Navigating and negotiating in a new field of knowledge

Norwegian farmers' journey into regenerative agriculture

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Abstract

Interest in regenerative agriculture has accelerated in recent years due to its potential to grow food in a way that actively increases soil health and sequesters carbon, making agriculture both a solution to climate change as well as more resilient to extreme weather events such as drought and flood. However, regenerative agriculture is still an undefined concept and is not much used in Norway. This thesis aims to understand how farmers navigate and negotiate new knowledges and practices in the emerging field of regenerative agriculture. I do this using a methodological bricolage based on 14 interviews with farmers throughout three growing seasons, participant observations, as well as articles and podcasts. I have used grounded theory to analyze my data, and illuminate the key findings using the concepts of cultural boundaries of knowledge, reciprocity, paradigm shifts and cognitive dissonance. My findings show that the main motivating factors for farmers to instigate regenerative agriculture were a desire to improve soil and crop health combined with a shift in mindset upon learning about the living microbial universe contained in their soil. Farmers who started regenerative practices gained new knowledge about their soil and plants, and developed a sense of reciprocity with the land. The farmers engaged with research not usually included in agricultural science. They learned from their own experiences and developed new practices that have not been used before in Norway, taking both financial and social risks. Thereby they stretched the cultural boundaries of Norwegian agricultural science and tradition. They were met with support, curiosity and skepticism. These innovative regenerative farmers contribute to a paradigm shift in agriculture. This shifts focus from plant to soil, and from mineral to microbial understandings of health and nutrition which catalyzes a change in farming practice. My research is relevant for farmers, agricultural consultants and politicians in Norway who wish to support a shift to regenerative agriculture and soil health. Understanding farmers' motivations and experiences is imperative for forming effective policy aimed to support farmer transitions – especially in a country like Norway where agriculture is regulated by state policy and subsidies.

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List of abbreviations and acronyms

CA	Conservation agriculture
EOV	Ecological Outcome Verification
FAO	Food and Agriculture Organization of the United Nations
HM	Holistic Management
ITPS	Intergovernmental Technical Panel on Soils
NLR	Norsk Landbruksrådgivning (The Norwegian Agricultural Consultancy)
NPK	Nitrogen, Phosphorus and Potassium
OA	Organic Agriculture
RA	Regenerative Agriculture
RI	Regeneration International
RN	Regenerativt Norge
VA	Vital Analyse

Translation of Norwegian words

Jordfruktbarhetskurs	Soil Fertility Course
Balderbrå	Mayweed
Karbon Agro	Conservation Agriculture
Kveke	Couch grass
Norsk Landbruksrådgivning	Norwegian Agricultural Consultancy

1. Introduction

Recently a new "buzzword" has entered the agricultural conversation: *regenerative agriculture* (RA). It originated in the United States during the 1980's but has recently resurged in the agricultural field both internationally and in Norway. There is no single agreed-upon definition of what "regenerative agriculture" means, and we will discuss the concept in chapter 2. However, in short, it can be understood as farming in such a way that the soil becomes healthier and more alive, with beneficial effects for ecosystems, the climate and farmers themselves. At a time when industrial agriculture is blamed for contributing to both global warming and ecosystem degradation, the concept of regenerative agriculture provides a new narrative, and potentially even a new paradigm.

Based on interviews and participant observations with farmers in the Southeast of Norway, this thesis we will explore how Norwegian farmers navigate in the still undefined field of regenerative agriculture. I will explore the agricultural paradigms they challenge, the scientific fields they mix, and the social barriers they bridge.

1.1 The problem with agriculture at large

Globally, agriculture is facing a crisis. Soil is the basis for growing food. It is the most biodiverse ecosystem, and the largest carbon pool on the planet (Bardgett and van der Putten 2014; Scharlemann et al. 2014). Yet it is being degraded so quickly that The Food and Agriculture Organization of the United Nations (FAO) have called it a "non-renewable resource", and already one third of the world's soils are highly degraded (FAO and ITPS 2015).

Not just the soil, but whole ecosystems are struggling in part because of agriculture. Excessive use of fertilizers and pesticides are polluting rivers, groundwater and oceans; insect populations are being drastically reduced, and biodiversity overall is suffering (Foley et al. 2011; Sánchez-Bayo and Wyckhuys 2019). The global food system is also driving climate change, accounting for 26 % of global greenhouse gas emission, and is one of the main causes for exceeding planetary boundaries (Ritchie 2019; B. M. Campbell et al. 2017; Rockström et al. 2009). At the same time it is pushing a global land grab, resulting in the displacement of rural and indigenous

populations and a loss of ecological knowledge of how to manage cultural landscapes (McMichael 2014; Wittman 2009).

Most food is produced through specialized, intensive agriculture which is dependent on synthetic fertilizers and pesticides, ever-larger machinery, monocrops, intensive ploughing, and seeds that have been developed to do well under these conditions – often denoted as "conventional" agriculture[1] (Altieri 2012; Lammerts van Bueren et al. 2011). This kind of agriculture is becoming ever more dependent on fossil fuels to sow, fertilize, spray and harvest, to the extent that Vandana Shiva (2008) has warned that we grow our food on oil, not soil. Richard Walker (2004, 191) names this system "petrofarming." Undoubtedly, conventional agriculture has made possible a tremendous increase in crop yield, but the long-term socioecological effects are showing to be severe.

Ironically, because growing food is dependent on a functioning environment, the way we farm today is undermining our ability to grow food tomorrow (DeLong et al., 2015). Currently, almost half of the global food production is grown in a way that exceeds safe planetary boundaries (Gerten et al. 2020). This is especially worrying considering that the world's population will keep growing until almost 10 billion by 2050. According to van Dijk et al. (2021), we will need to increase food production by 30-62% if climate change is taken into account. In their business-as-usual scenario, we will need to increase global food production by 51%. If a change in the local and global agricultural systems does not happen, the side effects of conventional agriculture may lead us into the Malthusian Catastrophe [2] it was designed to avoid, while further undermining the ecological basis for our existence.

Over 20 years ago, Keller and Brummer (2002) argued that industrial agriculture, as described above, stems from a mechanistic worldview, which is based in the "belief that natural systems are understandable, predictable and manipulatable" (264). In a similar but different approach, Jamie Lorimer (2020) describes industrial agriculture as

[1] Conventional agriculture is not homogenous. As Sumberg and Giller (2022) point out, the term "conventional" is often used as a strategy of homogenizing, normalizing and othering in agriculture. This is not the goal of this thesis, but the term "conventional agriculture" will be used because this is the language used by the farmers I interview.

[2] A Malthusian Catastrophe is when population growth outpaces a society's ability to produce food. The concept is named after Thomas R. Malthus, who anonymously published An Essay on the Principle of Population in 1798 where he also linked epidemics, war and famine to the over-usage of natural resources.

taking an "antibiotic" approach to growing food, characterized by efforts to "eradicate, control, rationalize, and simplify" (2020, 2). However, he posits that we are entering a "probiotic turn" in agriculture (and other fields) where we use "life to manage life" – a new paradigm (2020, 2). This thesis will investigate how the Norwegian farmers who begin with regenerative agriculture take this approach, as they choose agricultural practices based on not only the health of their plants, but also the health of their soil microbes. The Norwegian agricultural scene, however, is still mainly characterized by conventional agricultural.

1.2 Agriculture in Norway

Norway is a "cold, wet and steep" country for growing food (Bardalen, 2023). Only 3% of the country's area is arable land, of which two thirds is used for grasslands for grazing or harvesting silage. 30% of this arable land has soil good enough to grow grain (Regjeringen 2021a; SSB 2022). As much as 45% of the country can be used for rough grazing[3] (Svensson et al. 2021).

Because of the scarcity of arable land, the Norwegian Government encourages and regulates what kind of food is produced and where. Traditionally animals were a part of every farm, their manure being a vital fertilizer for vegetable and grain production up until the 1950's. However, after the WWII the government saw a need to increase food production. In a move to "optimalise the natural resource use" of the country, politicians decided to use subsidies to encourage solely grain farming in the fertile soils in eastern and southern Norway, and encourage meat and milk production to the mountainous areas (Johnsen and Smedshaug 2016, 20). This was called *kanaliseringspolitikken* or "canalisation politics". This type of politics would not have been possible to implement without the rise of synthetic fertilizer, in which Norway was also pioneering[4]. The government's strategy for agricultural development since the 1950's has been industrialization and effectivization, resulting in a steadily decreasing

[3] Rough grazing is a diminishing practice. Traditional grazing areas are growing into forests, much to the chagrin of locals, tourists, and researchers who strongly value these cultural landscapes for their beauty, biodiversity, contribution to food security and cultural value (Eiter and Bryn 2010).

