabit a situation where governance is present and active but cannot perceive what has happened. The institutions operating in the valley are not inactive. Programs, extension services, and technical advice all exist. The failure is that traditional governance approaches cannot hold the situation. Governance understands drought and can respond to it. But breakdown requires a different kind of question, whether farming remains possible at all, and governance has no categories for that question. This is the deeper structure of the categorical mismatch described in the findings, and I think it constitutes a dimension of recreancy that the existing literature has not developed.

Secondly, failure to correspond develops the connection between recreancy and ontological security that Ritchie (2024) identifies as undeveloped. The farmers' accounts give this connection specific content. Ontological security in the Limarí was built into the practical routines of farming, the seasonal rhythms of planting and irrigating, the expectation that reservoirs would refill, the planning of next year's crop. These routines were the protective cocoon that bracketed the precarity of farming in a semi-arid region. The megadrought degraded this cocoon over a decade until the routines stopped working and what farmers could previously take for granted about their daily lives came apart slowly rather than all at once. Ontological breakdown is the collapse of this practical trust at the scale of an entire livelihood configuration. When governance cannot perceive this collapse, recreancy operates at a level the existing literature has not reached.

6.3 Differentiated Correspondence and Environmental Inequality

Environmental justice scholarship has established that environmental harm is distributed along lines of race, class, and power (Mohai et al., 2009; Pellow, 2016; Schlosberg, 2013). Climate justice extends this analysis to adaptation, arguing that vulnerability and the capacity to respond are shaped by existing inequalities and that just adaptation requires attending to what different communities can actually do with available resources. This analysis suggests an additional dimension. Differential correspondence with governance constitutes a form of environmental injustice that operates through the gap between formal availability and actual fit. Governance formally serves all farmers in the Limarí, but correspondence is unevenly distributed in ways structured by capital, water access, and market position. The same programs that provide workable support for some become irrelevant categories for others, and this distribution tracks existing inequalities. Environmental injustice here takes the form of governance that is present but does not fit.

7. Conclusion

This chapter has examined ontological breakdown in Chile's Limarí Valley during the ongoing megadrought. Farmers describe a threshold crossing from chronic adversity to collapse. The megadrought changed reality in the valley in ways that governance categories cannot register, and the mismatch between governance response and the ontological situation of farmers is what I have proposed calling failure to correspond. The concept names the form institutional failure takes when governance and the governed no longer share the conditions that existing concepts of institutional failure assume..

This analysis contributes in two ways. The Limarí case shows that governance can be present and active while remaining unable to perceive the situation it faces, something that becomes visible through an ontological lens but stays hidden under institutional or technical analyses. And the concept of failure to correspond extends recreancy into slow-onset contexts where harm accumulates without the temporal markers that organize traditional recreancy research. The ontological dimension of recreancy developed through the Limarí case opens questions about whether similar dynamics operate in other slow-onset contexts. The connection between recreancy and ontological security, identified by Ritchie (2024) as undeveloped in the literature, finds empirical grounding in the Limarí case, where the collapse of basic trust that farming will be possible constitutes ontological breakdown at the scale of a livelihood and a territory.

The findings reveal that correspondence failure is structured by inequality. Position relative to the threshold of ontological breakdown is shaped by material resources and access to water. Governance that corresponds with privileged positions fails to correspond with marginal ones. This differential correspondence constitutes a dimension of environmental injustice in which the same formal response produces different outcomes because it meets different realities.

Limitations of this analysis should be acknowledged. The study captures farmer perspectives, and research with state actors would provide additional understanding of institutional constraints on correspondence. The single-case design means that comparative research could examine whether correspondence failure operates similarly in other slow-onset crises. Political ontology illuminates the nature of mismatch but does not itself provide governance solutions.

A full account of what correspondence would require exceeds the scope of this analysis. It would demand attention to how governance might learn to see differently and to the ethics of responding together with those affected. These questions remain for future inquiry.

The finding that some farmers have crossed the threshold without knowing it opens questions about whether the anthropo-not-seen also includes what the governed themselves cannot perceive from within a collapsing configuration.

But some of the farmers of the Limarí do know they have crossed a threshold. The old saying that Ovalle strangles but doesn't kill does not properly describe life anymore, and the farmers who are experiencing the breakdown know it. The challenge is governance capable of recognizing when its categories have ceased to fit and of responding to qualitative change. Under the Capitalocene, such recognition may require transformation of the extractivist logics that organize governance itself. Until then, ontological breakdown will continue to fall into the anthropo-not-seen, perceived by those who experience it but invisible to the institutions that claim to respond.

What Correspondence Would Require: Practical Directions.

This chapter does not prescribe specific policies, because a single case study cannot ground that kind of claim. But the findings point toward structural features that governance would need to develop if it were to move toward correspondence with the situation farmers in the Limarí inhabit.

First, categorical mismatch suggests that governance needs threshold-based categories that can register qualitative shifts, not only gradients of severity. The formal distinction between drought emergency and normal conditions does not hold a situation where cultivated area has contracted by roughly seventy percent and reservoir distribution has dropped to a fifth of its historical capacity. Participants described conditions that exceeded the criteria for catastrophe designation even by the metrics governance itself uses, yet the designation had not been made. Automatic triggers tied to infrastructure thresholds, like reservoir levels, cultivated area, and debt-to-income ratios, would begin to address the categorical gap. Debt relief linked to these triggers would acknowledge that the financial damage of prolonged drought is structural and cannot be resolved through seasonal credit cycles. No single threshold captures breakdown, but governance needs categories capable of registering when a configuration has collapsed.

Second, temporal mismatch points to the need for permanent institutional presence. Several farmers described a pattern in which governance attention arrived with political visits and disappeared with the first rain, a cycle that repeated across administrations without producing sustained response. Chronic crisis requires institutional architecture that does not reset with electoral or meteorological cycles, which is what one participant meant when demanding a permanent drought delegate. A permanent office responsible for drought governance in affected territories, with a mandate that extends across administrations and is not contingent on emergency declarations, would begin to match the temporality of the crisis it is supposed to address.

Third, differentiated breakdown reveals a structural gap in the existing governance architecture. Small farmers access INDAP programs and large operations have corporate resources, but mid-size farmers, too large for small-farmer support and too small for corporate resilience, fall into a category that governance does not recognize. Programs designed for this middle tier, with eligibility criteria that reflect the actual distribution of farm sizes in the valley, would address a form of environmental injustice that operates through categorical invisibility and not through the absence of programs.

IV. Chapter 4

1. Introduction

She was screaming at me, but I could not immediately understand what she wanted. The barn was hot, the air thick with the smell of pine shavings and manure in an enclosed space. I tried not to pay attention and keep doing the work I was supposed to do, following the instructions given to me by the person who runs the farm, but she was not going to be ignored. She had something to say, something she wanted from me, and I was not doing the necessary work to meet her where she was. I was not actually paying attention to her.

This was my fourth visit to the sanctuary, a summer afternoon in the rural mid-Atlantic, the kind of heat that burns and sits on your skin. By then I had learned some things, like how to fill the water buckets, where the feed was stored, which enclosures to clean first. At that point, I lacked the capacity to properly interpret her message. She screamed because us volunteers missed social cues about treats, which became apparent only after we had changed the water for Wallace and his companions without bringing them food. They vocalized their displeasure. Maise is a potbelly pig. Learning to read her signals took time, requiring presence, attention to patterns, repeated visits. By my later trips managed to understand that her screaming communicated different things in different contexts, that it carried information about her needs and expectations, that it was directed at me as someone who might respond.

This chapter examines farm animal sanctuaries as spaces where care labor cultivates a form of knowledge that governance frameworks cannot produce. I build from ethnographic fieldwork conducted at a sanctuary in the northeastern United States, a site that houses approximately sixty-six animals. One person, Jenniffer, runs it with limited volunteer support, and the work involves feeding, cleaning, shoveling manure, tending to wounds, and attending to the particular needs of individual animals. Through this work, sanctuary workers develop the capacity to correspond with animals, to place themselves alongside other beings and respond to them as subjects. I also attended a regional One Health workshop during my fieldwork period, an experience that made visible the contrast between sanctuary practice and the ontological understanding that characterizes most governance approaches to animal agriculture.

My main argument is that traditional agri-environmental governance cannot cultivate empathy because its frameworks stabilize animals as hazards, resources, and emissions sources, disappearing the living creature into the category. This stabilization serves governance purposes, explained in part because governing emissions from animal agriculture at global scale requires turning animals into calculable metrics. This stabilization also reflects what Maechler and Boisvert (2024) call valuation-centrism, a style of governance that defines nature exclusively as natural capital while systematically marginalizing alternative definitions of what nature is. Animals become resources through discourse and economic practice, turned into units that serve the extractive logics of agri-environmental assemblages. This framing forecloses certain relations. Animals who communicate and experience trauma, who form relationships and play, cannot appear within these frameworks as beings capable of engagement, only as things to be controlled (Arora et al., 2020, 2026). They persist as individuals disentangled from the networks that turn them into resources, but governance cannot see them.

I use the vocabulary of political ontology to analyze this situation. Following authors placed in the ontological turn (Blaser, 2009; de la Cadena, 2019; Mol, 1999), I treat ontology as practice, which means that different arrangements of bodies, technologies, institutions, and habits enact different realities. Climate governance enacts animals as calculable objects. Sanctuaries enact them as subjects of care. The same beings appear differently depending on the practices that make them visible. The political question is which practices get institutionalized. The ethical question, raised by multispecies justice scholarship, is whether governance's inability to see animals as subjects constitutes an injustice that demands contestation (Celermajer et al., 2022; Pellow, 2023).

Empathy, understood as something cultivated through practice, enables correspondence with beings that calculative frameworks cannot recognize. Sanctuaries cultivate empathy through embodied care, producing knowledge about animal needs, responses, and flourishing that governance cannot produce. Simply by existing they also constitutes an ontological refusal of the stabilization dominant frameworks require. This refusal has diagnostic value, revealing what governance excludes and what forms of knowledge it cannot produce.

Sanctuaries are structurally marginal. The sanctuary where I conducted fieldwork operates on donations and the personal funds of the owner, housing sixty-six animals while the industrial system it opposes processes nine billion chickens annually in the United States alone. Sanctuary workers understand this difference and do not claim to be replacing industrial agriculture. The sanctuary operates at a scale where empathy is possible and correspondence can develop, where animals can appear as individuals. This marginality is part of my argument because what empathy requires might be impossible to square with what governance at scale demands, and this explains why governance lacks what sanctuaries cultivate.

The chapter proceeds as follows. I first review literature on animals in climate governance, situating the problem within debates about valuation-centrism and the Anthropocene, before turning to political ontology, multispecies justice, and work on empathy and correspondence. I then describe the ethnographic site and methods. The empirical section presents my observations as a volunteer, focusing on topics like care work, spatial distribution, and narratives and histories. An epilogue described my trip to a regional One Health workshop during the fieldwork period, which crystallized the contrast between sanctuary practice and governance framing. In the discussion, I develop the argument that empathy is what governance lacks and what sanctuaries cultivate, focusing on the implications of this feature for understanding the limits of current agri-environmental governance. I conclude by considering what this diagnostic analysis means for thinking about governance and its possibilities.

2. Animals and Agri-Environmental Governance

2.1 Animals, Agri-environmental Governance, and Farm Sanctuaries

The presence of animals in agri-environmental governance arrangements tends to appear through sustainable development, climate change mitigation, and biosecurity framings, which position animals primarily as objects of management, resources to be optimized, or risks to be contained. Scholarship on animals and climate governance has documented how policy frameworks position farmed animals as sources of greenhouse gas emissions requiring technical intervention, whether through feed additives, manure management, or breeding programs aimed at reducing methane output per unit of production (Arcari, 2020; McGregor et al., 2021;

McGregor & Houston, 2018; Twine, 2020). This framing renders animals calculable, transforming living beings into variables within carbon accounting systems. Narayanan (2016) extends this analysis by showing how sustainable development frameworks construct animals through a logic of instrumentalization that limits consideration of their subjectivity or wellbeing as ends in themselves.

The calculability of animals within governance arrangements might relate to what Maechler and Boisvert (2024) call valuation-centrism, understood as the assumption that environmental problems can be adequately addressed through economic valuation and market-based mechanisms. Valuation-centric approaches need commensurability, so the diverse qualities of beings and relations get translated into comparable units like carbon equivalents, ecosystem service values, or productivity metrics. This translation produces a capitalocentric (Gibson-Graham, 1996) imaginary where nonhuman life appears as a factor of production or a site of externalities to be internalized.

A different kind of governance framework has emerged at a global scale in parallel to these valuation-centric approaches. One Health is an international framework promoted by the World Health Organization (WHO). The WHO describes it as 'an integrated, unifying approach to balance and optimize the health of people, animals and ecosystems' (World Health Organization, 2023) that is applied to areas such as antimicrobial resistance, zoonotic diseases, vector-borne diseases, food safety, and environmental health. The One Health framework integrates human, animal, and environmental health under unified governance structures, and it has produced real results. Cross-sectoral surveillance programs have contained outbreaks that single-sector approaches missed, and coordinated antimicrobial stewardship has reduced resistance in agricultural settings where governments committed resources to it (Hernandez et al., 2025). The Lancet One Health Commission, a panel of international experts convened by the medical journal *The Lancet* to produce a comprehensive synthesis on One Health (Winkler et al., 2025), pushes the framework further than previous versions, grounding it in principles of epistemological pluralism, equity, and stewardship. The Commission calls for evaluation frameworks that account for the wellbeing of animals and the environment alongside human health, and for governance reforms that go beyond the zoonotic disease focus that characterized earlier versions of the framework

(Hinchliffe, 2017). One Health has moved the governance conversation past the narrow instrumentalism of animals as disease reservoirs if the Lancet Commission is representative of the current state of the conversation in varied contexts and scales. The framework recognizes that human, animal, and environmental health are connected in ways that require coordinated responses. But there is still a limitation that concerns this research. Even in the Commission's expanded vision animal wellbeing appears as a component of how socioecological systems function. This framing sees that welfare is relevant only because it contributes to outcomes measurable at population and system scales (Lainé & Morand, 2020). The individual animal cannot appear within this framing as a subject of governance concern.

The political economic dimensions of agri-environmental governance play a critical role in shaping which ontologies of animality become dominant. The animal agriculture industry applies substantial influence over policy processes through lobbying, research funding, and participation in regulatory bodies (Jacquet et al., 2025; Loy & Jacquet, 2025). This influence tends to limit governance pathways that might challenge the ontological status of animals as property and commodities. Lucas (2021) argues that the structural power of agricultural capital operates by naturalizing certain ways of relating to animals while rendering alternatives unthinkable within policy discourse. The result is a governance landscape in which animals appear as objects to be counted, managed, and optimized, but rarely as subjects whose perspectives might inform how multispecies relations are organized.

Farm sanctuaries have emerged as important locations for contesting this governance regime. Sanctuaries operate outside the logic of production and valuation that characterizes agri-environmental governance, providing spaces where animals can live without serving instrumental purposes (Gillespie, 2018). Ethnographic research at farm sanctuaries has documented the daily practices through which caregivers attend to individual animals, learn their preferences and histories, and organize sanctuary life around animal needs (Rosenfeld, 2022; Scotton, 2017). This scholarship can be organized around two orientations that emphasize different dimensions of sanctuary work and its political significance.

The first orientation emphasizes the forms of care, refusal, and alternative relationality that sanctuaries enact. Weisberg (2024), drawing on Marcuse, argues that sanctuaries participate in political refusal simply by existing, regardless of whether they consciously organize as sites of activism. She claims sanctuaries create conditions for new ways of living with animals beyond the logic of domination and capital. The everyday activities of feeding, sheltering, and attending to animals transform caregivers into people who cannot participate anymore in the systematized violence that governance arrangements normalize, and this transformation operates through practice, not ideology. Abrell (2021) develops a related argument, describing sanctuaries as countersites where interspecies care becomes collaborative labor, a process through which humans and nonhumans learn to live together in specific places while contesting the ontological categories that governance relies upon.