[4] One of the world's biggest fertilizer companies, Yara, started up in Norway in 1905 (formerly named Norsk Hydro). After WWII, the Norwegian state bought the fertilizer company, and it still owns the largest share of 36.2 % in 2022 (Bryhn and Gram 2022; Regjeringen 2022).

number of farms and farmers. The farms that do exist grow larger and more mechanized (SSB 2019; NOU 2022:14).

Organic agriculture entered Norway as a grassroots movement in the 1970's as a reaction to the industrialization and widespread use of synthetic fertilizers and pesticides (Solemdal and Serikstad 2015). Since then, organic agriculture has (to some extent) been adopted into "mainstream" agriculture. For example, the largest agricultural consultancy *Norsk Landbruksrådgivning* (NLR)[5], offers consultancy in organic agriculture, and several agricultural schools teach it. Between 1999-2015 the government set several goals of increasing organic production[6]. However, none of the goals were reached and in 2016 the government outsourced the fate of organic production to market demand (Det Kongelige Landbruks- og Matdepartement 2016). Today, just under 5% of the country's production is certified organic (SSB 2023).

The Norwegian agricultural industry routinely pride themselves in producing just about the "cleanest" and "safest" food in the world, (Bjørkdahl and Syse 2021; Senterpartiet 2021; Staarvik 2022; Bjerkvik 2022; Sirdal Bondelag et al. 2022). Interestingly, conventional farmers often "experience their own production to be almost organic and organic farming to be something close to nonsense" (Bjørkhaug 2006, 129). Moreover, alternatives to conventionally produced food, such as organic, is marketed in such a way that conventionally grown food seems just as good as organic (Bjørkdahl and Syse 2021).

Therefore, there are few structural incentives for conventional farmers to begin with organic farming (or other alternative farming approaches). However, there are some incentives to increase sustainable agricultural practices, such as implementing cover crops and reducing autumn plowing (Landbruksdirektoratet 2022a; 2022b). Fields that are plowed after the growing season are vulnerable to erosion from autumn rains (Bechmann et al. 2020). This results in waterways that are polluted with both pesticides and synthetic fertilizers, causing eutrophication and ecosystem imbalances, despite national and regional environmental agricultural laws (Eklo and Stenrød 2021;

[5] NLR is a member based agricultural consultancy. Two thirds of their income is from membership dues and various consultancy project, and a little under one third comes from state support (NRL 2022).

[6] In 1999 the government set the goal of increasing organic production to 10%, and in 2009 the goal was increased to 15%. Since 2016 the government does not set a percentage as a goal, but writes that organic production should be led by the market (Det Kongelige Landbruksdepartementet 1999; Landbruks- og Matdepartementet 2009; Det Kongelige Landbruks- og Matdepartement 2016).

Bechmann et al. 2012). Soil compaction is also a growing problem in Norway. It is the result of driving heavy machinery on water-logged soils, which is becoming more and more difficult to avoid due to the heavier and more irregular rains that follow climate change (Hugh Riley 2016; Seehusen 2019).

In line with the soil degradation on a global scale, Norwegian agricultural soils loose 1% of organic matter every year due to plowing, and poor crop rotations (H. Riley and Bakkegard 2006). The Norwegian concept of state regulated *jordvern* (soil protection), is not about countering soil degradation. Rather about limiting the number of square meters of arable soil that is lost to infrastructure each year, due to the scarcity of available arable land in the country[7]. However, there is budding awareness about the importance of preserving and protecting the soil simultaneously.

In 2020 the Norwegian Directorate of Agriculture launched a report called the "National Program for Soil Health" (Landbruksdirektoratet 2020). The first part of their report explained the importance of using the term "soil health" instead of "soil quality" because the word health has connotations to something that is alive. This is perhaps a sign of Norwegian agriculture inching towards a "probiotic turn."

The report has catalyzed increased funding for projects and further developing existing grants in order to support agriculture that takes soil health into account (Viken Fylkeskommune 2022; Statsforvalteren i Oslo og Viken 2023). Policy, which takes farmers' own knowledge, perspectives and understandings of their structural environments into account, results in more socially just and environmentally effective agricultural transitions (Hale, Schipanski, and Carolan 2021; Burton and Farstad 2020). RA can be an important tool to develop agriculture in a sustainable direction – growing soil health and ecological resilience simultaneously as growing food. Therefore, this thesis can be useful for policy-makers who wish to support farmers in this process.

[7] The concept of Jordvernmål was implemented in 2004, with a goal of limiting the area of agricultural land lost to infrastructure to 600 hectares (6 million m2) per year. The goal has been updated several times, and in 2021 the government set a goal of limiting the loss of agricultural land to 300 hectares per year (Regjeringen 2021b; 2023).

1.3 Why study regenerative agriculture in Norway?

There are several reasons for researching farmers' experiences as they begin with regenerative agriculture (RA) in Norway.

First of all, farmers' own knowledge and experiences in their land is often both undervalued and under-studied, and knowledge about what factors influence farmers to shift to more sustainable practices is incomplete (Šūmane et al. 2018; Schoonhoven and Runhaar 2018). What motivates farmers to shift to regenerative agriculture, and how they experience this process is even less researched. The research that does exist comes from Australia, United States and New Zealand (Gosnell, Gill, and Voyer 2019; Kenny and Castilla-Rho 2022; Gosnell, Charnley, and Stanley 2020; Grelet et al. 2021). No research on Norwegian farmer's experiences with regenerative agriculture has been published as of yet[8]. This gap made me curious about what motivated Norwegian farmers to begin with regenerative agriculture and about their experiences. Especially in a social setting influenced both by tradition and the unwritten Law of Jante (*janteloven*) – a "cultural intolerance towards standing out, being different and overachieving" (Hunter et al. 2023, 120; Bjørkhaug 2006).

Secondly, it is interesting to study a term that has hit a "nerve" in society, agriculture and academia both locally and internationally. New concepts in agriculture have the potential to bring new dynamics, and challenge both traditional knowledge and practices. Norwegian agriculture changed dramatically during the early 1900s when the synthetic fertilizers and pesticides of conventional agriculture became commonplace. The last "new" term that entered the agricultural field in Norway with comparable force as RA, was "organic agriculture." The first organic farmers broke with the dominant agricultural paradigms (traditions, knowledges and practices) of their time. They chose not to use synthetic pesticides and fertilizers, and instead chose a holistic approach to growing food based more on natural resources and natural processes (Østergaard 1998; Solemdal and Serikstad 2015). The organic farmers influenced conventional agricultural science and practice as well, such as farm-based research together with the farmer. This

[8] In a Ruralis report on farmers' implementation of environmental measures, some of the interviewed famers had also begun with regenerative principles. However, the focus of the report is on the implementation of climate measures, not on the farmers' experiences with RA per se (Brobakk and Melås 2020). Rust et al. (2022) compared farmers perceived causes and solutions of soil degradation in Norway and the UK, and included "regenerative agriculture" as a keyword in their article, but do not engage with the concept more in the article. Isabelle Hugø (2023) has an article under review that engages with the topics of farmer experience and regenerative agriculture (Hugøy, 2023).

was a method that was not acknowledged by agricultural science at the time, but has proved to be useful in conventional agriculture (Solemdal and Serikstad 2015).

One of the first reports to mention regenerative agriculture is the NIBIO report "Possibilities and challenges in increased carbon sequestration in Norwegian agricultural soil" (Rasse et al. 2019). However, the authors show caution in recommending regenerative agriculture because it has not been tested in Norway yet.

> There is a need for substantial research, development, and testing in full scale at farms before we have a handbook[9] that shows how farmers can begin and run a regenerative farm under Norwegian conditions. (Rasse et al. 2019, 77 my translation).

Research institutions are saying "wait," but the farmers I have interviewed have already begun. This, combined with knowledge of the organic pioneers' experiences led me to wonder: are regenerative farmers also challenging science, practices and traditions? If so, in what way?

Thirdly, RA seems to be attracting both organic and conventional farmers alike. Organic, agroecology, permaculture and biodynamics have long been proposed as alternatives to conventional agriculture. However, there is a strong cultural resistance, and even aversion to these from many conventional farmers. Norwegian farmers who began with organic production in the 1980's up until the early 2000's experienced ridicule from their conventional colleagues (Østergaard 1998). Even today, there is much polarization between the two groups. Regenerative agriculture, however, is so new that it does not yet have at set definition, and it has not been institutionalized into the Norwegian food labelling system. RA is accessible to all farmers, potentially holding space for conversation and dialogue between farmers of different backgrounds. On the other hand, the openness of the concept also means there is a risk that it can be used for greenwashing (Schreefel et al. 2020). This openness made me curious as to how farmers navigate and negotiate the different agricultural labels and social groupings as they begin with regenerative agriculture.

[9] The original word is *veiledningspakke* in Norwegian, which directly translates to a guidance-package.

1.4 Aims and research question

This thesis aims to understand how farmers navigate and negotiate new knowledges and practices in the undefined field of regenerative agriculture. Its objectives are to understand what Norwegian farmers base their decision to begin with regenerative agriculture on. Are they motivated by finances, environmental values, new knowledge, or something else? Furthermore, I want to contextualize their new practices within larger agricultural paradigms, to understand why researchers like Rasse et al. (2019) cannot recommend farmers to begin with RA, and why the farmers I spoke with do so anyway. Lastly, I wish to explore the social aspects of these farmers's experiences. Because of the public nature of farming, farmers inevitably receive feedback from their community. How do they negotiate and navigate their different approaches with others – who may or may not support their choices? Therefore, my research question and sub-questions are:

> *How do Norwegian farmers navigate and negotiate new knowledge and practices in the undefined field of regenerative agriculture?*
>
> - *Why do Norwegian farmers begin and continue with regenerative agriculture?*
> - *How do they challenge agricultural paradigms, and to what effect?*
> - *How do they negotiate agricultural traditions, sciences, practices and social divides?*

I will answer these research questions using four concepts. I draw on Thomas Kuhn's (1962) *structure of scientific revolutions,* because I conceptualize knowledge and practices as situated within *paradigms*. Importantly, these paradigms are culturally and historically situated, and I see these paradigms as held in place by Thomas Gieryn's (1999) *cultural boundaries of knowledge*. Leon Festinger's (1952) psychological concept of *cognitive dissonance* help us understand why shifting paradigms can be difficult and is resisted by many. Finally, Mauss (1990) and Sahlin's (1972) concept of *reciprocity* will give us deeper insight into the farmers' experience as they begin growing food based on regenerative principles and a "probiotic" approach.

1.5 Thesis structure

In this introductory chapter I have set the scene, explained the challenges with both the global industrialized agriculture and the local challenges of Norwegian agriculture. I have also explained the relevance for studying regenerative agriculture in Norway and presented my research questions. In chapter 2, we delve into the field of regenerative agriculture itself, examining the historical and contemporary trajectory of the concept, and the tensions between various stakeholders' conceptualization of the concept. I also outline the regenerative field in Norway, describing the main networks and their differing approaches to RA. Next, chapter 3 outlines my methodological approach where I describe how I have collected and analyzed my data. In chapter 4, I outline the four concepts I will use to analyze my data: cultural boundaries of knowledge, reciprocity, paradigms and cognitive dissonance.

I weave my findings and discussion together throughout the analysis. Beginning in chapter 5, I give a short explanation of how Norwegian farmers understand what RA means. Then, we go on to explore why farmers experience what I argue is a paradigm shift when they shift perspective from above to below ground. Chapter 7 first explores how this perceptual shift also fosters a closer sense of reciprocity and a more personal way of learning about the land. In chapter 8, we dig deeper into the core practices connected to the dominant agricultural paradigm, which farmers are challenging. Chapter 9 continues the discussion on paradigms, but with a greater focus on farmers' role in innovation, developing agricultural science and the social negotiations of paradigm-changes. The chapter ends by placing the analysis of our case into a larger context. Chapter 10 summarizes the analysis.

2. Understanding regenerative agriculture

Regenerative agriculture (RA) is a concept under negotiation. Farmers, NGO's and agrichemical and food corporations all claim it as their own. In this chapter, I will first give a short explanation of agricultural terms that many use in comparison to RA. Then, I will outline the emergence and evolution of regenerative agriculture as a concept both internationally and in Norway.

2.1 Regenerative agriculture compared to other terms

Many use the words *organic agriculture, agroecology, conservation agriculture*, in order to define and explain regenerative agriculture. Before delving into the discussion on what regenerative agriculture is, let us first clarify these terms.

Organic agriculture

Organic agriculture has a long history and its meaning has changed over time. Like regenerative agriculture, organic agriculture is not one thing. IFOAM – Organics International define organic agriculture as

> a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved. (IFOAM 2008)

From the 1980's organic agriculture was institutionalized with labels and certification schemes (Arbenz, Gould, and Stopes 2016). Today organic regulations vary from country to country, but are mainly defined by their restrictions on synthetic fertilizers and pesticides (Schreefel et al. 2020). While organic agriculture aims to support ecological processes, it relies heavily on plowing in order to suppress weeds (Mitchell et al. 2019) – a practice which regenerative agriculture aims to reduce.

Agroecology

Agroecology is a scientific discipline, an agricultural practice and a social and political movement (Wezel et al. 2009). Agroecology as an agricultural practice emerged in the 1980's, often connected to social movements protesting the unintended consequences of

the Green Revolution and industrialization of agriculture. In 2003 Charles Francis[10] and colleagues proposed to define agroecology as "integrative study of the ecology of the entire food system, encompassing ecological, economic and social dimensions" (C. Francis et al. 2003, 100). This scaled up the definition of ecology to a encompass the entire planet, critiquing the global linear food system of production, distribution and consumption (Wezel et al. 2009).

Agroecology as an agricultural practice and regenerative agriculture are similar in that they aim to grow food in ways that work with and support ecological processes. However, it seems that RA has a more explicit focus on soil than agroecology. Agroecology on the other hand takes a larger ecosystem and food-system approach and has an established food-system and justice perspective that some claim is "poorly represented in regenerative agriculture" (Tittonell et al. 2022, 7). Regenerative agriculture is about soil.

Conservation agriculture

Conservation agriculture (CA) is based on three "pillars": minimum soil disturbance, keeping soil covered[11], and diversification, which is understood as using at least three different crops in rotation or co-planting (FAO 2023). A fourth pillar that is not clearly spelled out on FAO's pages is the use of glyphosate to end a crop, so a new one can be planted (Basch et al. 2022). In CA, keeping the soil intact and covered is seen as the most important for carbon sequestration and soil health. Proponents of CA chide organic agriculture for plowing, damaging soil structure and reducing carbon levels in soil (Mitchell et al. 2019). Organic agriculture, on the other hand, focus on eliminating synthetic fertilizers and poisons like glyphosate in the environment. Perhaps regenerative agriculture could be the best of both worlds, as suggested by Landers et al. (2021)?

2.2 The history of regenerative agriculture

The history of regenerative agriculture can be organized into three phases, which I call: *origin*, *resurgence* and *acceleration*. Regenerative agriculture was first used as a concept during the 1980's, but faded out, giving way to other concepts such as

[10] The same Charles Francis who researched and wrote the first articles on regenerative agriculture (C. A. Francis and Harwood 1985; C. A. Francis et al. 1985; C. A. Francis, Harwood, and Parr 1986).

[11] At least 30 % of the soil must covered with crop residues and/ or cover crops (FAO 2023).

sustainable agriculture, organic agriculture and agroecology. Between roughly 2010-2015 the concept resurged. Since 2016, its popularity accelerated with organizations, academics, consultants and farmers beginning to use the term again. During this phase of acceleration (which we are still in) there is a race to define what regenerative agriculture should be.