The second orientation asks whether and how animals might participate in the governance arrangements that affect their lives. Donaldson and Kymlicka (2023) provide the theoretical foundation through their argument that domesticated animals should be understood as co-citizens with claims to membership in political communities. Blattner et al. (2020) extend this through ethnographic research documenting the forms of agency that animals exercise through spatial practices, social roles, and participation in community norms, showing animals claiming and modifying spaces while integrating into multispecies communities where conflict resolution becomes shared practice. Castelló (2025) more recently builds on this tradition by arguing that animals at sanctuaries demonstrate norm compliance, cooperation, and protest, capacities that are necessary for participation in deliberative democracy.

Both orientations have generated important insights about what sanctuaries make possible. The first shows that sanctuaries constitute sites where the dominant ontology of animals as calculable objects can be refused through practices of care and attention. The second shows that animals possess capacities for political participation that governance arrangements fail to recognize. Nevertheless, these insights have not been brought into deep conversation with agri-environmental governance as a specific object of critique. Weisberg's interlocutor is Marcuse and the broader critique of technological rationality. Castelló and Blattner et al. are primarily concerned with demonstrating that animals meet criteria deliberative democratic theorists have

established for political participation. The specific governance arrangements that render animals calculable have remained mostly outside the frame of sanctuary scholarship.

This chapter addresses that gap by bringing sanctuary ethnography into conversation with agri-environmental governance through two analytical approaches: political ontology and correspondence. The following subsections develop these approaches before turning to the methods section and the ethnographic material.

2.2 Political Ontology and the Stakes of Exclusion

Which animals become objects of institutional concern, and on what terms, is shaped by cultural processes that determine how nonhuman life gets categorized, valued, and made visible within frameworks for managing nature (Lorimer, 2007; McCumber, 2026). Political ontology treats these processes as world-making in a specific sense, since ontologies are embodied in practices that enact realities and not only expressed through the categories and valuations that organize them (Blaser, 2009; Escobar et al., 2024; Mol, 1999). Different practices enact different realities, and the political question is which realities get enacted and which get excluded. Scholars (Blaser, 2024; De la Cadena, 2015; Escobar, 2017) developed this approach through engagement with Indigenous politics, arguing that conflicts over resources often involve ontological dimensions that Western frameworks cannot recognize. When Indigenous communities defend territories, they sometimes defend relations with beings that Western ontology does not acknowledge, and these conflicts concern what exists, what counts as real, what can appear as a matter of concern.

De la Cadena (2019) introduces the concept of the anthropo-not-seen to name beings and relations that exceed anthropocentric categories and are erased by modern and colonial governance structures. These beings persist but cannot appear within dominant frameworks, which lack the categories to make them visible. Climate governance, in the same way, cannot see animals as subjects of care. These animals persist whether or not governance sees them, meaning that their exclusion is an effect of how governance is organized, not a reflection of what animals are.

Non-human animals can only appear as subjects within arrangements that provide the conditions for empathic engagement. In governance frameworks organized around calculation, these

capacities persist but cannot become visible because the frameworks lack categories through which they could appear as matters of concern. De la Cadena's concept of the anthropo-not-seen helps illuminate the exclusion from the domain of what counts as real for governance purposes. The ontological stakes concern which realities governance can respond to and which remain outside its field of vision, a question with practical consequences for what interventions become possible and what arrangements get reproduced through policy.

Sharp et al. (2024) apply political ontology to dairy consumption in New Zealand, describing dairying as embedded in intransigent agrifood political ontologies. Their claim is that identities and practices are co-constituted, so changing practices requires changing identities. This insight applies to governance as well, suggesting that governance frameworks shape what practitioners can see and how they understand their work. The ontological stabilization of animals as resources is enacted through the daily practices of those who work within governance frameworks, from how veterinarians are trained to how metrics and categories are defined.

Puig de la Bellacasa (2015) extends political ontology to examine human-soil relations, arguing that productionist agriculture enacts soil as resource through temporal practices oriented toward accelerated yield and future value extraction. She identifies what she calls technoscientific futurity, a temporal regime that compresses present engagement in service of projected output, rendering it as substrate for crops while foreclosing ontologies of soil as living community. This temporal dimension of ontological exclusion applies to agri-environmental governance, which operates through monitoring cycles, baseline measurements, and emissions targets that similarly orient practice toward future outcomes. The calculative temporality of climate governance enacts animals through the same productionist logic that Puig de la Bellacasa identifies in soil science, translating living beings into manageable units whose value derives from their contribution to or subtraction from projected futures.

The exclusion of animals from governance concern raises ethical questions. Multispecies justice scholarship argues that the Anthropocene demands new frames of reference that recognize nonhuman animals as recipients of climate injustice (Celermajer et al., 2022). These approaches draw from environmental justice, animal rights, feminist philosophy, decolonial theory, and

interspecies anthropology to decenter human exceptionalism and foreground the relational nature of human life. The normative force of this analysis derives from the claim that animals' exclusion from governance concern is an ethical failure. If animals are potential recipients of injustice, then governance arrangements that cannot see them as such institutionalize injustice through their very categories. The structural features of calculative frameworks limit the possibility of recognizing certain beings as bearers of claims, which naturalizes their exclusion from the domain of justice. Sanctuaries contest this naturalization through practices that enact animals as beings whose flourishing matters independently of their contribution to human projects.

Critical Environmental Justice approaches integrate the category of species into the intersectional constructs that condition how environmental injustices impact different groups of humans and nonhumans (Pellow, 2023, 2025), Pellow borrows insights from the abolitionist movement to argue for radical visions that contest existing arrangements and build alternatives. Parallel to these frameworks, scholarship on the political ontology of climate change identifies cognitive injustices in how nature and reality are constructed and what kinds of actors and activities sustain them (Burman, 2017). If governance frameworks cannot see animals as subjects, then those frameworks are unjust. The normative claim is that this exclusion demands contestation, that the foreclosure of multispecies flourishing from governance concern is an arrangement that could and should be otherwise.

2.3 Empathy and Correspondence

If governance frameworks exclude animals as subjects, the question becomes what capacities would be required to relate to them differently. Vinciane Despret argues that empathy is not innate but has to be nurtured and placed into practice. Her work on human-animal relations examines how researchers and caretakers develop the capacity to understand what is meaningful for animals, a development that requires bodily engagement. The absence of the body in scientific research limits what can be known about animals. Embodied empathy, by contrast, emerges through shared presence and attention to how animals respond. Despret considers empathy as a methodological tool and disposition, instead of an emotion or the ability to mentally place oneself

in the shoes of another. Despret mentions that her definition of empathy is “the process by which one delegates to one’s body a question, or a problem, that matters and that involves other” (2013, p. 69). Thus, empathy is not feeling what the other feels, but making one’s body available for the response of another being. It is a cultivated, embodied attentiveness that develops through sustained engagement, where the researcher or caretaker learns to act with an animal rather than to interpret from a distance.

Despret's concept of correspondence also plays a critical role in this chapter's argument. Correspondence is about making oneself available to respond, to make embodied empathy something that can happen. It requires becoming someone to whom an animal can direct communication and from whom a response might come. This availability requires what Despret (2013, p. 59) calls 'partial affinities,' connections built at the margins of two embodied experiences where neither party remains unchanged by the encounter. The primatologists she studies learned to act with their baboons, which transformed how they moved, how they used their eyes and voice, how they inhabited shared space. Despret acknowledges that this approach is controversial and always under suspicion of being unscientific, since trying to reconstruct what is meaningful for animals and their perspectives challenges norms of neutral observation. The question is whether neutral observation can produce knowledge adequate to beings who communicate, respond, and act. Despret suggests it cannot, so understanding animals as subjects requires engaging with them as subjects and cultivating the capacity to correspond with them in practice.

Care ethics literature expands these insights into agricultural contexts. Seymour and Connelly (2023) apply a more-than-human ethic of care to regenerative agriculture in New Zealand, finding that farmers who engage in regenerative practices develop what they term regenerative relationships, characterized by attentiveness to more-than-human bodies, recognition of interdependence, and willingness to relinquish control over natural systems. Ellis (2022) examines urban beekeeping and finds that hobbyist beekeepers develop sensuous and embodied relationships with bees through practices organized around bee flourishing, not productivity. These studies suggest that empathic capacity can develop in agricultural contexts when specific

conditions are met, such as sustained time with particular animals and an orientation toward flourishing over extraction.

3. Method

This research is an ethnographic exploration of the relations and practices entangled in farm sanctuary work, informed by multispecies epistemologies. This research is an ethnographic exploration of the relations and practices entangled in farm sanctuary work, informed by multispecies epistemologies. Since the time Kirksey and Helmreich (2010) named multispecies ethnography as an emerging genre, the field has continued to develop along several lines, and scholars working within it take different positions on what the label requires. In their exploration of connections between ethnography and multi-species research, Hamilton and Taylor (2017) frame this space as an emergent paradigm that features a diversity of emerging approaches. The authors prefer calling this space of research 'multi-species methods' or 'human–animal ethnography,' on the grounds that 'multispecies ethnography' can be too narrow a label for projects aimed at accounting for animal subjectivities. García (2019) raises a different concern, arguing that multispecies research in contexts of animal confinement, production, and death generates ethical and methodological tensions that inherited anthropological frameworks leave open, and that working reflexively with these tensions is part of the methodology. These approaches share a commitment to address the anthropocentric bias of traditional ethnography, and reflecting on the pathways and insights of their experiences.

More recently, Cudworth (2024) has also reflected on the challenges of decentering the human in qualitative methods, identifying a paradox that presents a complex task for multispecies research. The inclusion of animals in research design does not prevent researchers from writing and thinking from an anthropocentric point of view. From her own research experience, Cudworth identifies a change in her perception from the design phase through to the writing, initially seeing herself engaging with multispecies research but after noticing her reliance on participant observation, interviews, and her own reflexivity, having trouble framing her research. Cudworth identifies this phenomenon as conforming to the inevitable humancentrism of ethnographic imaginations. More importantly, Cudworth recognizes the value of failing at doing

multispecies research, suggesting that experimenting with different field sites, contexts, and multispecies connections, and reporting on those experiences, might help social scientists identify and deal with the coloniality and anthropocentrism that are enmeshed in our research practices.

My methodology acknowledges and resonates with Cudworth's experience. While initially I was driven to de-emphasize humans and provide space for more-than-human subjectivities, after my first visits I noticed that most of my notes of observations are based mostly on my own experiences. Like Cudworth, I understand the value of an original disposition to challenge the ethnographic method to be responsive to multispecies worlds, while also acknowledging that in certain contexts is not possible to achieve.

In this work I employ ethnographic observation, collection of animal biographies, and attention to embodied experience to capture how the changing ontological positions of animals determine a specific set of socio-ecological relations. This research design is oriented towards addressing the ontological questions raised in the literature review. If conventional agri-environmental governance reduces animals to resources through both discourse and practice, then methodologies that illuminate alternative ways of relating to animals as subjects are critical for imagining different governance possibilities. As Hamilton and Taylor (2017, p. 176) identify, since animals do not write or tell, the researcher's task is to use human storytelling to bring them into the account as subjects with social importance. The methodological orientation in this chapter follows that framing. It builds an account of sanctuary life in which the animals appear as subjects, while the account itself remains supported by human experience and observations.

The primary site was a farm animal sanctuary in the northeastern United States, housing approximately sixty-six to sixty-seven animals from different species. Cows, pigs, goats, sheep, turkeys, roosters, hens, and ducks all inhabit this space. The property is approximately the size of six soccer fields and is operated by a single primary caretaker, Jennifer, with volunteer support. Fieldwork spanned from June through August 2025, consisting of 10 volunteer shifts totaling approximately 50 hours of on-site labor. Data collection involved participant observation through active engagement in daily care routines, such as feeding, cleaning, shoveling manure, and

tending to animal needs. Field notes documented daily care routines, animal behaviors, infrastructure, conversations with the sanctuary operator, and my own embodied experience of sanctuary labor.

Additionally, I attended a regional One Health workshop hosted by a university and clinic during the fieldwork period. The workshop lasted five hours and involved veterinarians working in animal agriculture. My attendance was observational, with notes taken on how animals appeared within workshop discourse and how global One Health frameworks were translated into regional practice. This observation provides a point of contrast for understanding how governance frameworks enact animals differently from sanctuary practices.

My observations were formalized in fieldnotes I took every time I visited the sanctuary, whenever I could write on my phone during the volunteering work and right after the work ended while returning home. Most of my notes were directed at describing the materiality of the sanctuary and the main highlights of a day, using a hierarchical structure based on my own tacit knowledge (Wolfinger, 2002), and paying special attention to the activities done and the interactions with the inhabitants. I also kept records of the materials I received in the workshop, along with the relevant notes I took during the workshop itself. When turning my notes into manageable data, I replaced the original names of human and nonhumans with aliases to guarantee their privacy and safety. My analytical approach aligned with what Harrison (2018) describes as an iterative-inductive process, where repeated engagement with fieldnotes generates insights as observations and theoretical frameworks interact, not by applying formal coding procedures. I organized my notes into a narrative structure guided by the temporality of the fieldwork and the theoretical concerns of this chapter. The analytical categories that structure the results section emerged through the process of writing itself instead of following a discrete coding phase. This orientation follows the post-coding movement in qualitative inquiry (Brinkmann, 2014; MacLure, 2013; St. Pierre & Jackson, 2014; Ulmer, 2017), which questions the idea that data exist as ready-made objects in the world, waiting to be collected and neutrally processed. If meaning is instead produced through the researcher's engagement with theory and with the particulars of a field, then what counts as data expands beyond what participants say to include the texts, concepts, and embodied experiences through which a project is made thinkable. The analytical approach

engages with political ontology and Despret's work on embodied empathy. I focus on how empathy is cultivated through practice and the knowledge it produces, and on how sanctuary practices constitute ontological refusal of the categories through which governance operates. My positionality as a volunteer participant aligns with Despret's argument that understanding animals as subjects requires engaging with them as subjects. I was not a purely observational researcher, and the engagement that shaped my analysis developed through physical labor and embodied experience. Other ethnographers have used the researcher's body as a source of knowledge in similar ways. For example, Wacquant (2005) does this through his apprenticeship in a Chicago boxing gym to properly describe the experience of habitus formation in relation to the body, and Holmes (2013) is able to describe the pain and inequalities involved in agricultural labor through his fieldwork with migrant farmworkers in the United States. This research follows that approach.

4. Results

4.1 Getting the Lay of the Land

There is a large Confederate flag waving ten minutes before arriving at the sanctuary. It sits near the highway, visible from the road, working as a reminder that this place exists inside a larger world that does not share its normative perspectives. The drive takes you through rural landscape, past farms where cows stand in fields without shelter and the kind of countryside where roadkill appears on the asphalt and nobody stops. But whenever I turned onto the property I could feel a shift, as in entering a different world, even if the road to the farm is only a two-minute drive, it felt like I was entering a place that was qualitatively different.

The property was once on a farm. Jennifer bought it and repurposed it for sanctuary work, and the sanctuary now sits surrounded by animal farms. The neighboring property is home to a herd of goats raised for goat-based products. I saw some of them during my visits but never interacted with them. One afternoon, having a glass of water in Jennifer's kitchen, she mentioned that she uses filters because of the high chance that runoff from nearby dairy operations has polluted the groundwater. The agricultural landscape surrounding the sanctuary shapes its material conditions.