Origin

The concept of regenerative agriculture originated in the United States during the 1980's. The first use of the term "regenerative" within the context of agriculture was by Medard Gabel (1979) in his report *HoPing: Food for Everyone.* In the chapter "Strategies for a Regenerative Food System" he maps out strategies for solving immediate hunger as well as working holistically toward regenerative food systems in the household, community, regional and global scales. He envisioned a regenerative food system as part and parcel of development, alleviating poverty, reducing energy needs and transforming energy systems. He includes what he calls the "North American" model of intensive, high-energy and high-input agriculture as important in order to end immediate hunger and famines. However, in the long-term we need to develop a "regenerative system; that is, one which is not based on depleting the stock of fossil fuel subsidies or other depletable resources or practices and that is efficient in all stages of food production and distribution" (210).

Robert Rodale, who collaborated with Medard on several projects during the 80's, coined and popularized the term "regenerative agriculture" and further articulated the concept in his influential article "Breaking New Ground: The Search for a Sustainable Agriculture" in the magazine *The Futurist* (Rodale 1983). Rodale's article is referenced in almost every article written on regenerative agriculture. However, O'Donoghue and colleagues (2022) are the only ones who actually quote Rodale's original text. As this chapter as well as my analysis show, Rodale's article still affects several core understandings of regenerative agriculture today, despite its relative inaccessibility, as it is not found online.

The way Rodale conceptualized regenerative agriculture was a fundamentally different way of growing food compared to how he saw conventional agriculture – as production systems based on "domination of nature". Conventional agriculture, in

Rodale's view, stemmed from Jethro Tull and Justus von Liebig. At the cusp of the industrial revolution in Britain in the middle of the 18th century, Tull improved the plow and popularized the idea that bare ground tilled intensively would give crops the best nutrients. A century later in Germany, Liebig further revolutionized agriculture with his mineral model of soil fertility, replacing the idea that plants needed humus to grow (Marchesi 2020).

Interestingly, while Rodale acknowledged organic agriculture as an alternative, Rodale posited that organic farmers operate from largely the same mindset of conventional farmers. He claimed that "they have repudiated some of the ideas that have stemmed from the work of von Liebig, but are attempting to fit their individualized non-dominance ideas around a method of agriculture that was planned to make dominance possible" (Rodale 1983, 18). He envisioned regenerative agriculture as an entirely different system, "depending to a very high degree on the free goods that nature provides. Farming would then change from a battle against nature into the art of encouraging nature to release the most benefits for human use with the least possible effort" (Rodale 1983, 18).

Rodale imagined an agriculture based on perennial crops that imitate the way nature regenerates degraded land with wild plants as they build soil, increase microorganisms, increase moisture and reduce soil erosion. This kind of agriculture would

> in effect reinvent food production in a way that marries the two goals of conservation and agriculture in a unified system that not only prevents erosion but actually builds the soil. In other words the fundamental idea of regenerative agriculture is to reinvent food production in a way that causes the resource base to get even better progressively over that causes the resource base to get even better progressively over time. And that is a very ambitious goal and we don't have all the information and the tools yet to do that. I think my hope, my dream is that regenerative agriculture will be based largely in perennial crops, not only trees and horticultural crops, but grain crops. (Rodale 1985, 13–14)

Importantly, Rodale acknowledged that the kind of agriculture he envisioned was not yet possible because of a lack of tools and knowledge. Research into natural processes and also towards developing perennial grains was necessary – research that farmers have limited capacity to carry out on their own. "Somehow, we must find a way to get

the idea of regeneration into the minds of the leaders of agricultural research, and convince them that the present fine-tuning of old methods is leading farmers deeper into trouble instead of toward effective solutions… Farmers and researchers will have to accept a totally different idea – perhaps the most challenging task of all" (Rodale 1983, 20). As we will see in the analysis, this shift of mindset that Rodale calls for is difficult, and involves a paradigm shift.

Wes Jackson founded the Land Institute in 1976 in Kansas, USA, working to domesticate perennial grains of sorghum, wheat and rice[12] – Rodale's vision. Jackson also advocated for the same things as Robert Rodale, but he described it as a Natural Systems Agriculture rather than regenerative (Jackson 1980) where the "never-plowed prairies serves as our teacher" (Jackson 2002, 115). During the 1990's, researchers within the USDA and Rodale Institute worked with the Land Institute to begin domesticating a perennial wheatgrass into a grain, now trademarked as *Kernza* (The Land Institute 2023). The Land Institute's vision is a perennial grain system independent of fertilizers, pesticides and fossil fuels, where the ecosystem "maintains its own health, runs on the sun's energy, recycles nutrients, and at no expense to the planet or people" (Jackson 2002, 115). However, regenerative agriculture as a concept has since scaled out and is not limited to perennial agriculture.

The ecologist Richard Harwood (1983) traced the roots of regenerative agriculture all the way back to the organic and biodynamic pioneers of the early 1900's such as Rudolf Steiner, Albert Howard, Lade Eve Balfour, Hans and Maria Muller, among others. According to Harwood they rebelled against the "complete restructuring of nature through the use of massive inputs to permit high productivity within a specialized, biologically simplified agricultural system" (1983, 24), and the "reductionism in agriculture brought on by the Industrial Revolution (1983, 27). This catalyzed a movement towards what Harwood called "wholistic [sic] thinking" (1983, 27) emphasizing composting, seeing soil, plant, animal and human health as interconnected, and acknowledging the important ways soil bacteria contribute to plant health. For example, Hans and Maria Muller are cited and describe soil as the "digestive organ" for plants (Harwood 1983, 28) – which is what recent research confirms as well (Berendsen, Pieterse, and Bakker 2012) and which I will discuss more later in this

[12] The Land Institute has successfully domesticated a perennial grain from wheatgrass, which is trademarked as Kernza (The Land Institute 2023).

thesis. While Harwood acknowledged the organic pioneers as contributing to various schools of regenerative agriculture, he also emphasized that regenerative agriculture "goes beyond the organic concept to include changes in macrostructure and social relevancy, and to increase rather than decrease production resources" (1983, 31). He found three themes that all farming systems based in regenerative philosophy share. First is the interrelatedness of all parts of a farming system, including the farmer and his family. Secondly, the importance of the innumerable biological balances in the system. Thirdly, the need to maximize desired biological relationships in the system, and minimize use of materials and practices which disrupt those relationships (Harwood 1983, 24).

Interestingly, defining regenerative agriculture was not entirely straight forward even in the 1980's. In a paper for a Regenerative Farming Practices workshop that Rodale Institute hosted with USAID, Morgan (1985) wrote:

> First, regenerative agriculture is not a single, universally applicable list of well-defined practices or technologies. It is a body of principles… Second, purity of concept is far less important than pragmatic effect… Third, regenerative agriculture (or any other agriculture, for that matter) is always set in a larger socio-economic context. The implementation of regenerative agriculture in programs appears again and again to be more of an art than a science." (Morgan 1985, 134)

It seems that most early literature on regenerative agriculture are papers written for workshops, such as the workshop on "Resource-Efficient Farming Methods for Tanzania" (Brusko 1983), the workshop on "Regenerative Farming Systems" (Rodale Institute 1985) by USAID and Rodale Institute, as well as papers written for a Hearing on the Agricultural Productivity Act of 1983 (U.S. Congress 1984). Active participants and paper authors were Gabel Medard, Richard Rodale as well as Richard Harwood and Charles Francis – two agronomists who worked together with Rodale during the early 1980's.

The first peer- reviewed journal article by Francis, Harwood and Parr (1986) describes regenerative agriculture as a potential path for small-scale farmers in developing countries to achieve food- and financial security. While regenerative agriculture is seen as similar to "alternative agriculture" and "organic agriculture", they anchor its conceptual bases in Harwood's three themes outlined above. The authors

outline typical low-input farming and best-practices that use only local resources, emphasizing how "knowledge of how biological interactions among species and the natural environment can lead to improved productivity" (1986, 66) as well as the importance of taking into account the total farm environment, local traditional systems and the farm family. In a critique to contemporary development, Francis et al. conclude that implementing strategies for rolling out regenerative agriculture can "encourage local autonomy and self-reliance, although these are quite a departure from most development approaches in vogue today" (1986, 72–73).

After the initial excitement about regenerative agriculture, the term lost its momentum in the 1990s, and the term "sustainable agriculture" skyrocketed; "agroecology" and "organic" were also on the rise (Giller et al. 2021). Perhaps it is no coincidence that the concept of sustainable agriculture became so popular, since 1987 was the year the World Commission on Environment and Development launched the term "sustainable development" (Brundtland 1987).

Resurgence and acceleration

In the aftermath of the 2008 oil crisis, regenerative agriculture was once again proposed as a potential solution to the expected food crisis due to industrial agriculture's utter dependence on fossil fuels. Proponents mirrored arguments for rolling out regenerative agriculture in developing countries during the 80's . A few years later, the main narrative around regenerative agriculture shifted to being able to solve climate change through sequestering carbon in the soil, a narrative that spread wide and far.

The story of regenerative agriculture being a solution for climate change fit like a glove into the zeitgeist of our time. In 2015 world leaders finally agreed to limit global warming to "well below 2°C" (UNFCCC 2015, 2). During this conference the French Minister of Agriculture proposed and founded the '4 per 1000 initiative', with the goal of increasing the carbon content of the world's soils by 0.4% per year (4p1000 n.d.). In addition, the UN had declared 2015 the "International Year of Soil", in order to raise awareness about the importance of soil for food security, climate change adaption, ecosystem functions, poverty alleviation and the importance of soil health for meeting the Sustainable Development Goals of 2030 (FAO 2015).

During the 80's, regenerative agriculture was promoted by the Rodale Institute and those connected to it. This time, various actors within agriculture such as non-profits, institutes, companies, consultants and researchers all began to use the term – contributing to the myriad of meanings associated with regenerative agriculture. However, three main organizations put regenerative agriculture on the map and contributed to its resurgence and narrative related to climate change, before "everyone" started using it.

Rodale Institute

In 2014, after several decades of relative silence on RA, the Rodale Institute published the white paper "Regenerative Organic Agriculture and Climate Change: A Down-to-Earth Solution to Global Warming". Here they posit that "recent data from farming systems and pasture trials around the globe show that we could sequester more than 100% of current annual CO2 emissions with a switch to widely available and inexpensive organic management practices, which we term "regenerative organic agriculture" (Rodale Institute 2014, 1). They continued to popularize regenerative agriculture, and in 2018 they launched their own regenerative label, the Regenerative Organic Certified. It is based on the USDA Certified Organic standards, but also requires that a farm "increases soil organic matter over time and sequesters carbon below and above ground, which could be a tool to mitigate climate change; improves animal welfare; and provides economic stability and fairness for farmers, ranchers, and workers" (Regenerative Organic Certified 2021, 3).

Soils have long been suggested as an opportunity to sequester carbon and mitigate climate change (R. Lal 2004; Rattan Lal 2010). However, we still lack a complete understanding of soil carbon and its sequestration potential, since soil carbon sequestration is affected by a range of factors, such as soil type, climate, weather, microbial activity, fertilizers, and continued management practices among others (Davidson and Janssens 2006; Kon Kam King et al. 2018; Dynarski, Bossio, and Scow 2020). Despite this "a complete understanding of soil carbon and the sequestration potential should not be a prerequisite for action" (Kane 2015, 28).

Savory Institute

The Savory Institute is another key organization that began using the term regenerative agriculture during this decade. Rather than focusing on arable agriculture, Allan Savory developed a method for grazing animals in a way that actively builds soil and supports ecosystems, as well as a framework for decision making, Holistic Management (HM) (Savory and Butterfield 1999). The Savory Institute and HM were also popularized through the narrative of carbon sequestration, countering desertification and climate change mitigation (Savory 2013). Because a large segment of farmers in Norway is using HM, I will describe this entrance point into regenerative agriculture in a bit more depth.

Allan Savory worked to restore degraded grasslands in the Zimbabwean savannah in the 60's. Initially, he thought the reason for grassland degradation was too much grazing by wildlife, and shot 40 000 elephants (sic), which "was [his] life's biggest mistake" (Savory 2013). To his chagrin, he found that culling wildlife only worsened desertification, and shifted approach.

Inspired by Smuts (1926) concept of holism[13], Savory saw land degradation as the consequence of reductionist decision making, and saw the beneficial role that large herds of grazing animals contributed to grasslands. Grazing animals eat part of the grass and remove its dead leaves as well, so it has space to grow new leaves. Animal saliva even stimulates grass growth (Li et al. 2014), and they naturally fertilize grasslands before moving on to fresh grazing areas. Savory developed HM through the 70's and 80's, which culminated in the influential book *Holistic Management: A New Framework for Decision Making* (Savory and Butterfield 1999). Here HM is outlined as a framework for decision based in ecological processes that take into account the "whole", that is, all resources available (natural, financial and social). Importantly, HM begins with farmers identifying what their holistic context is through writing both a "quality of life" statement, where land managers begin by expressing how they want their life to be based on their values, as well as a description of their desired future resources (in terms of people, land management, nutrient cycles) look like in 100 or 500 years. Although the framework can be applied to any system, it is mostly known for and associated with grazing practices.

[13] A little known paradox is that Jan Smuts was a white supremacist who used his political power to fiercely defend and promote racial segratation in South Africa; he only applied the concept of holism to white people (Schwarz 2011; Morefield 2014).

In 2013 Savory hosted a popular and contested Ted Talk, where he showed how using Holistic Management framework to graze large herds of animals in ways that mimicked natural herds on the savannah reversed desertification. In the presentation he also made the claim regenerating the world's grasslands would take the world back to pre-industrial levels of carbon in the atmosphere (Savory 2013). Holistic Management began being associated with or seen as interchangeable with regenerative agriculture this same year (Schwartz 2013), with more books and academic articles to follow (C. White 2014; Kastner 2016; Soloviev and Landua 2016; C. Rhodes 2017; R. Teague and Barnes 2017; W. R. Teague et al. 2016; Gosnell, Gill, and Voyer 2019).

Savory's claim that holistically managing grasslands using herds of cattle can reduce emissions to pre-industrial times has also been heavily contested. Many have critiqued Savory both for overstating the carbon sequestration and ecological restoration of HM-managed grasslands (Briske et al. 2013; 2014; Carter et al. 2014; Nordborg and Röös 2016). He is also criticized for dismissing the studies that critique HM as not actually measuring HM (Nordborg and Röös 2016). However, others support the need for a different research approach which takes into account whole-systems (W. Richard Teague 2017), acknowledging that most rigorous studies comparing HM to other management techniques do not take into account the social parameters that are key to HM, because they are too difficult to measure (Gosnell, Grimm, and Goldstein 2020).

The Savory Institute also developed the first outcome-based regenerative label, Ecological Outcome Verification (EOV). The Savory Institute defines EOV as

> a scientific methodology that provides metrics to land regeneration. It is the first outcome based, contextually relevant method that allows monitoring regeneration with a holistic approach. (Savory Institute 2021, 33).

An EOV measures "five key outcomes that define land regeneration: ground cover, water infiltration, biodiversity, primary productivity, soil carbon and health" (Savory Institute 2021, 33). EOV is also taught to farmers as a practical tool for continually evaluating the health of their farm.

Regeneration International

The third organization to contribute to the resurgence of RA was the non-profit Regeneration International (RI). It was founded in 2015 by 60 people representing businesses, the farming and scientific communities, educational institutions, policymakers and NGOs. Their director is André Leu, the former president of IFOAM Organics International, "indicating overlap between the organic and regenerative movements" (Hermani 2020, 45). Leu also played a prominent role in supporting an promoting the '4 per 1000' initiative mentioned above (Regeneration International 2019a). RI's mission is:

> to promote, facilitate and accelerate the global transition to regenerative food, farming and land management for the purpose of restoring climate stability, ending world hunger and rebuilding deteriorated social, ecological and economic systems. (Regeneration International 2023).

Importantly, they take a *political* approach, highlighting the need to transform the entire food system in order to:

> restore farmers' independence by ending corporate control over the global food system, end world hunger, revitalize local economies, and promote social justice and fair trade. (Regeneration International 2019b).

It is no surprise that on their steering committee we find Vandana Shiva, the ecofeminist and social activist who has spent most of her life supporting farmer independence and battling agrichemical companies about (among other things) the patenting of seeds and rollout of GMO crops. Regeneration International sees regenerative agriculture as a global farmers movement, and are working hard to keep corporations from gaining the power of definition (Leu 2023).