The sanctuary housed sixty-seven animals when I began my fieldwork in June 2025, sixty-six by the time I finished. Only one person runs it. Jennifer does the daily work of feeding, cleaning, and caring for all sixty-six animals, with volunteer support that comes and goes. She told me that her turning point came during the COVID-19 pandemic, when news stories reported animals being culled because processing plants had shut down. That was her aha moment. She described the chain of death that precedes sanctuary arrival. Animals dying in UPS trucks during transport, at Tractor Supply stores, in the homes of people who buy them without knowing how to care for them. Only some make it to places like this one. She learned more about it while opening the sanctuary. The residents of the sanctuary have arrived because they have been abandoned, subjected to cruel treatment, or managed to be separated from the animal–industrial complex where they were born to be killed.

The property has a spatial logic organized around animal needs and the practical requirements of care. At the entrance, ducks enjoy a small pool and grass, joined by some hens and roosters. The barn comes next, housing Stella and Maisie, two potbelly pigs who share a space. Maisie screams. She screams loudly and constantly, a sound that carries across the property, that you learn to interpret over time. Next to the barn, more ducks and roosters and hens have their enclosures, and next to them is where the sheep and goats spend the night. A fenced area beside the barn is where the sheep and goats move during the day, climbing structures Jennifer built for them, trying to eat your clothes if you get close enough.

Up a small hill sit four chicken coops arranged in sequence. In the first, two turkeys live with Edgar, a rooster. The next coop holds one rooster and three hens, then three more hens in the following one. The final coop is where Kieran lived before he died, where four roosters became three became one over the course of my fieldwork. The roosters and hens have whole corncobs that serve as entertainment and food. Some of the hens wear protective covers that shield them from the mating pressures of the roosters. Some of the female ducks do not have that protection, and you can see the backs of their heads missing plumage since they cannot fight back. These ducks cannot fly, a consequence of breeding practices that have turned them into manageable food sources.

Down the hill is the cow shed, where about ten cows sleep and find shade and protection from rain. Jennifer mentioned that cows on neighboring farms do not have the same luck. The shed looks cramped when all the cows are inside during hot afternoons, bodies pressed together, but they choose to be there. During the heat wave that coincided with my early visits, the air felt heavy and the humidity oppressive. Flies swarmed the cows constantly, and I watched them try to get rid of the insects by swishing tails and shaking heads. We would try to spray them with a product that repelled the flies, but some of them did not like it and ran away from us.

About five minutes walking from the main area, a fenced enclosure holds Wallace, Cassia, and Henry, three large pigs. Two of them apparently escaped from a truck headed to a finishing farm and had been residents for a long time. The younger one, Henry, had only recently been approved to move from the barn and share the space with his comrades. They have a small shed where they sleep and two mud pools, holes where water collects for the mud baths that pigs need because they lack sweat glands. Wallace and his companions eat forty pounds of food daily.

The infrastructure that sustains daily life at the sanctuary carries a certain tension, since much of it comes from the same industrial system the sanctuary refuses. The pigs eat 'hog fattening feed' from bags designed for production operations. The buckets and chicken coops were built for farms oriented toward output, not care. Jennifer gets feed and products from the local agricultural supply store. The motorcycle she uses to move between areas of the property, pulling carts loaded with feed or manure, is essential to operations but breaks down, gets stuck, and requires constant maintenance. The compost pile is about half the size of a soccer field, a mountain of decomposing manure that you walk on like snow, sinking with each step. There is limited technology. The work is physical, done with rakes and shovels and carts.

The sanctuary operates as a space where the rules that govern animal life elsewhere do not apply. Inside the fence these animals are not food. They do not suffer the conditions of animal agriculture. They live for themselves, their daily lives are not organized around future use but around simply living. Jennifer cares for them so they can be good and happy. The sanctuary exists within a larger world where animals are resources and the logic of extraction organizes relations

between humans and other species. This context shapes what sanctuary work requires and what it makes possible.

Jennifer runs this operation mostly by herself. Volunteers help on some days, but she carries the burden of the daily labor and financial costs, the feeding and cleaning and tending to wounds and managing the complex social dynamics of sixty-six animals who have preferences and dislikes, who get along with some and not others, who require attention to their particular needs. She does this work with limited resources, dependent on donations and occasional grants. Sometimes it feels unstable, like it might all disappear or crumble in the blink of an eye. But Jennifer and the inhabitants of the sanctuary take it day by day.

4.2 The Hard Work of Caring

One of things I expected to be doing as a volunteer was to pet animals and play with them. When reading about multispecies scholarship, especially the one connected to ethological work, I imagined spending time developing rapport with the non-human participants of my research. Actually, an important part of my time was spend shoveling and transporting manure. This gap between expectation and reality says something about what sanctuary work involves, which is less about the moments of connection that draw people to care for animals and more about the daily labor that makes those moments possible. The work is repetitive. There is need to deliver food and water for all animals, cleaning buckets and pools with brushes, shoveling shit. This last phrase carries negative connotations in common usage, but in this context we do it to care for the wellbeing of the animals and their space. It's work that requires physical activity, and Jennifer, who was in her late 60s, felt it daily because of the bruises, strains, and even fractures that come with farm management at this scale.

The routine begins in the morning when Jennifer arrives to open the enclosures. The animals are waiting. They cannot be let out before she gets there because of predators like hawks and skunks. There is a dog that might help with protection, but the animals need to be confined overnight for their safety. On the days when Jennifer was late, because she had to go to the doctor or because something else came up, everyone was pretty mad. Ducks, roosters, sheep, and pigs vocalizing a lot, letting us know by screaming that they wanted out.

Once the animals are released, the work begins. We start with food and water, moving from one area to another with buckets of feed and fresh water. We cleaned the pools where the ducks hung out. It could feel like the work without merit, since once they could access the clean water they immediately pooped. We cleaned the areas where the sheep stay, where the goats roam, where Stella and Maisie live. We placed wood shavings and pellets that absorb the manure. The smell of pine shavings mixed with the smell of animals and waste.

Scooping cat litter does not prepare you for shoveling manure. This was one of my early realizations. The scale is different, the weight is different, the physical demands are different. My first visit to the sanctuary happened during a heat wave. The air was heavy with humidity. We sweated a lot. Most of the animals were trying to deal with the heat, finding shade under trees, seeking the cool air from fans in the barn and shed. We spent one or two hours in the cow shed that first day, shoveling manure. Bertie, one of the friendlier cows, was with us a lot of the time. We had to move the cows so we could rake and shovel, place the waste in a wagon, then move it to the compost pile. Wood pellets go on the floor to absorb what comes next. When we finished, the cows came back and started playing with the fresh bedding, tossing it around, helping to spread it. They looked happy.

The physical intensity of this work requires an able body capable of labor. I felt it in my legs, my lower back, my hands. I got blisters from using the rake and shovel. My feet were sore and tired by the end of our shifts. My body hurt. I would not have been able to do this without help. Jennifer does this daily, mostly by herself. It is work that is hard on the body, and I think about how this labor is something constant for her.

During one of my visits, I was cleaning the cow shed and found myself standing between Puck and Barnaby, two of the larger cows. I felt so small. They could have easily crushed me between them. They weigh around 2000 pounds. They did not crush me. They watched, they licked things, Puck licked everything she could reach. Barnaby headbutted another volunteer hard, which Jennifer told us was a sign that they were accepted. Knowledge of animals accumulates this way. Through bodily presence, through being close enough to be licked or headbutted, through feeling your own smallness next to beings who could easily move you around.

Stella and Maisie, the potbelly pigs in the barn, are on a diet. They grew too large because they were not cared for properly in their previous home, living close to their own feces, not getting the attention they needed. Now they get measured portions and belly rubs. Maisie bit me on the leg during my first visit, a tight grip that did not break skin but let me know she was there.

The labor here is economically unproductive in the conventional sense. Every inhabitant produces a lot of manure. The hours spent shoveling that manure generate no commodity, create no market value. While I was raking one day, I thought about how valuable this manure might be for some farmers, and how value is actually something that does not matter here. The work is about maintaining lives. It is, in a way, turning potential lives that were about harm, abuse, and neglect into lives that can be about simply living.

At the end of my shifts, I would hope that my work made their living conditions better, that it alleviated Jennifer's workload. This hoping is part of the labor too, part of what develops through physical engagement with the animals and the place. You become invested in their wellbeing because your body has worked for it. The labor of care is about making oneself available, becoming someone the animals might address and to whom they might direct their needs. Correspondence is felt in the body.

The sanctuary requires infrastructure to keep running. Fences to keep everyone where they can be cared for best. The shed for the cows, the enclosure for Wallace and his companions, the fence that keeps the goats and sheep in a specific place, the barn, the coops for the birds. All of this requires maintenance. We helped repair fences that were broken during one visit. The material world of the sanctuary demands constant attention, labor, and presence. Maintaining a space that enacts alternatives is difficult work, and the body keeps a score.

4.3 From Care to Correspondence

Learning to read what animals communicate takes time. On my fourth visit, we missed social cues. Maisie screamed so high that I could not hear Jennifer or the other volunteers. We later understood that she screamed because we did not give her treats. Wallace and his companions were 'hangry' because we went down to change their water and did not bring them any food. By then I had been to the sanctuary several times. I thought I was getting the hang of it. I had not

yet learned to read what the animals were telling us. I realized that correspondence develops through repeated failures to respond adequately. And that gradual adjustments bring you closer to what the animals are trying to communicate.

Maisie screams so much. This was one of my early observations, written down without understanding. She screams loudly and for a long time. On later visits, I began to notice that her screaming meant different things in different contexts. Screaming for treats sounds different from screaming because something is wrong, and both differ from the everyday sounds of pigs being pigs. Developing the capacity to interpret these signals requires presence, attention to patterns, and repeated exposure. It is knowledge that cannot be acquired from a document or a dataset.

The sheep also let us know things by screaming. They wait to enter while we clean their stalls, vocalizing to tell us they want to be let in. For there to be so many animals, one could have thought it might be louder. Maisie and the roosters are the ones who keep being loud, but everyone else keeps mostly quiet. The quiet ones communicate too, just through means other than sound. Cassia, who for a few weeks was confined to the barn while her ear heals, kept tipping her water bucket. I think she was trying to make a mud bath like the one she had outside. This is interpretation, reading behavior as communication, guessing at what an animal might want based on what you know about pigs and mud and confinement.

Each animal has a biography, an origin story that Jennifer shares with volunteers and visitors. Wallace and Cassia jumped from a truck on its way to a finishing farm. The cows were rescued from dairy operations where they were deemed not productive enough, especially the males. The turkeys and roosters came from people who bought them at Tractor Supply and later abandoned them. These stories matter. They circulate through the oral tradition of sanctuary work, told during tours and when training new volunteers. The animals help to co-constitute these stories with their own biographies and personalities. Stella and Maisie were so overweight when they arrived that they could not see properly. They underwent rehabilitation and placed on a diet. Maisie was impatient for her food from the beginning. Henry did not eat or leave the corner of his enclosure when he first arrived. Now he runs around whenever Jennifer drives her ATV, full of energy.

The personalities emerge through repeated contact. Puck licks everything. Barnaby headbutts people he accepts. The goats try to eat your clothes, and you have to grab them by the horns to stop them from going under the fence to eat the pig food. Simon runs back up to where the food is, looking so happy. The cows play with fresh bedding. The ducks poop immediately in clean water. I spent some time screaming with Maisie, matching her vocalizations, which felt ridiculous but also like a form of engagement.

Caring for the animals means being aware of the pecking order, making sure that the weaker ones have access to food and wellbeing. There is a lot of multispecies management involved. Pigs cannot play with ducks because they might harm them. Male ducks need to be kept away from females so they do not hurt them. A rooster can be bullied by other roosters and needs to be moved to live with the turkeys. The turkeys keep laying eggs and do not move as much, even to their own detriment, going hungry and thirsty because they will not leave the nest. Some animals need to be secluded and can only roam freely once others are not around. Stella came out of the stables during one visit and roamed around, using one of the pools for a mud bath, enjoying freedom that was possible because of how the day's schedule worked out.

This management proceeds from correspondence, not calculation. Jennifer does not claim to feel what Cassia feels when confined to the barn, but she has made herself available to Cassia's responses over years of shared presence, and she can read in the tipped water bucket a communication about needs that confinement frustrates. Confining Cassia in the barn while her ear heals means she has to be away from her usual place, away from the mud pools she needs, but the alternative is infection. Another volunteer, watching the ducks file into their stalls, said it looked like school. The confinement is needed to keep everyone safe. These are governance decisions, but they are made through attention to particular animals and their needs. Metrics and protocols play no role.

Jennifer has spent years developing this capacity, learning to read the signals of sixty-six animals, knowing their histories, understanding what each one needs. Volunteers develop it partially through repeated visits. I became knowledgeable enough to take care of feeding and changing water for Wallace and his companions, to stop the goats from trying to eat the pig food. This is

knowledge that comes through embodied engagement, through showing up and doing the work and paying attention.

The accumulation takes time. You cannot rush correspondence. The daily rhythms of sanctuary work are organized around animal needs, around feeding schedules and cleaning routines and the opening of enclosures in the morning and the closing at night. This temporal structure is different from industrial production cycles, where time is organized around outputs and efficiencies. Here, time is organized around care, around the repetitive, attentive, open-ended work of maintaining lives. The work of the sanctuary is to make sure constantly and daily that these animals and their biographies are kept alive and cared for.

Being in a sanctuary is a privilege of being disenrolled from mistreatment. It is material and symbolic work of separation and maintenance. Separation from the physical spaces of harm, maintenance of biographies and lives that would otherwise have ended in slaughter or neglect. The animals are loved and taken care of, referenced as family members.

Death is part of this correspondence. Kieran died during my third visit. We were cleaning the water buckets and feeding the animals, and when we got to the place where the roosters were, Jennifer screamed from her gut. There it was, Kieran's body. She tried to identify where the culprit could have entered, but there was no sign of forced entry. Out of the four roosters in that coop, only one is still alive. There is no hint as to who the murderer was.

Jennifer's scream stayed with me. It came from somewhere deep, a sound of grief for an individual animal whose death mattered.

The faces at the end of my shifts stayed with me. Barnaby, Wallace and his companions, Lula, Puck, the ducks and goats. I left each shift hoping my work made their days slightly better, that it took some weight off Jennifer. This attachment developed through physical engagement, the labor of care, and learning to read what the animals communicate. It is something that grew through repeated presence, through correspondence.

4.4 The Room Where It Happens

The One Health workshop happened right in the middle of my fieldwork. Attending was not a part of my original research plan but it seemed like a serendipitous opportunity to connect my fieldwork with policy-oriented conversations. By then I had already shoveled manure alongside Bertie and Puck, learned to interpret some of Maisie's screaming, and witnessed Kieran's death. The workshop felt like a blip, a parenthesis in my volunteer work, a day spent in an air-conditioned conference room at a hotel instead of in the heat with the residents of the sanctuary. I code-switched into a person from a university. There was no farm work. I just sat there, listened, and took notes.

The symposium was about One Health. It brought together veterinarians, public health officials, and medical professionals. Around thirty to forty people sat in the conference room. I came to the workshop thinking One Health might represent a move past the anthropocentrism of previous governance configurations. I wanted to see how it worked at a local scale, how professionals who deal with animals in a regional context used the framework in practice. The opening remarks placed the event in a context of chaos, political and climate-related, with references to uncertainties in public health produced by recent actions of the US administration. There was a brief mention of the spread of the latest strain of avian influenza. The initial presenter framed the symposium in relation to the need for more research in the context of diseases.

The previous paradigm, which is also the current governance structure, was described as being about deploying the correct drugs for the correct microbes. In the United States, for example, 80% of produced antibiotics are used in agriculture (M. J. Martin et al., 2015). Antibiotic resistance is seen as a public health threat, and much of the symposium focused on antimicrobial stewardship, on being good stewards of these resources so they remain effective. I have encountered the language of stewardship in my other work with farmers, where it relates to taking care of the land and supporting sustainable agriculture. Here the stewardship was about managing antibiotics, managing resistance and risk. The animals appeared primarily as sites where these risks emerge and must be controlled.