Regenerative agriculture's third phase, *acceleration*, begins around 2016/2017. From these years and onward, the term's popularity accelerated, both in the academic field and popular interest (Giller et al. 2021; Hermani 2020). Diverse agricultural actors such as farmers, consultants, consultancy-firms, non-profits, institutes, food companies, agrochemical companies and researchers began using the term, with varied interpretations depending on their interests, resulting in a myriad of meanings associated with regenerative agriculture. I also call it acceleration because of the race between various actors to define the term. In this section, I am focusing on the

development of RA on the international scene, and will outline the emergence of RA in Norway in section 2.4.

A first definition

In 2017, the organizations The Carbon Underground and Regenerative Agriculture Initiative[14] developed a definition paper for regenerative agriculture. It was developed together with various stakeholders from different sectors, including Regenerative International. A number of food companies (large[15] and small), organizations[16], institutions[17], and people[18] (but no agrichemical companies) have since been signed the 2-page definition paper. They write:

> 'Regenerative Agriculture' describes farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle. Specifically, regenerative agriculture is a holistic land management practice that leverages the power of photosynthesis in plants to close the carbon cycle, and build soil health, crop resilience and nutrient density. (The Carbon Underground and Regenerative Agriculture Initiative 2017, 1).

The authors also acknowledge the "damaging effects to soil from tillage, applications of agricultural chemicals and salt based fertilizers, and carbon mining. Regenerative agriculture *reverses this paradigm* to build for the future" (The Carbon Underground and Regenerative Agriculture Initiative 2017, 1, my italics). They also emphasize the need to rebuild the soil microbiome through inoculating the soil with composts and keeping the soil covered with living plants.

The social aspect is central to many who promote regenerative agriculture (Regeneration International 2019b; Rodale Institute 2020; Savory and Butterfield 2016; C. Rhodes 2017; Hes and Rose 2019). As Vandana Shiva (2008) observed 16 years ago in her book *Soil Not Oil*, the solution to poverty, food production and climate change

[14] California State University in Chico started the Regenerative Agriculture Initiative in 2016, and in 2019 it developed into the Center for Regenerative Agriculture & Resilient Systems (CSUChico 2023).
[15] Such as Danone, Ben and Jerry's and Dr. Bronners
[16] Such as Regeneration International, Rodale Institute, IFOAM, Vía Organica
[17] Such as the Norwegian Høgskulen for Grøn Utvikling
[18] Such as the famous soil scientists Elaine Ingham

are the same. However, a social/political perspective is absent in the definition paper, which is perhaps what makes it palatable for so many different stakeholders to agree on. The paradigm of the agriculture that mines both the soil of its carbon content, and depends on fossil-fuel mediated input to make up for a degraded soil is nonetheless an important one.

Mainstream media

A slew of books (Perkins 2016; Savory and Butterfield 2016; Hawken 2017; Massy 2017; Montgomery 2017; Brown 2018; Tree 2018) and newspaper articles (Lovins 2014; Eisenstein 2015; Velasquez-Manoff 2018) and podcasts (John Kemf, n.d.) on regenerative agriculture entered the public sphere. Australian farmer Charles Massy (2017) and U.S. farmer Gabe Brown (2018) both published popular books that describe how they not only transitioned from conventional to regenerative farming, but changed their minds and perspectives in the process. As Massy writes,

> This alternative view held that soils were not inanimate chemical boxes, that our farm was instead a complex living entity of dynamic cycles, energy flows and networks of self-organizing functions and coeveolved nebulous systems beyond imagining. Later still, I would discover that such a parallel universe paradoxically comprised both the most ancient Indigenous and yet also newest scientific knowledge, and that it related profoundly to human health, to farm and animal health, and to planetary health. (Massy 2017, 6).

In addition, these influential farmers as well as Joel Salatin, Richard Perkins and Singing Frog Farms, among countless others spreading information about regenerative agriculture through social media. Several of the interviewed farmers have mentioned these farms/farmers.

Research and academic definitions

As academics began writing about regenerative agriculture, conceptualizations of the term multiplied. Some continued to frame it as a way to mitigate climate change and increase food security by building soil health with ripple effects to ecosystem health generally (Kastner 2016; Toensmeier 2016; C. Rhodes 2017; LaCanne and Lundgren

2018; Rattan Lal 2020). During its initial resurgence, regenerative agriculture was ben described as something similar or equal to permaculture (C. J. Rhodes 2012). The more dominant descriptions during the period of acceleration is something "more than organic" (Kastner 2016; C. Rhodes 2017), an improved version of conservation agriculture (CA (Toensmeier 2016; Mitchell et al. 2019; Landers et al. 2021), or portrayed as an agroecological system (Elevitch, Mazaroli, and Ragone 2018; Hes and Rose 2019). Others have described regenerative agriculture as an "umbrella term" for climate smart agriculture, albeit one that

> goes above and beyond [climate smart agriculture] in that its focus is on enhancing and restoring holistic, regenerative, resilient systems supported by functional ecosystem processes and healthy, organic soils capable of producing a full suite of ecosystem services, among them soil carbon sequestration and improved soil water retention. (Gosnell, Grimm, and Goldstein 2020, 4)

Lorenz and Lal (2023), who also write about RA as an important tool for climate change mitigation, see regenerative agriculture as a combination of organic and conventional agriculture.

In light of these plural understandings of RA, a need for a common definition was rapidly emerging. Two articles were published in 2020 that reviewed the existing literature on regenerative agriculture trying to make sense of what it means (Schreefel et al. 2020; Newton et al. 2020a). As Newton et al. (2020) state, a common definition is necessary in order to produce analytically relevant studies, in order to test claims, as well as to prevent greenwashing and reduce confusion among consumers who already navigate a large number of ecolabels. Newton et al (2020) do not synthesize a definition of their own but emphasize the importance for anyone writing about regenerative agriculture to state their description.

In their review, Newton et al. (2020) find two ways of defining regenerative agriculture: as a method or outcome. A combination of these is also possible. A *method-based approach* to regenerative agriculture defines it by what the farmer does or does not do, with the assumption that the correct method will yield desired results. Methods often associated with RA are for example not tilling the soil, not using synthetic fertilizers or pesticides, integrating animals, and using cover crops. The potential pitfalls of a method-based approach can be found by looking over to organic agriculture (OA).

In the 80's, regulation and certification schemes of organic agriculture began to be implemented. These were based on methods, most notably the exclusion of synthetic fertilizers of pesticides (Arbenz, Gould, and Stopes 2016; Schreefel et al. 2020). Unfortunately, organic certification standards "fail to entirely capture the aspects that are at the core of the organic philosophy" (Schreefel et al. 2020, 6). There are organic farms that adhere to the original pioneers' views of holistic farms, but we also have what Guthman (2004) calls the "conventionalization" of organic farms that only adhere to the bare minimum criteria but otherwise look and act like a conventional farm (Altieri 2012; Best 2008). Few method-based regenerative labels exist[19], and none in Norway.

An *outcome-based approach* defines regenerative agriculture by the results, or outcomes, of one or more factors, such as carbon sequestration, changes in soil health, or changes in biodiversity (Newton et al. 2020b). The outcome-based approach is seen as able to avoid some of the pitfalls that came with defining organic agriculture based on minimum standards and methods. It allows for highly varied agricultural systems, and with this approach, even conventional farmers can become "regenerative" as long as there is ecological improvement on their farm. The strength of this approach is that it allows for farmers to take into account their unique context. Each farm is unique in relation to soil type, weather, and surrounding landscapes, so a practice that is beneficial for soil health or biodiversity on one farm might not work on another. The challenge with taking a "many roads lead to Rome" approach is that not everyone agrees on what "Rome" is. Organizations like Regenerative International see RA as an important stepping stone for ending corporate control over the global food system, and supporting farmer independence. On the other hand, agrichemical companies like Syngenta see RA as an "evolution of conventional agriculture" (Syngenta Group 2023). This approach aims to perpetuate their existing business models where farmers remain dependent on them for agricultural input (fertilizers, pesticides and seeds) and are defining RA as a way to maintain relevance and influence.

[19] The Rodale institute have their own certification scheme for regenerative agriculture, the Regenerative Organic Certified label. It is based on the minimum requirements of organic agriculture but adds three categories: soil health, animal welfare and social health. Certified Regenerative is another label by the non-profit organization A Greener World.

Some outcome-based certifications exist, such as the Savory Institute's Ecological Outcome Verification (EOV)[20] which is offered in Norway by the organization Regenerativt Norge, but only for areas that are grazed.

The same year, Schreefel et al. (2020) also decided to analyze the concept of RA. They found that core focus in RA is environmental sustainability, with soil at the base. They also found a socio-economic dimension in RA. However, this "socio-economic dimension… relies currently on divergent objectives and lacks a framework for implementation" (Schreefel et al. 2020, 6). There was much more agreement around soil health, with a focus on soil biology, cover crops, and reduced tillage. However, the social aspect was still important enough to include it in their definition.

> Regenerative agriculture is an approach to farming that uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting services, with the objective that this will enhance not only the environmental, but also the social and economic dimensions of sustainable food production. (Schreefel et al., 2020, p. 6).

O'Donoghue, Minasny and McBratney (2022) are the latest authors to propose an academic definition of RA:

> any system of crop and/or livestock production that, through natural complexity and with respect to its contextual capacity, increases the quality of the product and the availability of the resources agriculture depends upon; soil, water, biota, renewable energy and human endeavor. (O'Donoghue, Minasny, and McBratney 2022, 20)

This definition includes the same aspects that Schreefel et al. (2020) do. However, it avoids using the contested concept of ecosystem services (Schröter et al. 2014).

Giller et al. (2021) are some of the few who critique RA's rapidly growing popularity, and see it as a "re-framing of what have been considered to be two

[20] EOV measures the short- and long-term improvements of five key outcomes based on the status of the farm when the start the certification process: ground cover, water infiltration, biodiversity, primary productivity, and soil carbon and health (Savory Institute 2021).

Another outcome-based label is the Soil Carbon Initiative (SCI). SCI was launched by The Carbon Underground and measures soil health and carbon, biodiversity above and below ground, water, and progress towards *elimination* of chemical inputs ("Soil Carbon Initiative" n.d.).

contrasting approaches to agricultural futures, namely agroecology and sustainable intensification, under the same banner" (13). Furthermore, they claim that much of what is proposed in RA[21] is simply the "canon of 'Good Agricultural Practices'" (22). They also highlight "the tension between, on the one hand, a compelling, high-level narrative that identifies a problem, its causes and how it should be addressed, and on the other, the complexity of divergent local realities, arises with all universalist schemes to 'fix' agriculture and the 'failing' food system" (Giller et al. 2021, 21).

They emphasize the importance for anyone involved with regenerative agriculture to engage with the following five questions:

1. What is the problem to which Regenerative Agriculture is meant to be the solution?
2. What is to be regenerated?
3. What agronomic mechanism will enable or facilitate this regeneration?
4. Can this mechanism be integrated into an agronomic practice that is likely to be economically and socially viable in the specific context?
5. What political, social and/or economic forces will drive use of the new agronomic practice?

I engage with these questions throughout the analysis. However, attempting to answer them in full is beyond the scope of this thesis.

Corporate definitions

While academics discuss what regenerative agriculture is and should be, for the past few years corporations have been working hard towards rolling out their own definitions of regenerative agriculture.

In 2018 the consultancy firm J.W. Thompson launched a new trend report called "The New Sustainability: Regeneration" (Stafford 2018). Soon after this, companies began using the term, implementing their own definitions and frameworks. In contrast to other alternative agricultural movements such as organic and agroecology, which pioneers have worked hard to be accepted, the concept regenerative agriculture has

[21] According to Giller et al. (20221) these include crop residue retention, cover cropping and reduced tillage.

quickly been adopted and even appropriated by corporations. The benefits of this new pathway for alternative agriculture might be that transition occurs quicker when companies themselves want to change. However, the pitfalls may be greenwashing and over-marketing the actual impacts on the farms.

The One Planet Business for Biodiversity (OP2B) coalition as well as the Sustainable Agriculture Initiative Platform (SAI Platform) perhaps best illustrate how corporations want to lead the global move to regenerative agriculture. Both these networks are made up of many of the same multinational food- and agrichemical corporations[22], with the aim to collaborate on developing sustainable agriculture. OP2B defines regenerative agriculture as

> a nature-based solution that aims to transition agriculture from being a primary source of environmental degradation to a primary source of regeneration of modified ecosystems. (WBCSD 2021, 1)

The SAI Platform is developing a Regenerative Agriculture Programme that will "enable a single, trusted and cost-effective way to apply regenerative agriculture principles worldwide, supporting farmers and protecting nature" (SAI Platform 2023b), led by companies such as Nestlé, PepsiCo, Arla, Unilever, Coca Cola, Kelloggs, Starbucks, Bayer, Yara and Syngenta.

Despite being part of these networks, many companies have also developed their own slightly varied criteria for defining and implementing regenerative agriculture (Nestlé 2022; Unilever 2021; Yara 2022; Syngenta Group 2023; PepsiCo 2023) – at least until the SAI Platform's Regenerative Agriculture Programme is rolled out (PepsiCo 2023). Most companies agree on regenerative principles such as minimizing soil tillage, keeping the ground covered, diversifying crops, integrating livestock, and sequestering carbon. Agrochemical companies also make sure to frame regenerative agriculture as using "data-enabled precision placement of seeds, crop protection and

[22] The founding members of OP2B in 2019 were: Danone, Kellogg's, Nestlé, Unilever, Yara, Barry Callebaut, DSM, Firmenich, Google, Jacobs Douwe Egberts, Balbo Group , Kering, Livelihoods Funds, L'Oreal, Loblaw Companies Limited, Mars, Migros Ticaret, McCain Foods, and Symrise (OP2B 2019).

The founding members of the SAI Platform Regenerative Agriculture Programme in 2023 are: Kellogg's, KraftHeinz, Nestle, Pepsico, Starbucks, Yara, Syngenta, Bayer, Unilever, Mars, Diageo, Döhler, FrieslandCampina, Griffith Foods, Ingredion, Kepak, Kappert, McCain, Mc, Nordzucker, Südzucker, Ocean Spray, Synlait and Treatt (SAI Platform 2023a).

crop nutrition" and "targeted and optimized use of mineral fertilizers" (Syngenta Group 2023; Yara 2023b, 4) . This allows them to continue business-as-usual selling pesticides while still fronting RA. The social aspect is only included as increased profitability for farmers.

Interestingly, these companies are also adopting Rodale's (1983) narrative of sustainability not being enough (Unilever 2021; Nestlé 2022). For example, Nestlé writes that their own sustainability program had not been enough, and that they are now "moving to the next stage in this journey - implementing regenerative farming practices at-scale and in-depth, to help restore degraded landscapes" (Nestlé 2022, 4). Taking it even further, the OP2B coalition writes that they are

> determined to *drive transformational systemic change* and catalyze action to protect and restore cultivated and natural biodiversity within the value chains, engage institutional and financial decision-makers, and develop and promote policy recommendations that promote nature-positive biodiversity. (WBCSD 2023, my italics)

Any claim of transformation of the food system deserves further scrutiny, and perhaps especially so when proposed by food and agrichemical corporations themselves. Syngenta, one of the world's biggest pesticide companies, is also promoting regenerative agriculture as transforming global food systems.

> Agriculture is entering a transformative era. Although the green revolution has been successful in feeding a rapidly growing human population, it has also depleted the Earth's soil and its biodiversity and contributed to climate change. These extractive practices are not sustainable. We must move quickly to transform agriculture by employing a suite of practices known as regenerative agriculture. (Syngenta Group 2023)

The language that Syngenta uses blames "agriculture" and the "green revolution" for the depletion of our common soil, but does not acknowledge their own role (or the role of other agrichemical companies) in promoting and accumulating capital based on this degeneration of ecosystems. It is a paradox that Syngenta simultaneously promotes RA and soil health yet is the world's largest exporter of pesticides. The Basel-based company has several factories throughout Europe that produce pesticides too toxic to be legal in the EU. However, these are exported to countries with less strict legislation

such as Brazil, Morocco, Ukraine, Mexico and South Africa (Gaberell and Viret 2020). As Vandana Shiva said, as she was representing Regeneration International at the Extinction or Regeneration Converence:

> [Regenerative agriculture] is not a corporate invention, please don't get mistaken… We cannot hand it over to the corporations, because I have read every paper they've published, from the Syngentas to all the others. They use our language, about what it is, and then what they're doing is about hyper-industrialism. So we've got to reclaim regenerative, show that it is the same as organic, the same as agroecology, and depending on the circles and the spheres, use the words that are popular in that sphere. But don't give up regenerative agriculture, define it more deeply. (Leu 2023)

In their white paper Soloviev and Landua (2016) proposed four levels of regenerative agriculture. The higher the level, the larger, and more encompassing societal transformations. The first and most basic level, what they call "functional regenerative agriculture", focuses on soil regeneration, crops and carbon sequestration. At the fourth and final level they envision an "ecosystemically vibrant, socially equitable, culturally diverse, and spiritually meaningful global system of regenerative potential" (1). What actors agree on is increasing soil health and soil carbon sequestration – the "lowest level" of regenerative agriculture (Soloviev and Landua 2016). Or as Schreefel et al. put it, the soil is the base (Schreefel et al. 2020). Challenging the global food system as such, and the power that private corporations have in the food system is more contentious.