One presenter told the room that the threats are closer than we might think. There are bacteria present in cats and dogs, and the potential possibility of transmission for people who sleep with

those animals is higher. She told us that close contact with animals is a potential concern. I thought about my weeks at the sanctuary, the amount of interaction I had with manure and saliva, and the duck poop in the pools. From the perspective of veterinarians at this conference, sanctuary work might be seen mostly as a risk of disease transmission.

There was a joke. One presenter, introducing a talk related to the UN document "Bracing for Superbugs," made a comment about people who keep pet goats in their homes, keeping them in diapers. The joke was about how weird those people are. The room laughed. I did not. The gap between myself and the room opened up in that moment. The goats at the sanctuary do not wear diapers, but they do try to eat your clothes, and Jennifer has built structures for them to climb, and they are cared for as individuals with personalities. The joke assumed a shared understanding that such care is absurd.

The presenters referred to certain animals as "food producing species." This language was used consistently by the veterinarians and public health professionals. One speaker talked about "very cute" steers that are used for food, a matter-of-fact tone that did not register the implications of the phrase. Animals were framed as livestock from the beginning of several talks.

The presenter saw the work of veterinarians as caring to maintain the animal's immune system. This is care of a sort, but it is care oriented toward keeping animals healthy enough to be productive, limiting the possibility of them becoming vectors for disease that might affect humans. The animal matters because their health affects human health and their body might harbor pathogens. This is the One Health framework in practice, emphasizing the connection between human and animal health, but with the connection organized around human risk and benefit.

I wanted to ask questions. I wanted to raise the framing of animals as food and animals as vectors for disease, to ask whether other ways of thinking about animals might be possible. I decided against it. It did not seem like the place where I could get these professionals to change how they saw animals. Their perspectives are intertwined with what they do for a living, the institutional structures that employ them and the animal agriculture industry that their work supports. Veterinarians are tightly connected to this system.

The slogan of the symposium, "One Health, One Voice", made me think about diversity, about whether this framework's emphasis on unity might work against difference. The sanctuary operates with a different voice, one that does not appear in these symposiums. This different voice lacks the institutional backing to move from practices to policies or governance actions. One Health is a relatively recent framework, but it reproduces anthropocentrism and is probably a lot stronger than what farm sanctuaries have accomplished at a policy level. The power differential is vast.

Leaving the workshop felt like finding a subculture I was not aware of, a world of professionals managing animal health for human benefit in conference rooms with air conditioning and poster sessions and coffee breaks. Three days later I was back at the sanctuary, back to the heat and the manure and the animals waiting for their enclosures to be opened. One Health as a paradigm might not be so different from what already exists in environmental governance, or maybe it is different, but not in ways that serve the normative goals I had hoped for. It still carries that animals-as-vectors thinking, the framing of animals as risks to be managed. Care does not enter the equation.

What I noticed most was absence. Empathy and correspondence, seeing animals as individuals with biographies, had no place in the workshop. The capacities I had been developing at the sanctuary, the capacity to notice and respond to what animals communicate, had no place in the technocratic framework of One Health. The framework lacked categories through which they could appear, which meant that empathy, correspondence, and attention to individual biographies remained outside the domain of what the workshop could recognize as relevant knowledge. The veterinarians were not cruel or indifferent. They had dedicated careers to animal health. The ontological framing remained mainly instrumental.

5. Discussion

5.1 What Governance Lacks

The tools available for governing at scale entail rendering animals as calculable objects, which forecloses the possibility of relating to them as beings capable of response. Animals are generally

seen as less-than-human, as co-inhabitants in a world that belongs to us. This means that once animals are rendered as objects within governance frameworks, they cannot elicit the kind of response that empathy involves.

The One Health workshop made this dynamic visible in a particular way. Veterinarians at the workshop were not indifferent to animals. Their professional formation involved years of proximity to animal bodies, and many spoke of their work with evident concern for animal welfare. Krzywoszynska (2019) describes care arrangements of this type as probiotic, in which non-human entities are enrolled into projects of human well-being and attended to because their health is intrinsically connected to human health. These animals shape the conditions from which disease emerges, and their bodies may harbor pathogens that threaten human populations. Care of this kind is real, but it operates within a network configured toward anthropocentric ends, and that the animal remains a node in a system oriented toward human flourishing. Its own flourishing matters only insofar as it contributes to human projects. The relation of care at the sanctuary is configured differently, oriented toward the residents' well-being without reference to what they might produce, cause, or prevent.

This structural impossibility follows from governance's economic premises. To govern animal agriculture globally requires rendering it calculable, measurable in emissions factors, feed conversion ratios, and disease incidence rates. This is what Maechler and Boisvert (2024) refer to as valuation-centrism. The sanctuary operates outside this logic. The hours spent shoveling do not generate commodities or value. This is precisely what allows correspondence to develop. The sanctuary enacts what Gibson-Graham would recognize as a non-capitalist economy of care, one where value is not extracted but sustained.

The absence of empathy from governance frameworks produces specific epistemic limitations that shape which interventions become thinkable and which remain foreclosed. This absence matters in several domains. Governance frameworks that cannot recognize animal communication, trauma, or play cannot incorporate animal responses into adaptive management, address the welfare dimensions of agricultural transitions, or differentiate between arrangements that merely sustain life and those that enable flourishing. These limitations help

explain why policies aimed at reducing emissions often worsen conditions for animals even when they achieve their stated environmental goals. These limitations are intrinsically connected to the tendency of agri-environmental interventions to produce unintended consequences and to encounter resistance from actors whose knowledge operates beyond than calculative abstraction (Arora et al., 2020; Sullivan, 2017).

Empathy, as Despret argues, must be cultivated through sustained bodily engagement with particular beings, a process that requires time, presence, and attention to the specific ways that animals respond and communicate. This process produces correspondence, the capacity to be addressed by and to respond to another being. Over years of shared presence with sixty-six animals, Jennifer has learned what Maisie's screaming means in different contexts, what Cassia wants when she tips her bucket. Jennifer can correspond with these animals because years of shared presence have attuned her body to their signals. This knowledge, produced through embodied co-presence, cannot be scaled to the level at which climate governance operates, transferred through documents or datasets, or institutionalized through policy instruments that require standardization and abstraction.

In a different register, climate governance operates at scales where empathy is structurally impossible. One cannot correspond with nine billion chickens, or with livestock aggregated across millions of farms. Choosing calculative frameworks means choosing scale, and governance that operates globally must abstract from the particularity that empathic relations require. This is a structural feature of global governance, not an accidental limitation that could be remedied through better intentions or more inclusive processes.

The consequence of this structural limitation is that governance produces knowledge of one kind while remaining blind to knowledge of another kind. Governance knows feed conversion ratios, emissions factors, land use patterns, and zoonotic disease risks, all of which can be quantified, compared, and targeted for intervention. It does not know that cows play with bedding, that pigs get hangry when their routines are disrupted, that roosters can be mourned when they die. This blindness matters because it shapes what interventions are thinkable within governance frameworks, constraining the range of possible responses to the challenges posed by animal

agriculture in the context of climate change. Governance that cannot see animals as subjects cannot govern toward multispecies flourishing.

5.2 Ontological Refusal and Its Significance

Sanctuaries work as sites of ontological refusal, where daily care practices contest the stabilization of animals as resources that governance requires. This refusal operates at the level of practice, not discourse, enacted through the labor of individualization and the temporal structures of care that shape the material arrangements sustaining sanctuary work. Through these practices, animals appear differently than they do within governance frameworks, as individuals with histories and personalities, against their reduction to calculable units of production.

There are things that appear at the sanctuary that cannot appear within climate governance or One Health frameworks. Maisie's screaming as communication requiring interpretation, Kieran's death as a loss to be mourned, the cow who plays with bedding as a being capable of play. These appearances can be understood through the anthropo-not-seen, beings and relations that persist but cannot appear within dominant frameworks that lack the categories through which they could become visible.

Beyond this diagnostic value, the sanctuary demonstrates a different way of living with animals, one where care, not extraction, is the organizing principle. It is a space where humans and animals coexist through relations of correspondence. Calculation plays no role. Work oriented toward animal flourishing maintains lives without producing commodities. This work requires physical effort that generates no market value. It exists as an alternative at the margins, small in scale and dependent on donations and volunteer labor, but it is real. It shows that a different relation is possible, that another way of being with animals can be enacted even within the constraints imposed by the dominant system.

5.3 The Micro and the Macro

A tension runs through this analysis. Sanctuaries cultivate empathy at the micro scale of daily practice, while governance stabilizes animals as objects at the macro scale of policy. These two modes of relating to animals exist in what might appear to be separate spaces, with little

possibility of mutual influence between them. The sanctuary cannot easily inform governance because governance cannot see what the sanctuary makes visible. The categories through which each operates do not translate into the other.

The workshop I attended made this separation concrete in experiential terms. In the same region, during the same weeks of my fieldwork, two different ontologies of farm animals were being enacted. In the sanctuary, animals appeared as subjects of care with biographies, beings who communicate and respond. In the workshop, animals appeared as vectors and resources whose health serves human interests through zoonotic disease prevention and food safety. These ontologies do not communicate with each other in any straightforward way. The veterinarians in the workshop and the sanctuary operator live in the same geographic space and work with the same species of animals. They do not inhabit the same world in terms of how animals appear and what relations with them are possible.

Governance could include aims beyond emissions reduction and disease management, recognizing multispecies flourishing as a legitimate concern and creating conditions that might foster empathy in some governance contexts, even if not at the scale of global policy. The sanctuary cannot provide the institutional blueprint for this, but it demonstrates that sustained care for animals as individuals is possible under unfavorable structural conditions

Movements for the rights of nature have begun to codify nonhuman entities as subjects of legal concern, and Indigenous ontologies that never accepted the human-nature divide are gaining political recognition in some contexts. These initiatives remain marginal and contested, but they indicate that the foreclosure enacted by current governance is historically specific. The sanctuary participates in this broader contestation or refusal by demonstrating that relations of care and correspondence with farm animals are possible, sustainable, and actual.

The structural conditions of empathy, small scale, sustained presence, and embodied labor, might be fundamentally incompatible with global governance, which depends on abstraction and standardized policy instruments. Some reconciliation might be possible by creating protected spaces where empathy can develop and incorporating empathic knowledge into governance deliberations. This would expand what counts as relevant expertise in policy contexts. Sanctuaries

demonstrate that different ways of living with animals produce knowledge and relations that governance cannot produce. Whether that knowledge can ever inform governance deliberation remains an open question.

6. Conclusion

Farm sanctuaries cultivate empathy with animals through embodied care, and this sustained practice constitutes an ontological refusal of the categories through which governance operates. This marginality to economic circuits allows empathic relations to develop. The refusal operates as an ontologically distinct world at the margins, at limited scale, sustained by donations and the labor of volunteers. In this sense, refusal is analytically different from perspectives that understand sanctuaries as a form of prefigurative politics. Prefigurative political action attempts to manifest alternative futures within the present moment by implementing changes that directly challenge dominant social structures (Jeffrey & Dyson, 2021). Ontological refusal differs from political prefiguration in that its significance is diagnostic, not programmatic. The sanctuary shows that current arrangements are not the only possible ones, that the dominant system does not exhaust the possibilities for living with animals.

Empathy, as I have defined it, might function as a necessary component of any governance arrangement that would take multispecies flourishing seriously as a concern. The separation between multispecies flourishing and climate governance is naturalized, as if there were no alternative to governing animals as objects. Sanctuaries denaturalize this separation by showing that another relation exists, even if only at the margins.

The chapter leaves open whether empathy can be institutionalized in governance contexts, a question that might not have a general answer independent of specific arrangements and conditions. As discussed, empathy may be incompatible with governance operated at large scales. This incompatibility, if it holds, clarifies what is at stake in debates about the future of agri-environmental governance. Certain governance goals, like multispecies flourishing, may require institutional innovations that create protected spaces for empathic engagement within or alongside governance frameworks, spaces where the knowledge that correspondence produces can inform deliberation even if it cannot be scaled. Advisory panels could work as one of such

institutional innovations, which might include sanctuary operators and caregivers alongside veterinarians and policy officials who could bring expertise build through sustained correspondence into governance processes that currently have no access to it. From a different perspective, public funding for sanctuaries could sustain not only the material conditions that make correspondence possible but also the capacity of these sites to cultivate empathy beyond their boundaries. Operators like Jennifer cannot maintain the daily labor of care and engage in broader governance conversations when they depend on donations and personal resources alone.

Political ontology insists that different practices enact different realities, and that the question of which realities get enacted is a political question with material consequences. Multispecies justice adds that it is also an ethical question, one that concerns what governance owes to beings whose flourishing it affects. Sanctuaries cannot fix the exclusion of animals from governance concern at scale. They can refuse to accept this exclusion as necessary, and in that refusal, keep open the possibility of arrangements that might one day be otherwise.

The Confederate flag I passed on my way to the sanctuary stayed visible from the property throughout my fieldwork. It served as a reminder that the space where empathy grows exists within a larger world organized around different values and commitments. Bringing empathic knowledge into governance would require crossing that distance, translating capacities developed through embodied care into frameworks built for calculation and scale. The structural conditions that make such translation difficult are the same conditions that make the sanctuary necessary in the first place, a world where animals appear as resources and extraction organizes human-animal relations, where the ethos signaled by that flag and the ethos enacted in the sanctuary coexist without communication. The existence of sanctuary practices means that the reality enacted by governance is not the only reality, that other ways of living with animals are actual, not just imaginable. These alternatives exist at the margins, with few resources and little institutional support, but they exist, and their existence holds open questions that dominant frameworks would prefer to consider settled.

V. Chapter 5: Conclusion

This dissertation has examined agri-environmental governance across three sites where climate change intersects with agricultural practice. In each case, governance responds to environmental problems but fails to correspond with the situations that the affected communities inhabit. The metrological regimes of U.S. nutrient governance make certain environmental flows calculable while producing soil life as structurally ungovernable. Drought governance in Chile's Limarí Valley operates with technical precision but cannot perceive the collapse of the farming configuration that made agriculture viable. Climate governance stabilizes animals as calculable objects and limits the possibility of relating to them as subjects capable of response. These failures differ in their mechanisms, but in each case governance categories do ontological work, shaping what can be perceived and addressed while rendering other realities invisible.

Correspondence threads through these three analyses. Each chapter asks whether governance can respond to the conditions that people and beings actually inhabit. Each chapter reveals a different dimension of how correspondence fails and what it requires. The conclusion develops these dimensions into prismatic governance, a framework oriented toward accepting ontological multiplicity and working with it.

1. What Each Chapter Contributes

Chapter 1 demonstrated that governance tools shape what governance can see. Metrological regimes are constitutive of what counts as governable. The chapter's main contribution to prismatic governance is the finding that regimes are heterogeneously constituted, meaning that different institutional configurations produce different ontological affordances. Thus, foreclosure is configuration-specific and potentially reconfigurable. Prismatic governance would need reflexivity about its own tools, the capacity to recognize which configurations foreclose which realities and to ask how infrastructure could be rebuilt to engage what it currently excludes.

The analysis of the Limarí in Chapter 2 showed that correspondence is unevenly distributed. The same governance response corresponds with some farmers and not others, depending on their

resources and how they are positioned relative to the water market. Reconversion workshops correspond with the well-capitalized farmer who least needs help and fail to reach those whose farming configuration has collapsed. This differentiation is structured by power, and even partial correspondence reproduces injustice when it tracks existing inequalities. This finding means governance would need to track how its responses land differently across the social field, and to build mechanisms for accountability when correspondence tracks existing inequalities.

Chapter 3 argued that correspondence requires cultivated capacity. Empathy with animals develops through sustained bodily engagement at the sanctuary, producing knowledge that governance frameworks cannot generate. Governance lacks this capacity because abstraction, scale, and calculation limit the conditions under which empathy develops. The implication is that governance needs practices that bring it into contact with beings and relations it currently excludes, and would protect spaces where forms of knowledge derived from correspondence can inform deliberation even if they cannot be scaled.

2. From Diagnostic to Orientation

De la Cadena's (2019) concept of the anthropo-not-seen identifies the worlds and relations that governance, organized through modern and colonial categories, is structurally unable to perceive. The diagnostic shows that certain realities are actively foreclosed. The three chapters of this dissertation confirm the diagnostic across different sites. Soil life, ontological breakdown, and animal subjectivity all persist but remain outside what governance can engage.

But the diagnostic might leave governance without a way forward. Governance either operates as complete domination, closing off alternatives through the institutional power of metrological regimes and calculative frameworks, as Chapters 1 and 3 show, or it is present but unable to act properly responding to a situation that has ceased to exist for those it is supposed to serve, as Chapter 2 shows. Both positions describe real dynamics. Neither offers a pathway forward.

Political ontology's relationship to governance faces a structural difficulty. Its diagnostic shows that governance limits realities through its ontological commitments. The difficulty is that if foreclosure is constitutive, if governance categories necessarily enact one reality while rendering

others invisible, then there is no clear institutional pathway forward. Governance infrastructure requires reducing complex realities to manageable categories, and the same arrangements that make governance possible also produce foreclosure. Transformation would seem to require capacities that the diagnostic itself determines governance does not have.

Political ontology scholarship tends to resolve this difficulty by pointing toward refusal, contestation, or the protection of spaces where alternative ontologies can persist outside state frameworks. These are important political strategies, but they are limited as governance strategies. Each chapter of this dissertation arrives at a similar edge. The heterogeneity of metrological regimes, the concept of failure to correspond, and empathy as a relational capacity all identify what governance lacks. Moving past this difficulty requires a resource that political ontology alone does not provide. Governance needs a shared ground that makes institutional action possible even when different arrangements constitute that ground differently.

Prismatic governance attempts to move from diagnostic to orientation. It accepts the insight of political ontology that reality is multiple and that governance frameworks are constitutive, and the insight of the anthropo-not-seen that certain realities remain structurally invisible under current arrangements. Given these conditions, it asks how governance might be configured to work with ontological multiplicity.

The prism metaphor does specific work here. Prismatic governance would take what appears as a single governance problem and refract it into its multiple dimensions and realities. 'Megadrought' refracts into intensified adversity for some and ontological breakdown for others. Under nutrient governance, what appears as a single management problem conceals the difference between soil treated as substrate and soil engaged as living community. The same holds for animal agriculture, where the category flattens the distance between animals governed as resources and animals known as subjects. Current governance sees one color where there are many. Prismatic governance would make the spectrum visible.

This does not mean that prismatic governance resolves the tensions political ontology identifies. It works within those tensions, accepting that governance always reduces complexity while insisting that the specific reductions currently in place are open to contestation. The practical

question becomes which institutional alignments can be reconfigured and what capacities governance would need to engage with what it currently excludes.

3. Shared Materiality in Multiple Worlds

Prismatic governance assumes that the realities governance cannot see are reachable, that they persist somewhere governance could learn to engage with them. But political ontology's emphasis on ontological multiplicity complicates this assumption. If different practices enact genuinely separate worlds, then what governance forecloses may belong to ontological domains it cannot access, and prismatic governance becomes a contradiction in terms. The concept of correspondence that this dissertation develops shares intellectual ground with Ingold's (Ingold, 2017, 2018, 2021) broader project on attending and responding within the world, and Ingold's engagement with the ontological turn offers a productive way into this problem. Ingold argues that differences between ways of inhabiting the world unfold within one shared world of ongoing life, not across ontological boundaries. His position differs from the nature/society dualism that political ontology critiques. Ingold's one world is not what Escobar (2017) calls a "One-World World," considered as the colonial imposition of a single ontology over others. It is a world of ongoing mutual constitution, open-ended, where any engagement contributes to its formation and where differences are real and perceivable. Gatt and Looers (2025), summarizing the movements in this debate, note that proposals for a multiverse of separate worlds face serious difficulties. If different ontologies inhabit genuinely separate worlds, the material harm that colonial and extractive practices cause within conditions that all parties depend on risks appearing as a misunderstanding between incommensurable positions rather than as directed violence enacted within a world that is shared. Multiple worlds proposals also foreclose pathways toward decolonization by making it difficult to explain how anyone can learn from or perceive the damage done to ways of life that are not their own. Gatt and Looers also note that Escobar has moved toward a relational understanding of a pluriversal world, influenced partly by Ingold's work, suggesting that the opposition between one world and many worlds is less rigid than it initially appeared.

Escobar's most recent relational perspective (Escobar et al., 2024) does not abandon political ontology's position that different practices constitute different realities. It reframes it within a relational foundation where interdependence comes first and nothing preexists the relations that constitute it. The authors write that relationality points to "the radical interdependence of all things," (Escobar et al., 2024, p. 6) and that "there is an important difference between relationality understood as a fundamental condition of existence and reality, on the one hand, and the notion of connection between already existing entities, on the other" (2024, p. 8). Ontological difference, in this framing, is produced through relational practice within conditions that all beings inhabit, not distributed across separate worlds that governance would need to bridge. Escobar's movement toward this position, alongside Gatt and Loovers' critical assessment of multiple worlds proposals, suggests that within the political ontology tradition there has been a movement toward grounding ontological multiplicity in relational interdependence rather than in the separateness of worlds from one another. Multiple worlds remain real, but they are produced through relational practice rather than located behind boundaries that would make them mutually inaccessible.

The cases examined in this dissertation sit within this productive space between political ontology and Ingold's materialism. The water in the Limarí is shared between farmers and the state, just as the soil in Vermont is shared between the farmers who work it and the metrological regimes that measure it. At the sanctuary, the feed bags say "hog fattening feed," the barns were built for production operations, and the animals' bodies carry the marks of industrial breeding in ducks that cannot fly and pigs that grew too large. The material substrate of sanctuary life and industrial agriculture overlaps concretely.

Political ontology remains essential to the analysis because the differences produced through these varied arrangements are not differences of perspective or interpretation. They are performative. The metrological regimes and calculative frameworks through which governance operates actively produce soil as nutrient substrate, animals as emissions sources, and drought as a manageable variable, shaping what can be perceived and acted upon while making other realities ungovernable. An institutional analysis without the conceptual apparatus of political

ontology that treated these as technical gaps would miss that the infrastructure making governance possible and the infrastructure producing foreclosure are the same thing.

4. Prismatic Governance Against Existing Frameworks

Scalar governance, including multilevel and polycentric approaches, diagnoses governance failure as a problem of fit between institutional scale and problem scale. The solution involves reorganizing governance across levels and coordinating between them. But scalar governance assumes the problem is the same problem at every scale, that "drought" or "climate change" names a single object that different jurisdictions must coordinate around. The Limarí case shows that the problem can be different things for different actors at the same scale, a qualitative distinction that scalar thinking does not contain.

Adaptive governance diagnoses the problem as rigidity in the face of change, and the solution involves monitoring, feedback, and institutional learning. But adaptive governance assumes we know what we are adapting to. It adapts within a framework that has already defined what counts as the problem. Governance in the Limarí adapts to "drought" without perceiving that the situation has crossed into ontological breakdown, a shift that the category of adaptation itself cannot hold.

Prismatic governance starts from the diagnosis that the problem is the idea of a single world. Governance fails because it cannot correspond with what is actually happening, projecting categories onto situations that may not fit them. This includes the scalar problem (correspondence may fail because we are at the wrong level) and the adaptive problem (correspondence may fail because conditions changed). Correspondence can fail even at the right scale and with adaptive flexibility if governance cannot perceive the nature of what it encounters.

5. Justice as a Dimension of Correspondence

Each chapter engages with a different dimension of justice, and their convergence in the conclusion suggests that prismatic governance is intrinsically a justice-oriented framework.

Chapter 1 engages with epistemic justice through the analysis of how metrological regimes privilege calculable knowledge forms while marginalizing others. Farmers' relational knowledge of soil, their questions about microbial life and alternatives to synthetic inputs, carry epistemic legitimacy but lack the institutional infrastructure that would translate them into governance action. The foreclosure of soil-as-living-community from governance capacity is an epistemic injustice structured by the same institutional arrangements that make nutrient flows governable.

The Limarí case addresses environmental justice through the finding that differential correspondence constitutes a form of injustice. The same governance programs land differently depending on farmers' resources and position, functioning as support for some while becoming irrelevant for others. Governance is present in the valley, but it does not fit the conditions that most affected farmers inhabit. The slow-onset character of the megadrought deepens this injustice. The crisis has no clear start and no clear end, and farmers who cannot access the programs that do exist are left to absorb years of accumulating losses without the kind of emergency declaration that would force governance to respond differently.

Chapter 3 relates to multispecies justice through the argument that governing animals only as resources and emissions sources constitutes an ethical failure. If governance frameworks cannot see animals as beings whose flourishing matters independently of their contribution to human projects, then those frameworks institutionalize injustice through their categories.

These three dimensions of justice, epistemic, environmental, and multispecies, are connected because in each case governance categories determine who and what can appear as a matter of concern. Exclusion from this domain of visibility is a form of injustice, one that determines what can exist as a governance concern. Prismatic governance, by expanding what governance can perceive and correspond with, is oriented toward addressing injustice. It does not claim to eliminate foreclosure, but it insists that current exclusions are contingent and potentially reconfigurable.

6. Methodological Reflections

The methodology of this dissertation, ethnographic intentionality, is intrinsically connected to the argument about correspondence. The claim that governance fails because it cannot perceive what is happening implies that perceiving what is happening is both possible and difficult, requiring sustained engagement with specific places and beings.

Each chapter involved a different form of engagement and a different analytical approach. Open coding organized the institutional analysis of Chapter 1. Thematic analysis with iterative coding supported the ontological analysis of Chapter 2. Chapter 3 followed post-coding traditions that treat writing as the main analytical act. This methodological variation is part of what the dissertation argues. Law (Law, 2004) thinks of the messy reality as multiple and differently enacted through different practices, thus methodology cannot be singular without collapsing what it is trying to see. The coding and analytical choices across the three chapters are each adequate to what that chapter was trying to perceive, and held together, they enact the kind of plural attention the dissertation argues governance itself would need. This is what I understand ethnographic intentionality to require at the scale of a dissertation.

In the United States, interviews with farmers across three states and analysis of policy documents revealed how institutional configurations produce specific ontological affordances. In Chile, returning to my hometown produced knowledge that depended on familiarity, on knowing what the valley had been and being able to perceive what it was becoming. The sanctuary required something different, the embodied participation in care labor produced knowledge that simple observation could not provide. This variation is part of the argument, since no single methodological orientation can perceive everything. Governance that relies on a single mode of knowing will miss what that mode cannot see.

The multi-site design of this dissertation resonates with Tsing et al. argument (2024) that the Anthropocene is patchy, meaning that different places experience different configurations of damage and possibility, and that knowledge adequate to these conditions requires attention to specific sites. The Limarí valley, Vermont's nutrient governance, and the sanctuary are not generic cases of drought, agricultural emissions, or animal agriculture. Each contains specificities that

matter for understanding how governance works and fails, accessible only through the kind of sustained engagement that ethnographic intentionality supports.

But this dissertation extends Tsing et al. approach by also considering institutional analysis. Farmers in the Limarí valley articulate breakdown that governance frameworks cannot hold, and in Vermont they attend to soil life that the metrological regime cannot register. The sociological addition is connecting what ethnographic engagement perceives with the institutional analysis of why governance cannot perceive it and what reconfigurations might change that. This is the kind of analytical move that Breslau (2000) suggested was available to sociology when he argued that the discipline could work with flat ontology and develop new research agendas. Breslau's argument was that sociology's capacity to connect locally contingent associations of humans and nonhumans with structural classifications like class and power gave it a specific contribution to make within the ontological turn. Prismatic governance attempts to build on that suggestion. The concept emerges from an analytical field that holds nitrogen formulas, animal bodies, water infrastructure, and governance categories together, treating the differences across sites not as differences of framing or culture but as different arrangements of humans and nonhumans that perform different realities. The sociological contribution is connecting what those arrangements produce in specific places to the structural question of how governance performs and forecloses the realities it is responsible for managing.

My positionality shapes this analysis in ways I have tried to make visible throughout the dissertation. Coming from the Limarí Valley, I carry familiarity that enabled perception of what was changing. My engagement with multispecies justice through vegan practice meant I arrived at the sanctuary with questions formed through a specific normative orientation. I also inherit intellectual traditions from the global south that have attended to what technocratic governance misses. And writing as an international student during a period of intensified policing of immigrant bodies, I write from a position shaped by attentiveness to how states deploy categories that determine who can be seen and who becomes invisible. These positions are the conditions under which correspondence with these specific realities became possible for me. Prismatic governance would require holding multiple such positions together. The multiplicity of what needs to be perceived demands a multiplicity of ways of perceiving.

This type of research should matter as much as global modeling and international negotiations for agri-environmental governance. Decades of global perspectives have not prevented emissions from rising or climate effects from multiplying and differentiating across communities. Something is missing from how we know and govern this crisis. Global science claims to see from everywhere and nowhere at once, what Haraway (1988) called the god trick. This view has its uses, but it cannot correspond with the situated realities where climate change lands. Ethnographic attention sees from somewhere, from a body positioned in a specific place among specific others, and that positioning is what allows it to perceive the multiplicity that standard governance approaches flatten.

7. Limitations and Future Directions

This dissertation captures perspectives from farmers, sanctuary workers, non-human animals, and policy documents, but sustained research with state actors would provide additional understanding of institutional constraints on correspondence. Each chapter is a single case, and comparative research could examine whether the dynamics described here operate similarly in other slow-onset crises, metrological regimes, and sites of ontological refusal.

As a complete work of research, it uses multiple research sites and different methodological approaches across its chapters. I do not follow one case with one approach. I think this is an effective method when considering the phenomenon being explored. This study examines how contemporary agri-environmental governance is enacted across different contexts and how it connects with technology, nature, and the economy. These questions benefit from a multi-site design that can attend to variation. The design trades depth in any one case for the capacity to perceive differences across governance configurations, and this trade-off follows from the theoretical argument. If governance refracts differently across contexts, then research designed to perceive that refraction is better positioned than a single-case study to identify the patterns that prismatic governance describes. Comparative research with deeper engagement in fewer sites could develop what this design identifies but cannot fully explore.

Prismatic governance, as proposed here, is an orientation, not a policy prescription. It identifies three things governance would need: reflexivity about tools, attention to differentiated

correspondence, and cultivated capacities for new forms of relation. It does not specify the institutional mechanisms through which these could be developed. Building those mechanisms is work that requires collaborative engagement between researchers, practitioners, and the communities whose realities governance must learn to perceive.

I think there is a productive connection between prismatic governance and the tradition of pluriversal thinking (Arora et al., 2026; Demaria et al., 2023; Escobar, 2017). The pluriverse names a world where many worlds fit, a commitment to ontological multiplicity that has been developed through Latin American scholarship and indigenous movements. I see prismatic governance as one way of making pluriversal commitments operational in governance contexts, translating the philosophical commitment to multiple worlds into attention to how governance tools, categories, and institutional arrangements could be reconfigured to hold difference. I do not develop this connection fully here, but I think the pluriversal tradition could inform the design of governance arrangements capable of corresponding with the multiplicity of realities that the climate crisis produces.

The three cases in this dissertation show that the knowledge governance needs already exists in the places where climate change lands. Farmers in the Limarí articulate ontological breakdown, farmers in the U.S. ask questions their metrological regime cannot answer, and the sanctuary worker knows her animals as individuals with biographies. This knowledge is produced through sustained engagement with specific places and beings, and it tells governance something it cannot learn from its own categories. Prismatic governance would begin by taking this knowledge as evidence that the realities governance must engage are more diverse and more alive than its current categories can hold. Building the institutional conditions for this kind of engagement is the work that lies ahead.

VI. Bibliography

- Abrell, E. (2021). *Saving animals: Multispecies ecologies of rescue and care*. U of Minnesota Press.
- Acosta, A. (2013). Extractivism and neoextractivism: Two sides of the same curse. *Beyond Development: Alternative Visions from Latin America, 1*, 61–86.
- Adkins, L., & Lury, C. (2011). Introduction: Special measures. *The Sociological Review, 59*(2_suppl), 5–23.
- Akrich, M. (1992). The de-scription of technical objects. *Shaping Technology/Building Society. Studies in Sociotechnical Change*, 205–224.
- Alblas, E. (2023). Bringing nature back to agricultural land: Bridging ambition and reality in agri-environmental governance. In *The future of environmental law* (pp. 252–269). Edward Elgar Publishing.
- Allan, R. P., Arias, P. A., Berger, S., Canadell, J. G., Cassou, C., Chen, D., Cherchi, A., Connors, S. L., Coppola, E., Cruz, F. A., & others. (2023). Intergovernmental panel on climate change (IPCC). Summary for policymakers. In *Climate change 2021: The physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change* (pp. 3–32). Cambridge University Press.
- Álvarez, L., & Coolsaet, B. (2020). Decolonizing environmental justice studies: A Latin American perspective. *Capitalism Nature Socialism, 31*(2), 50–69.
- Amin, A., & Thrift, N. J. (2004). *The Blackwell cultural economy reader*. Wiley Online Library.

Anderson, S. (2025). Attorneys say they can't see immigration clients at alligator alcatraz.

Forbes. <https://www.forbes.com/sites/stuartanderson/2025/07/09/attorneys-say-they-cant-see-immigration-clients-at-alligator-alcatraz/>

Aqueduct Water Risk Atlas. (n.d.). Retrieved January 8, 2025, from

https://www.wri.org/applications/aqueduct/water-risk-atlas/#/?advanced=false&basemap=hydro&indicator=w_awr_def_tot_cat&lat=30&lng=-80&mapMode=view&month=1&opacity=0.5&ponderation=DEF&predefined=false&projection=absolute&scenario=optimistic&scope=baseline&threshold&timeScale=annual&year=baseline&zoom=3

Arcari, P. (2020). The Problem with 'Food' Animals. In P. Arcari (Ed.), *Making Sense of 'Food'*

Animals: A Critical Exploration of the Persistence of 'Meat' (pp. 31–54). Springer

Singapore. https://doi.org/10.1007/978-981-13-9585-7_2

Arora, S., Dyck, B. V., Sharma, D., & Stirling, A. (2020). Control, care, and conviviality in the

politics of technology for sustainability. *Sustainability: Science, Practice and Policy*, 16(1),

247–262. <https://doi.org/10.1080/15487733.2020.1816687>

Arora, S., Ghosh, B., & Stirling, A. (2026). Decolonising innovation in sustainability transitions for

pluriversal justice and wellbeing. *Environmental Innovation and Societal Transitions*, 58,

101064. <https://doi.org/10.1016/j.eist.2025.101064>

Ballesteros, A., & Winthereik, B. R. (2021). *Experimenting with ethnography: A companion to*

analysis. Duke University Press.

Barry, A. (2002). The anti-political economy. *Economy and Society*, 31(2), 268–284.

<https://doi.org/10.1080/03085140220123162>

- Bauer, C. J. (2004). Results of Chilean water markets: Empirical research since 1990. *Water Resources Research*, 40(9). [https://doi.org/https://doi.org/10.1029/2003WR002838](https://doi.org/10.1029/2003WR002838)
- Beegle, D., Carton, O., & Bailey, J. (2000). Nutrient management planning: Justification, theory, practice. *Journal of Environmental Quality*, 29(1), 72–79.
- Blaser, M. (2009). Political ontology. *Cultural Studies*, 23(5–6), 873–896.
<https://doi.org/10.1080/09502380903208023>
- Blaser, M. (2013). Ontological conflicts and the stories of peoples in spite of europe: Toward a conversation on political ontology. *Current Anthropology*, 54(5), 547–568.
<https://doi.org/10.1086/672270>
- Blaser, M. (2024). Incomún. *Un Ensayo de Ontología Política Para El Fin Del Mundo (Único)*. Adrogué: La Cebra.
- Blattner, C. E., Donaldson, S., & Wilcox, R. (2020). *Animal Agency in Community*. 6.
- Blok, A. (2011). Clash of the eco-sciences: Carbon marketization, environmental NGOs and performativity as politics. *Economy and Society*, 40(3), 451–476.
<https://doi.org/10.1080/03085147.2011.574422>
- Breslau, D. (2000). Sociology after humanism: A lesson from contemporary science studies. *Sociological Theory*, 18(2), 289–307.
- Brinkmann, S. (2014). Doing Without Data. *Qualitative Inquiry*, 20(6), 720–725.
<https://doi.org/10.1177/1077800414530254>
- Bronson, K. (2022). *The immaculate conception of data: Agribusiness, activists, and their Shared Politics of the future*. McGill-Queen's Press-MQUP.

- Bryant, G. (2016). The politics of carbon market design: Rethinking the techno-politics and post-politics of climate change. *Antipode*, 48(4), 877–898.
- Budds, J. (2004). Power, nature and neoliberalism: The political ecology of water in Chile. *Singapore Journal of Tropical Geography*, 25(3), 322–342.
<https://doi.org/https://doi.org/10.1111/j.0129-7619.2004.00189.x>
- Burawoy, M. (2000). Conclusion: Grounding globalization. In M. Burawoy, J. A. Blum, S. George, Z. Gille, T. Gowan, & others (Eds.), *Global ethnography: Forces, connections, and imaginations in a postmodern world* (pp. 337–350). University of California Press.
- Burawoy, M. (2025). Why and how should sociologists speak out on Palestine? *The Sociological Review*, 73(2), 249–260.
- Burman, A. (2017). The political ontology of climate change: Moral meteorology, climate justice, and the coloniality of reality in the Bolivian Andes. *Journal of Political Ecology*, 24(1), 921–930.
- Buttel, F. H. (2006). Sustaining the unsustainable: Agro-food systems and environment in the modern world. *Handbook of Rural Studies*, 213–229.
- Çalışkan, K., & Callon, M. (2009). Economization, part 1: Shifting attention from the economy towards processes of economization. *Economy and Society*, 38(3), 369–398.
- Callon, M. (1998a). Introduction: The Embeddedness of Economic Markets in Economics. In M. Callon (Ed.), *The Laws of the Markets* (pp. 1–57). Blackwell.
- Callon, M. (Ed.). (1998b). *The laws of the markets*. Blackwell Publishers/Sociological Review.

- Callon, M. (2007). What Does it Mean to Say That Economics is Performative? In D. MacKenzie, F. Muniesa, & L. Siu (Eds.), *Do Economists Make Markets? On the Performativity of Economics* (pp. 311–357). Princeton U. Press.
- Callon, M. (2021). *Markets in the Making: Rethinking Competition, Goods, and Innovation* (M. Poon, Ed.; O. Custer, Trans.). Zone Books.
- Carcamo, P., Gardezi, M., Ryan, B., & Stock, R. (2025). The future governance of AI in agriculture: Advancing justice-based approaches. In *Oxford intersections: AI in society*. Oxford University Press. <https://doi.org/10.1093/9780198945215.003.0022>
- Carney, J. A. (2021). Subsistence in the Plantationocene: Dooryard gardens, agrobiodiversity, and the subaltern economies of slavery. *The Journal of Peasant Studies*, 48(5), 1075–1099.
- Carolan, M. (2017). Agro-Digital Governance and Life Itself: Food Politics at the Intersection of Code and Affect. *Sociologia Ruralis*, 57(S1), 816–835. <https://doi.org/10.1111/soru.12153>
- Carolan, M. (2022). Acting like an algorithm: Digital farming platforms and the trajectories they (need not) lock-in. In *Social innovation and sustainability transition* (pp. 107–119). Springer.
- Castelló, P. P. (2025). The fabric of zoodemocracy: A systemic approach to deliberative zoodemocracy. *Critical Review of International Social and Political Philosophy*, 0(0), 1–26. <https://doi.org/10.1080/13698230.2024.2437870>

Ceaza. (2024, June 19). Luego de las precipitaciones: Embalse La Paloma aumentó de 1% a 3%.

Ceaza. <https://ceaza.cl/2024/06/19/luego-las-precipitaciones-embalse-la-paloma-aumento-1-3/>

Celermajer, D., Schlosberg, D., Rickards, L., Stewart-Harawira, M., Thaler, M., Tschakert, P., Verlie, B., & Winter, C. (2022). Multispecies justice: Theories, challenges, and a research agenda for environmental politics. *Trajectories in Environmental Politics*, 116–137.

Chagnon, C. W., Durante, F., Gills, B. K., Hagolani-Albov, S. E., Hokkanen, S., Kangasluoma, S. M., Kontinen, H., Kröger, M., LaFleur, W., Ollinaho, O., & others. (2022). From extractivism to global extractivism: The evolution of an organizing concept. *The Journal of Peasant Studies*, 49(4), 760–792.

Chakrabarty, D. (2009). The climate of history: Four theses. *Critical Inquiry*, 35(2), 197–222.

Chao, S. (2022). (Un) worlding the Plantationocene: Extraction, extinction, emergence. *eTropic: Electronic Journal of Studies in the Tropics*, 21(1), 165–191.

Ciplet, D. (2025). Expansive climate governance: Advancing transformative climate justice through the six pillars of climate action. *Climate and Development*, 17(10), 947–952.
<https://doi.org/10.1080/17565529.2025.2486369>

Cooper, M. H. (2015). Measure for measure? Commensuration, commodification, and metrology in emissions markets and beyond. *Environment and Planning A: Economy and Space*, 47(9), 1787–1804. <https://doi.org/10.1068/a130275p>

Cope, M. R., Slack, T., Blanchard, T. C., & Lee, M. R. (2016). It's Not Whether You Win or Lose, It's How You Place the Blame: Shifting Perceptions of Recreancy in the Context of the

Deepwater Horizon Oil Spill. *Rural Sociology*, 81(3), 295–315.

<https://doi.org/10.1111/ruso.12096>

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, 2(3), 198–209.

Cudworth, E. (2024). *Animal entanglements: Muddied living in dog–human worlds*. Rowman & Littlefield.

Cunsolo, A., & Ellis, N. R. (2018). Ecological grief as a mental health response to climate change-related loss. *Nature Climate Change*, 8(4), 275–281. <https://doi.org/10.1038/s41558-018-0092-2>

Cusworth, G., Brice, J., Lorimer, J., & Garnett, T. (2023). When you wish upon a (GWP) star: Environmental governance and the reflexive performativity of global warming metrics. *Social Studies of Science*, 53(1), 3–28. <https://doi.org/10.1177/03063127221134275>

de la Bellacasa, M. P. (2015). Making time for soil: Technoscientific futurity and the pace of care. *Social Studies of Science*, 45(5), 691–716. <https://doi.org/10.1177/0306312715599851>

De la Cadena, M. (2010). Indigenous cosmopolitics in the Andes: Conceptual reflections beyond “politics.” *Cultural Anthropology*, 25(2), 334–370.

De la Cadena, M. (2015). *Earth beings: Ecologies of practice across Andean worlds*. Duke University Press.

de la Cadena, M. (2019). Uncommoning nature: Stories from the anthropo-not- seen. In P. Harvey, C. Krohn-Hansen, & K. G. Nustad (Eds.), *Anthropos and the material* (pp. 35–58). Duke University Press. <https://doi.org/doi:10.1515/9781478003311-003>

- Demaria, F., Kothari, A., Salleh, A., Escobar, A., & Acosta, A. (2023). Post-development: From the Critique of Development to a Pluriverse of Alternatives. In *The Barcelona School of Ecological Economics and Political Ecology: A Companion in Honour of Joan Martinez-Alier* (pp. 59–69). Springer.
- DePuy, W., Weger, J., Foster, K., Bonanno, A. M., Kumar, S., Lear, K., Basilio, R., & German, L. (2022). Environmental governance: Broadening ontological spaces for a more livable world. *Environment and Planning E: Nature and Space*, 5(2), 947–975.
<https://doi.org/10.1177/25148486211018565>
- Despret, V. (2013). Responding Bodies and Partial Affinities in Human–Animal Worlds. *Theory, Culture & Society*, 30(7–8), 51–76. <https://doi.org/10.1177/0263276413496852>
- Donaldson, S., & Kymlicka, W. (2023). Doing politics with animals. *Social Research: An International Quarterly*, 90(4), 621–647.
- Duncan, E., Rotz, S., Magnan, A., & Bronson, K. (2022). Disciplining land through data: The role of agricultural technologies in farmland assetisation. *Sociologia Ruralis*, 62(2), 231–249.
<https://doi.org/10.1111/soru.12369>
- Ebert, K., Liao, W., & Estrada, E. P. (2020). Apathy and color-blindness in privatized immigration control. *Sociology of Race and Ethnicity*, 6(4), 533–547.
- Edelstein, M. R. (2013). When recreancy becomes the norm: Emergency response planning and the case of tar sands upgrading in the Alberta industrial heartland. *Research in Social Problems and Public Policy*, 21, 119–175. Scopus. [https://doi.org/10.1108/S0196-1152\(2013\)0000021011](https://doi.org/10.1108/S0196-1152(2013)0000021011)

- Ehrenstein, V. (2018). Carbon sink geopolitics. *Economy and Society*, 47(1), 162–186.
<https://doi.org/10.1080/03085147.2018.1445569>
- Ellis, R. (2022). Social reproduction, playful work, and bee-centred beekeeping. *Agriculture and Human Values*, 39(4), 1329–1340. <https://doi.org/10.1007/s10460-022-10319-0>
- Escobar, A. (2011). *Encountering development: The making and unmaking of the Third World* (Vol. 1). Princeton University Press.
- Escobar, A. (2017). Sustaining the Pluriverse: The Political Ontology of Territorial Struggles in Latin America. In M. Brightman & J. Lewis (Eds.), *The Anthropology of Sustainability: Beyond Development and Progress* (pp. 237–256). Palgrave Macmillan US.
https://doi.org/10.1057/978-1-137-56636-2_14
- Escobar, A., Osterweil, M., & Sharma, K. (2024). *Relationality: An emergent politics of life beyond the human*. Bloomsbury Publishing.
- Fletcher, J. R. (2024). An ontological turn in the sociology of personal life: Tracing facet methodology's connective ontology. *The Sociological Review*, 72(3), 475–492.
- Forney, J. (2016). Blind spots in agri-environmental governance: Some reflections and suggestions from Switzerland. *Review of Agricultural, Food and Environmental Studies*, 97(1), 1–13.
- Forney, J., Rosin, C. J., & Campbell, H. (Eds.). (2018). *Agri-environmental governance as an assemblage: Multiplicity, power, and transformation*. Routledge, Taylor & Francis Group.
- Franklin, S. (2017). Staying with the Manifesto: An interview with Donna Haraway. *Theory, Culture & Society*, 34(4), 49–63.

- Freudenburg, W. R. (1993). Risk and recreancy: Weber, the division of labor, and the rationality of risk perceptions*. *Social Forces*, 71(4), 909–932. <https://doi.org/10.1093/sf/71.4.909>
- Freudenburg, W. R. (2000). The 'Risk Society' Reconsidered: Recreancy, the Division of Labor, and Risks to the Social Fabric. In M. J. Cohen (Ed.), *Risk in the Modern Age: Social Theory, Science and Environmental Decision-Making* (pp. 107–120). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-62201-6_5
- Galway, L. P., Beery, T., Jones-Casey, K., & Tasala, K. (2019). Mapping the solastalgia literature: A scoping review study. *International Journal of Environmental Research and Public Health*, 16(15), Article 2662. <https://doi.org/10.3390/ijerph16152662>
- García, M. E. (2019). Death of a Guinea Pig: Grief and the Limits of Multispecies Ethnography in Peru. *Environmental Humanities*, 11(2), 351–372. <https://doi.org/10.1215/22011919-7754512>
- Gardezi, M., Michael, S., Stock, R., Vij, S., Ogunyiola, A., & Ishtiaque, A. (2022). Prioritizing climate-smart agriculture: An organizational and temporal review. *Wiley Interdisciplinary Reviews: Climate Change*, 13(2), e755.
- Gardezi, M., & Stock, R. (2021). Growing algorithmic governmentality: Interrogating the social construction of trust in precision agriculture. *Journal of Rural Studies*, 84, 1–11. <https://doi.org/10.1016/j.jrurstud.2021.03.004>
- Garlick, B., & Symons, K. (2020). Geographies of Extinction: Exploring the Spatiotemporal Relations of Species Death. *Environmental Humanities*, 12(1), 296–320. <https://doi.org/10.1215/22011919-8142374>

- Garreaud, R. D., Boisier, J. P., Rondanelli, R., Montecinos, A., Sepúlveda, H. H., & Veloso-Aguila, D. (2020). The central Chile mega drought (2010–2018): A climate dynamics perspective. *International Journal of Climatology*, *40*(1), 421–439.
- Gatt, C., & Loovers, J. P. L. (2025). Beyond perception: Tim Ingold, anthropology and the world. In *Beyond perception* (pp. 1–29). Routledge.
- Ghosh, R. (2023). Data-driven governance and performances of accountability: Critical reflections from US agri-environmental policy. *Science as Culture*, 1–27.
- Gibson-Graham, J. K. (1996). *The end of capitalism (as we knew it): A feminist critique of political economy* (NED-New edition). University of Minnesota Press.
<http://www.jstor.org/stable/10.5749/j.cttts7zc>
- Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age*. Stanford University Press.
- Gill, B. (2016). Can the river speak? Epistemological confrontation in the rise and fall of the land grab in Gambella, Ethiopia. *Environment and Planning A: Economy and Space*, *48*(4), 699–717.
- Gill, D. A., Ritchie, L. A., Straub, A. M., Micah, R. J., Boyle, E. Y., & Kersen, T. M. (2026). Resource Loss, Slow Violence, and Psychosocial Stress: The 2022 Pearl River Flood in Jackson, Mississippi. *Social Sciences*, *15*(4), 254. Publicly Available Content Database (3334527258). <https://doi.org/10.3390/socsci15040254>
- Gillespie, K. (2018). *The cow with ear tag #1389*. University of Chicago Press.
<https://doi.org/doi:10.7208/9780226582993>

- Goldman, M., & A. Schurman, R. (2000). Closing the “great divide”: New social theory on society and nature. *Annual Review of Sociology*, 26(1), 563–584.
- Gudynas, E. (2016). Modos de producción y modos de apropiación, una distinción a propósito de los extractivismos. *Actuel Marx/Intervenciones*, 20, 95–121.
- Gugganig, M., Burch, K. A., Guthman, J., & Bronson, K. (2023). Contested agri-food futures: Introduction to the Special Issue. *Agriculture and Human Values*, 40(3), 787–798.
<https://doi.org/10.1007/s10460-023-10493-9>
- Gullion, J. S. (2018). *Diffraction ethnography: Social sciences and the ontological turn*. Routledge.
- Hamilton, L., & Taylor, N. (2017). *Ethnography after humanism: Power, politics and method in multi-species research*. Springer.
- Haraway, D. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies*, 14(3), 575–599.
- Haraway, D. (2015). Anthropocene, capitalocene, plantationocene, chthulucene: Making kin. *Environmental Humanities*, 6(1), 159–165.
- Haraway, D., Ishikawa, N., Gilbert, S. F., Olwig, K., Tsing, A. L., & Bubandt, N. (2016). Anthropologists are talking—about the Anthropocene. *Ethnos. Revista Do Instituto Português de Arqueologia, História e Etnografia*, 81(3), 535–564.
- Harlan, S. L., Pellow, D. N., Roberts, J. T., Bell, S. E., Holt, W. G., & Nagel, J. (2015). Climate justice and inequality. *Climate Change and Society: Sociological Perspectives*, 127–163.
- Harrison, A. K. (2018). *Ethnography*. Oxford University Press.
- Hebinck, A., Klerkx, L., Elzen, B., Kok, K. P. W., König, B., Schiller, K., Tschersich, J., van Mierlo, B., & von Wirth, T. (2021). Beyond food for thought – Directing sustainability transitions

- research to address fundamental change in agri-food systems. *Environmental Innovation and Societal Transitions*, 41, 81–85. <https://doi.org/10.1016/j.eist.2021.10.003>
- Hernandez, A., Lee, J., & Kang, H. (2025). Navigating the Interconnected Web of Health: A Comprehensive Review of the One Health Paradigm and Its Implications for Disease Management. *Yonsei Medical Journal*, 66(4), 203–210. <https://doi.org/10.3349/ymj.2024.0108>
- Hinchliffe, S. (2017). More than one world, more than one health: Re-configuring inter-species health. In *Global health and geographical imaginaries* (pp. 159–175). Routledge.
- Hokkanen, S. (2024). Soil extractivism: Political ontology of soil erasure in the European Union's agricultural politics. *Journal of Rural Studies*, 108, 103298. <https://doi.org/https://doi.org/10.1016/j.jrurstud.2024.103298>
- Holmes, S. M. (2013). *Fresh Fruit, Broken Bodies* (1st ed.). University of California Press. JSTOR. <http://www.jstor.org.ezproxy.lib.vt.edu/stable/10.1525/j.ctt7zw45x>
- Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288.
- Ingold, T. (2017). On human correspondence. *Journal of the Royal Anthropological Institute*, 23(1), 9–27. <https://doi.org/10.1111/1467-9655.12541>
- Ingold, T. (2018). One world anthropology. *HAU: Journal of Ethnographic Theory*, 8(1–2), 158–171. <https://doi.org/10.1086/698315>
- Ingold, T. (2021). *Imagining for real: Essays on creation, attention and correspondence*. Routledge.

- IPCC. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA.
https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf
- Jacquet, J., Morris, V., Loy, L., & Eshel, G. (2025). Early US meat industry knowledge and response to global warming. *Environmental Research Letters*, 20(3), 031006.
<https://doi.org/10.1088/1748-9326/adb6c0>
- Jeffrey, C., & Dyson, J. (2021). Geographies of the future: Prefigurative politics. *Progress in Human Geography*, 45(4), 641–658.
- Kirksey, S. E., & Helmreich, S. (2010). The Emergence of Multispecies Ethnography. *Cultural Anthropology*, 25(4), 545–576. <https://doi.org/10.1111/j.1548-1360.2010.01069.x>
- Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences*, 90–91(1), 1–16.
<https://doi.org/10.1016/j.njas.2019.100315>
- Krähmer, K. (2025). Degrowth in global spaces: Extractivism and practices of socio-ecological transformation in the geography of Chile’s global fruit trade. *Geoforum; Journal of Physical, Human, and Regional Geosciences*, 160, 104230.
<https://doi.org/https://doi.org/10.1016/j.geoforum.2025.104230>
- Krzywoszynska, A. (2019). Caring for soil life in the Anthropocene: The role of attentiveness in more-than-human ethics. *Transactions of the Institute of British Geographers*, 44(4), 661–675. <https://doi.org/https://doi.org/10.1111/tran.12293>

Kuzma, S., Bierkens, M. F. P., Lakshman, S., Luo, T., Saccoccia, L., Sutanudjaja, E. H., & Van Beek, R. (2023). *Aqueduct 4.0: Updated decision-relevant global water risk indicators*

[Technical Note]. World Resources Institute. <https://doi.org/10.46830/writn.23.00061>

Lainé, N., & Morand, S. (2020). Linking humans, their animals, and the environment again: A decolonized and more-than-human approach to “One Health”. *Parasite (Paris, France)*, 27, 55. <https://doi.org/10.1051/parasite/2020055>

Lal, R. (2024). Soil, soul, spirituality, and stewardship. *Journal of Soil and Water Conservation*, 79(1), 10A-14A.

Lansing, D. M. (2012). Performing Carbon’s Materiality: The Production of Carbon Offsets and the Framing of Exchange. *Environment and Planning A: Economy and Space*, 44(1), 204–220. <https://doi.org/10.1068/a44112>

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Harvard university press.

Law, J. (2004). *After method: Mess in social science research*. Routledge.

Leach, M., Bloom, G., Ely, A., Nightingale, P., Scoones, I., Shah, E., & Smith, A. (2007). *Understanding Governance: Pathways to sustainability* (STEPS Working Paper No. 2). STEPS Centre.

León-Corwin, M., Ritchie, L. A., & Long, M. A. (2025). Fractured views: Environmental risk perceptions in Oklahoma and Colorado’s oil and gas landscapes. *The Extractive Industries and Society*, 24, 101750. <https://doi.org/10.1016/j.exis.2025.101750>

Liboiron, M. (2016). Redefining pollution and action: The matter of plastics. *Journal of Material Culture*, 21(1), 87–110.

- Linaza, M. T., Posada, J., Bund, J., Eisert, P., Quartulli, M., Döllner, J., Pagani, A., G. Olaizola, I., Barriguinha, A., Moysiadis, T., & others. (2021). Data-driven artificial intelligence applications for sustainable precision agriculture. *Agronomy*, *11*(6), 1227.
- Loconto, A., Prudham, S., & Wolf, S. (2024). *Environmental governance through metrics: Guest introduction* (pp. 1–15). Taylor & Francis.
- Loconto, A., & Rajão, R. (2020). Governing by models: Exploring the technopolitics of the (in) visibilities of land. *Land Use Policy*, *96*, 104241.
- Lohmann, L. (2005). Marketing and making carbon dumps: Commodification, calculation and counterfactuals in climate change mitigation. *Science as Culture*, *14*(3), 203–235.
<https://doi.org/10.1080/09505430500216783>
- Lorimer, J. (2007). Nonhuman Charisma. *Environment and Planning D: Society and Space*, *25*(5), 911–932. <https://doi.org/10.1068/d71j>
- Lowenberg-DeBoer, J., & Erickson, B. (2019). Setting the Record Straight on Precision Agriculture Adoption. *Agronomy Journal*, *111*(4), 1552–1569.
<https://doi.org/https://doi.org/10.2134/agronj2018.12.0779>
- Loy, L., & Jacquet, J. (2025). The animal agriculture industry’s obstruction of campaigns promoting individual climate action. *Climate Policy*, 1–10.
- Lucas, A. (2021). Risking the earth part 2: Power politics and structural reform of the IPCC and UNFCCC. *Climate Risk Management*, *31*, 100260.
<https://doi.org/https://doi.org/10.1016/j.crm.2020.100260>
- MacKenzie, D. (2009). Making things the same: Gases, emission rights and the politics of carbon markets. *Accounting, Organizations and Society*, *34*(3–4), 440–455.

- Mackenzie, D. (2017). A material political economy: Automated Trading Desk and price prediction in high-frequency trading. *SOCIAL STUDIES OF SCIENCE*, 47(2), 172–194. (WOS:000400116500002). <https://doi.org/10.1177/0306312716676900>
- Mackenzie, D. (2022). Spoofing: Law, materiality and boundary work in futures trading. *Economy and Society*, 51(1), 1–22. <https://doi.org/10.1080/03085147.2022.1987753>
- Mackenzie, D. A. (2009). *Material markets: How economic agents are constructed*. Oxford University Press. (001543528).
- Mackenzie, D., & Millo, Y. (2003). Constructing a market, performing theory: The historical sociology of a financial derivatives exchange. *American Journal of Sociology*, 109(1), 107–145.
- MacLure, M. (2013). The wonder of data. *Cultural Studies ↔ Critical Methodologies*, 13(4), 228–232. <https://doi.org/10.1177/1532708613487863>
- Maechler, S., & Boisvert, V. (2024). Valuing nature to save it? The centrality of valuation in the new spirit of conservation. *Global Environmental Politics*, 24(1), 10–30.
- Malin, S. A., Ryder, S., & Lyra, M. G. (2019). *Environmental justice and natural resource extraction: Intersections of power, equity and access* (No. 2; Vol. 5, pp. 109–116). Taylor & Francis.
- Martin, L. L. (2024). Conceptualising US immigration detention as carceral real estate. *Antipode*, 56(2), 558–580.
- Martin, M. J., Thottathil, S. E., & Newman, T. B. (2015). Antibiotics Overuse in Animal Agriculture: A Call to Action for Health Care Providers. *American Journal of Public Health*, 105(12), 2409–2410. <https://doi.org/10.2105/AJPH.2015.302870>

- Mason, R. E., Merrill, S. C., Görres, J., Faulkner, J., & Niles, M. T. (2021). Agronomic and environmental performance of dairy farms in a warmer, wetter climate. *Journal of Soil and Water Conservation*, 76(1), 76–88. <https://doi.org/10.2489/jswc.2021.00169>
- Mathews, A. S. (2020). Anthropology and the anthropocene: Criticisms, experiments, and collaborations. *Annual Review of Anthropology*, 49(1), 67–82.
- McCauley, D., & Heffron, R. (2018). Just transition: Integrating climate, energy and environmental justice. *Energy Policy*, 119, 1–7.
<https://doi.org/10.1016/j.enpol.2018.04.014>
- McCumber, A. (2026). Animals as Natural Wealth: Heterogeneity and Inequality in the Valuation of Natural Wonders. *The Sociological Quarterly*, 1–21.
<https://doi.org/10.1080/00380253.2026.2628715>
- McGregor, A., & Houston, D. (2018). Cattle in the anthropocene: Four propositions. *Transactions of the Institute of British Geographers*, 43(1), 3–16.
- McGregor, A., Rickards, L., Houston, D., Goodman, M. K., & Bojovic, M. (2021). The Biopolitics of Cattle Methane Emissions Reduction: Governing Life in a Time of Climate Change. *Antipode*, 53(4), 1161–1185. <https://doi.org/10.1111/anti.12714>
- Menegat, S., Ledo, A., & Tirado, R. (2022). Greenhouse gas emissions from global production and use of nitrogen synthetic fertilisers in agriculture. *Scientific Reports*, 12(1), 14490.
<https://doi.org/10.1038/s41598-022-18773-w>
- Miller, P. (2004). Governing by numbers: Why calculative practices matter. *The Blackwell Cultural Economy Reader*, 179–189.

- Mohai, P., Pellow, D., & Roberts, J. T. (2009). Environmental justice. In *Annual Review of Environment and Resources* (Vol. 34, Issue Volume 34, 2009, pp. 405–430). Annual Reviews. <https://doi.org/https://doi.org/10.1146/annurev-environ-082508-094348>
- Mol, A. (1999). Ontological politics. A word and some questions. *The Sociological Review*, 47(1_suppl), 74–89. <https://doi.org/10.1111/j.1467-954X.1999.tb03483.x>
- Mol, A. (2002). *The body multiple: Ontology in medical practice*. Duke University Press.
- Moore, J. W. (2016). *Anthropocene or capitalocene?: Nature, history, and the crisis of capitalism*. Pm Press.
- Nabuurs, G.-J., Mrabet, R., Abu Hatab, A., Bustamante, M., Clark, H., Havlík, P., House, J., Mbow, C., Ninan, K. N., Popp, A., Roe, S., Sohngen, B., & Towprayoon, S. (2022). Agriculture, forestry and other land uses (AFOLU). In P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, & J. Malley (Eds.), *Climate change 2022: Mitigation of climate change. Contribution of working group III to the sixth assessment report of the intergovernmental panel on climate change*. Cambridge University Press. <https://doi.org/10.1017/9781009157926.009>
- Narayanan, Y. (2016). Where are the Animals in Sustainable Development? Religion and the Case for Ethical Stewardship in Animal Husbandry. *Sustainable Development*, 24(3), 172–180. <https://doi.org/10.1002/sd.1619>
- Nelson, A. M., Moriasi, D. N., Talebizadeh, M., Steiner, J. L., Gowda, P. H., Starks, P. J., & Tadesse, H. K. (2018). Use of soft data for multicriteria calibration and validation of Agricultural

- Policy Environmental eXtender: Impact on model simulations. *Journal of Soil and Water Conservation*, 73(6), 623–636. <https://doi.org/10.2489/jswc.73.6.623>
- Nixon, R. (2011). *Slow violence and the environmentalism of the poor*. Harvard University Press.
- Noor, M. A., Nawaz, M. M., Hassan, M. U., Sher, A., Shah, T., Abrar, M. M., Ashraf, U., Fiaz, S., Basahi, M. A., Ahmed, W., & Ma, W. (2020). Small Farmers and Sustainable N and P Management: Implications and Potential Under Changing Climate. In R. Datta, R. S. Meena, S. I. Pathan, & M. T. Ceccherini (Eds.), *Carbon and Nitrogen Cycling in Soil* (pp. 185–219). Springer Singapore. https://doi.org/10.1007/978-981-13-7264-3_6
- O’Brien, K. (2012). Global environmental change II: From adaptation to deliberate transformation. *Progress in Human Geography*, 36(5), 667–676. <https://doi.org/10.1177/0309132511425767>
- Ofstehage, A. (2024). Making soil in the plantationocene. *The Journal of Peasant Studies*, 51(3), 603–623.
- Ortiz-Przychodzka, S., Benavides-Frías, C., Raymond, C. M., Díaz-Reviriego, I., & Hanspach, J. (2023). Rethinking economic practices and values as assemblages of more-than-human relations. *Ecological Economics*, 211, 107866.
- Osherenko, G. (2014). Understanding the failure to reduce phosphorus loading in Lake Champlain: Lessons for governance. *Vermont Journal of Environmental Law*, 15(2), 323–360.
- Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage publications.

- Pellow, D. N. (2016). TOWARD a CRITICAL ENVIRONMENTAL JUSTICE STUDIES: Black lives matter as an environmental justice challenge. *Du Bois Review: Social Science Research on Race*, 13(2), 221–236. <https://doi.org/10.1017/S1742058X1600014X>
- Pellow, D. N. (2023). Environmental justice, climate justice, and animal liberation movements: Confronting the problems of social difference. In *The oxford handbook of comparative environmental politics*. Oxford University Press.
<https://doi.org/10.1093/oxfordhb/9780197515037.013.5>
- Pellow, D. N. (2025). *What is critical environmental justice?* John Wiley & Sons.
- Pereira, L. M., Davies, K. K., Den Belder, E., Ferrier, S., Karlsson-Vinkhuyzen, S., Kim, H., Kuiper, J. J., Okayasu, S., Palomo, M. G., Pereira, H. M., Peterson, G., Sathyapalan, J., Schoolenberg, M., Alkemade, R., Carvalho Ribeiro, S., Greenaway, A., Hauck, J., King, N., Lazarova, T., ... Lundquist, C. J. (2020). Developing multiscale and integrative nature–people scenarios using the Nature Futures Framework. *People and Nature*, 2(4), 1172–1195.
<https://doi.org/10.1002/pan3.10146>
- Pickering, A. (2000). The objects of sociology: A response to Breslau’s “Sociology after humanism.” *Sociological Theory*, 18(2), 308–316.
- Pickering, A. (2017). The ontological turn: Taking different worlds seriously. *Social Analysis*, 61(2), 134–150.
- Pillow, W. (2003). Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education*, 16(2), 175–196.

- Pörtner, H.-O., Roberts, D. C., Poloczanska, E. S., Mintenbeck, K., Tignor, M., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., & Okem, A. (2022). IPCC, 2022: Summary for policymakers. In H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, & B. Rama (Eds.), *Climate change 2022: Impacts, adaptation and vulnerability. Contribution of working group II to the sixth assessment report of the intergovernmental panel on climate change* (pp. 3–33). Cambridge University Press. <https://doi.org/10.1017/9781009325844.001>
- Redford, K. H., & Adams, W. M. (2009). Payment for ecosystem services and the challenge of saving nature. *Conservation Biology*, 23(4), 785–787.
- Rickard, T., & Ludwig, D. (2025). Rivers across worlds: A conceptual framework for ontological inclusion & exclusion in participatory water governance. *Environment and Planning E: Nature and Space*, 8(1), 251–277. <https://doi.org/10.1177/25148486241280157>
- Ritchie, L. (2024). Recreancy. In *Elgar encyclopedia of environmental sociology* (pp. 463–469). Edward Elgar Publishing.
- Ritchie, L. A., Gill, D. A., & Farnham, C. N. (2013). Recreancy Revisited: Beliefs about Institutional Failure Following the Exxon Valdez Oil Spill. *Society & Natural Resources*, 26(6), 655–671. <https://doi.org/10.1080/08941920.2012.690066>
- Ritchie, L. A., Long, M. A., Leon-Corwin, M., & Gill, D. A. (2021). Citizen perceptions of fracking-related earthquakes: Exploring the roles of institutional failures and resource loss in Oklahoma, United States. *Energy Research & Social Science*, 80, 102235. <https://doi.org/10.1016/j.erss.2021.102235>

- Robertson, M. (2012). Measurement and alienation: Making a world of ecosystem services. *Transactions of the Institute of British Geographers*, 37(3), 386–401.
<https://doi.org/10.1111/j.1475-5661.2011.00476.x>
- Rodríguez-Ortega, T., Olaizola, A., & Bernués, A. (2018). A novel management-based system of payments for ecosystem services for targeted agri-environmental policy. *Ecosystem Services*, 34, 74–84.
- Rose, D. B. (2011). *Wild dog dreaming: Love and extinction*. University of Virginia Press.
- Rose, D. B. (2012). Multispecies Knots of Ethical Time. *Environmental Philosophy*, 9(1), 127–140. JSTOR.
- Rosenfeld, H. (2022). Sanctuaries as multispecies safe spaces. In *Feminist animal studies* (pp. 165–182). Routledge.
- Ruder, S.-L., Faxon, H. O., Orzel, E. C., Devkota, R., & Bronson, K. (2026). Reviewing the evidence on precision agriculture and environmental sustainability. *Npj Sustainable Agriculture*, 4(1), 9. <https://doi.org/10.1038/s44264-026-00128-x>
- Schlosberg, D. (2013). Theorising environmental justice: The expanding sphere of a discourse. *Environmental Politics*, 22(1), 37–55. <https://doi.org/10.1080/09644016.2013.755387>
- Scott, J. C. (2020). *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.
- Scotton, G. (2017). Duties to socialise with nonhuman animals: Farmed animal sanctuaries as frontiers of friendship. *Animal Studies Journal*, 6(2), 86–108.

- Seymour, M., & Connelly, S. (2023). Regenerative agriculture and a more-than-human ethic of care: A relational approach to understanding transformation. *Agriculture and Human Values*, 40(1), 231–244. <https://doi.org/10.1007/s10460-022-10350-1>
- Shapin, S. (1995). Here and everywhere: Sociology of scientific knowledge. *Annual Review of Sociology*, 21(1), 289–321.
- Sharp, E. L., Rayne, A., & Lewis, N. (2024). The ‘Good Kiwi’ and the ‘Good Environmental Citizen’?: Dairy, national identity and complex consumption-related values in Aotearoa New Zealand. *Agriculture and Human Values*, 41(4), 1617–1629. <https://doi.org/10.1007/s10460-024-10564-5>
- St. Pierre, E. A., & Jackson, A. Y. (2014). Qualitative Data Analysis After Coding. *Qualitative Inquiry*, 20(6), 715–719. <https://doi.org/10.1177/1077800414532435>
- Stanley, T. (2024). Carbon ‘known not grown’: Reforesting Scotland, advanced measurement technologies, and a new frontier of mitigation deterrence. *Environmental Science & Policy*, 151, 103636. <https://doi.org/10.1016/j.envsci.2023.103636>
- Steffen, W., Grinevald, J., Crutzen, P., & McNeill, J. (2011). The Anthropocene: Conceptual and historical perspectives. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 369(1938), 842–867.
- Steglich, E. M., Osorio, J., Doro, L., Jeong, J., & Williams, J. R. (2023). *Agricultural policy/environmental eXtender model: User’s manual version 1501* [User Manual]. Natural Resources Conservation Service. <https://epicapex.tamu.edu/media/pkff4m34/the-apex1501-user-manual-november-2023.pdf>

- Stemler, S. (2001). An overview of content analysis. *Practical Assessment, Research & Evaluation*, 7(17), 1–6.
- Stock, R., & Gardezi, M. (2021). Make bloom and let wither: Biopolitics of precision agriculture at the dawn of surveillance capitalism. *Geoforum*, 122, 193–203.
<https://doi.org/10.1016/j.geoforum.2021.04.014>
- Straub, A. M., Ritchie, L. A., Gill, D. A., Fullerton, A. S., Boyle, E., & Kersen, T. M. (2025). A legacy of recreancy?: Perceptions of routinized governmental failure in Jackson, MS. *International Journal of Disaster Risk Reduction*, 128, 105756.
<https://doi.org/10.1016/j.ijdrr.2025.105756>
- Sullivan, S. (2017). On ‘Natural Capital’, ‘Fairy Tales’ and Ideology. *Development and Change*, 48(2), 397–423. <https://doi.org/10.1111/dech.12293>
- Sullivan, S. (2023). Ag-tech, agroecology, and the politics of alternative farming futures: The challenges of bringing together diverse agricultural epistemologies. *Agriculture and Human Values*, 40(3), 913–928. <https://doi.org/10.1007/s10460-023-10454-2>
- Temper, L., & Del Bene, D. (2016). Transforming knowledge creation for environmental and epistemic justice. *Current Opinion in Environmental Sustainability*, 20, 41–49.
<https://doi.org/https://doi.org/10.1016/j.cosust.2016.05.004>
- Tironi, M., & Barandiarán, J. (2014). Neoliberalism as political technology: Expertise, energy, and democracy in Chile. *Beyond Imported Magic: Essays on Science, Technology, and Society in Latin America*, 305.
- Tsing, A. (2005). *Friction: An ethnography of global connection*. Princeton University Press.

- Tsing, A. L. (2015). *The mushroom at the end of the world: On the possibility of life in capitalist ruins*. Princeton University Press.
- Tsing, A. L., Deger, J., Saxena, A. K., & Zhou, F. (2024). *Field guide to the patchy anthropocene: The new nature*. Stanford University Press.
- Turnhout, E., Neves, K., & Lijster, E. de. (2014). 'Measurementality' in Biodiversity Governance: Knowledge, Transparency, and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (Ipbes). *Environment and Planning A: Economy and Space*, 46(3), 581–597. <https://doi.org/10.1068/a4629>
- Twine, R. (2020). Where are the nonhuman animals in the sociology of climate change? *Society & Animals*, 31(1), 105–130.
- Ulmer, J. B. (2017). Writing slow ontology. *Qualitative Inquiry*, 23(3), 201–211. <https://doi.org/10.1177/1077800416643994>
- Urquiza, A., & Billi, M. (2020). Water markets and social–ecological resilience to water stress in the context of climate change: An analysis of the Limarí Basin, Chile. *Environment, Development and Sustainability*, 22(3), 1929–1951. <https://doi.org/10.1007/s10668-018-0271-3>
- USDA. (2022a). *State Fact Sheets-Report-Table Grape Production in Chile—Field Visit to the Atacama Region*. <https://www.ers.usda.gov/data-products/state-fact-sheets/>
- USDA. (2022b, September 12). *How to Get Started with Nutrient Management*. Farmers.Gov. <https://www.farmers.gov/conservation/nutrient-management>
- van der Ploeg, J. D. (2020). Farmers' upheaval, climate crisis and populism. *The Journal of Peasant Studies*, 47(3), 589–605. <https://doi.org/10.1080/03066150.2020.1725490>

van der Velden, D., Klerkx, L., Dessein, J., & Debruyne, L. (2025). Governance by satellite: Remote sensing, bureaucrats and agency in the common agricultural policy of the European Union. *Journal of Rural Studies*, *114*, 103558.

<https://doi.org/https://doi.org/10.1016/j.jrurstud.2024.103558>

Van Dooren, T. (2014). *Flight ways: Life and loss at the edge of extinction*. Columbia University Press.

Velden, D. van der, Klerkx, L., Dessein, J., & Debruyne, L. (2024). Cyborg farmers: Embodied understandings of precision agriculture. *Sociologia Ruralis*, *64*(1), 3–21.

Veltmeyer, H., & Ezquerro-Cañete, A. (2023). Agro-extractivism. *The Journal of Peasant Studies*, *50*(5), 1673–1686. <https://doi.org/10.1080/03066150.2023.2218802>

Vermont Agency of Agriculture, Food & Markets. (n.d.). *VPFP Vermont Pay For Phosphorus Program*. Retrieved March 31, 2024, from https://agriculture.vermont.gov/sites/agriculture/files/doc_library/VPFP_OnePager.pdf

Vermont Agency of Agriculture, Food and Markets. (2023, January 15). *Payment for Ecosystem Services and Soil Health Working Group Final Report*.

<https://legislature.vermont.gov/assets/Legislative-Reports/PES-Working-Group-Final-Report-15Jan2023.pdf>

Vicuna, S., Alvarez, P., Melo, O., Dale, L., & Meza, F. (2014). Irrigation infrastructure development in the Limarí Basin in Central Chile: Implications for adaptation to climate variability and climate change. *Water International*, *39*(5), 620–634.

<https://doi.org/10.1080/02508060.2014.945068>

- Wacquant, L. (2005). Carnal Connections: On Embodiment, Apprenticeship, and Membership. *Qualitative Sociology*, 28(4), 445–474. <https://doi.org/10.1007/s11133-005-8367-0>
- Weisberg, Z. (2024). Sanctuaries as refusal. *Politics and Animals*, 11.
- Wilson, J. (2024). Modeling the measurement of carbon dioxide removal: Perspectives from the philosophy of measurement. *Frontiers in Climate*, 5, 1283333.
- Winkler, A. S., Brux, C. M., Carabin, H., das Neves, C. G., Häslér, B., Zinsstag, J., Fèvre, E. M., Okello, A., Laing, G., Harrison, W. E., Pöntinen, A. K., Huber, A., Ruckert, A., Natterson-Horowitz, B., Abela, B., Aenishaenslin, C., Heymann, D. L., Rødland, E. K., Berthe, F. C. J., ... Amuasi, J. H. (2025). The Lancet One Health Commission: Harnessing our interconnectedness for equitable, sustainable, and healthy socioecological systems. *The Lancet*, 406(10502), 501–570. [https://doi.org/10.1016/S0140-6736\(25\)00627-0](https://doi.org/10.1016/S0140-6736(25)00627-0)
- Wise, R. M., Fazey, I., Stafford Smith, M., Park, S. E., Eakin, H. C., Archer Van Garderen, E. R. M., & Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, 28, 325–336. <https://doi.org/10.1016/j.gloenvcha.2013.12.002>
- Wolcott, H. F. (1987). On ethnographic intent. In G. Spindler & L. Spindler (Eds.), *Interpretive ethnography of education: At home and abroad* (pp. 37–60). Lawrence Erlbaum.
- Wolf, S. A., & Ghosh, R. (2020). A practice-centered analysis of environmental accounting standards: Integrating agriculture into carbon governance. *Land Use Policy*, 96, 103552. <https://doi.org/10.1016/j.landusepol.2018.08.003>
- World Health Organization. (2023, October 23). *One Health*. One Health. <https://www.who.int/news-room/fact-sheets/detail/one-health>

Zalasiewicz, J. (2009). *The earth after us: What legacy will humans leave in the rocks?* OUP
Oxford.

Ziadah, R. (2025). Genocide, neutrality and the university sector. *The Sociological Review*, 73(2),
241–248.