However, as we will see, reaching the first level of regenerative agriculture, improving the soil, is not easy either. It requires a shift in mindset and challenging certain long established paradigms and traditions.

2.3 Regenerative agriculture in Norway

While the concept of regenerative agriculture (RA) is adopted widely internationally, the dominant agricultural scene in Norway seems a bit hesitant. The agricultural research institution NIBIO, the Norwegian Research Council, and the largest agricultural consultancy *Norsk Landbruksrådgivning* (NLR) are careful to use the concept. Instead, they focus on and use the concept of soil health.

The term RA began being used in Norway around 2016/2017 by a small group of farmers, consultants and organizations. Currently, three main organizations are actively using the concept: Regenerativt Norge, VitalAnalyse and the College of Agriculture and Rural Development[23]. Local farmer-networks who share experiences, knowledge, support and tools with each other are emerging. Some examples of these are Regenerativt Faglag i Østfold, Faglag for Regenerativt Landbruk i Trøndelag, and Regenerativt Landbruksnettverk i Rogaland. One department of the largest agricultural consultancy Norsk Landbruksrådgivning (NRL), NRL Østafjells work closely with Regenerativt Norge on regenerative grazing and are exploring if the Savory Institute's Ecological Outcome Verification (EOV) can be used in Norway (NRL 2023). Some of these groups approach the concept of regenerative agriculture from different angles, but there is overlap and collaboration between these networks as well.

The two main organizations relevant for this thesis are VitalAnalyse and Regenerativt Norge. They differ in approach to regenerative agriculture, but have the same goals. Some interviewed farmers work mainly with one or the other, and some draw inspiration from both. The description of both of these organisations are based on information on their websites and interviews with representatives.

Regenerativt Norge is a Norwegian branch of the Savory Institute, and understand regenerative agriculture mainly as the regeneration of *grasslands*, where the most important tool are herds of grazing animals. The founders of Regenerativt Norge (RN) promoted Holistic Management (HM) years before they started their organization in 2020. As we saw earlier, it was not until more recent years that HM began being equated with RA, which we see reflected in this organization as well. They founded the organization in order to gain "definitional power" over the concept and counter what they registered as a greenwashing by corporations (personal communication, 2022). They define it as:

> Enabling the highest thinkable vitality in ecosystems at the same time as efficiently satisfying human needs. (Regenerativt Norge, 2022)

They emphasize the importance of measuring actual regeneration before calling a farm regenerative. Therefore, members of this organization often say that "regenerative agriculture is a result, not a method" (Qvale 2021), taking an *outcome-based approach*

[23] Høgskulen for grøn utvikling

(Newton et al. 2020a). They offer courses and certification with Savory's Ecological Outcome Verification (EOV) which measures improvement of ecosystem processes over several years – but only for farmers with grazing animals. However, they have started to develop an EOV for grain fields[24].

VitalAnalyse (VA) is an agricultural consultancy foundation that focuses on increasing soil fertility and works with farmers in all agricultural systems – with or without animals. Since 2017, they have been holding a course called *Jordfruktbarhetskurset* (the Soil Fertility Course). It focuses on learning about the importance of microbially mediated plant nutrition, as well as understanding the interplay of soil life with soil chemistry. Farmers also learn about the importance of inoculating soil with compost and ferments in order to bring back beneficial soil microbes, as well as how to farm without or with less plowing and less agricultural input on the farm. In 2018 they received funding to start the project *Referansegårds-prosjektet* (Reference farm project) in order to test out and document their approaches (Holten 2021). VitalAnalyse has adopted and teach new methods for arable production (see appendix III for a description of the 5-step method[25]), and measure the outcomes of these methods with soil tests, plant sap analysis, and microbiometers. Therefore, they can be understood to take a hybrid *outcome*- and *method-based approach* (Newton et al. 2020a).

Norges Bondelag is the largest Norwegian farmer union. In 2021 they joined an initiative launched by Svenskt Sigill[26] with the goal of creating a definition for regenerative agriculture suited for a Nordic context[27]. Svenskt Sigill saw that despite the lack of consensus on what RA is, corporations were already beginning to market their products with regenerative agriculture. Therefore, they created this initiative in order to prevent greenwashing, support farmers with uniform requirements, and facilitate "real improvements for our sustainability challenges" (Svenskt Sigill 2022, my translation). However, because of diverging understandings of what RA is and should be, the

[24] See Appendix IV for information over what an EOV measures.
[25] The method allows grain farmers to control weeds and increase soil fertility without plowing or using pesticides, but instead work to support soil microbes. It was developed by Dietmar Näser and Friedrich Wenz in Germany (Näser 2021), and VitalAnalyse has modified it to suit Norwegian conditions.
[26] Svenskt Sigill is a Swedish environmental labelling organization for Swedish food production.
[27] The Nordic context involves short growing seasons, harsh winters that can make cover crops difficult, traditional practices of perennial ley, the importance of good soil drainage, and a relatively low pH (Svenskt Sigill 2022).

working group never reached a final framework before their funding ran out. The one that was underway combined a *method*- and an *outcome-based approach*.

2.4 Summary

In conclusion, the history of regenerative agriculture can be divided into three main phases: origin, resurgence and acceleration – which we are still in today. There is agreement that regenerative agriculture's main goal is to improve soil health. However, there are various approaches as to how this is best done. There is also disagreement if regenerative agriculture should be understood by its practices (method-based) or its outcomes (outcome-based). There are benefits and pitfalls with each approach. Furthermore, many claim that RA can facilitate a "transformation" or "paradigm shift" in the global food system. However, they have very different understandings of which paradigms are to be shifted.

The nascent regenerative network in Norway is already diverse and self-organizing, with different approaches and sources of inspiration and knowledge. VitalAnalyse combine a method- and outcome approach to understanding RA, while Regenerativt Norge argue strongly for an outcome-based definition and certification to prevent greenwashing. Despite their differences, they both work in parallel towards supporting farmer independence and working towards growing food with natural processes that boost diversity below and above ground.

3. Methodology

3.1 Qualitative research

I embarked upon this research project with an interest in the lived experiences of the farmers who farm using regenerative principles. Therefore, it was natural to choose a qualitative research method, which allows one to "gain an intimate understanding of people, places, cultures and situations through rich engagement and even immersion in the reality being studied" (O'Leary 2017, 142). I chose to explore this primarily through 14 semi-structured interviews with farmers on-site at their farms. These interviews were supplemented with participant observation at regenerative courses and field-days, informal conversations as well as analyzing relevant articles, podcasts and websites.

I used an emergent design, in which the research methods unfolded as I came to know farmers and other significant actors in the field and was introduced to ideas and events (O'Leary 2017). This chapter makes sense out of the reiterative, reflexive and exploratory process that is qualitative research.

3.2 Methodological bricolage

There are myriad of ways to conduct qualitative research, each with their strengths and weaknesses. Therefore, I chose the interdisciplinary qualitative methodology of *bricolage* (Kincheloe 2005; Rogers 2012; Ehn, Löfgren, and Wilk 2016; Pratt, Sonenshein, and Feldman 2022) to guide my research. Bricolage can be seen as a creative mixed-methods approach where the researcher employs a variety of methodological tools (O'Leary 2017, 123).

Denzin and Lincoln (1999) first incorporated bricolage into the *SAGE Handbook of qualitative research*, and has been further developed by mainly Kincheloe and Berry (Kincheloe and Berry 2004; Kincheloe 2005; 2011; Berry 2011). Within this qualitative approach, the researcher becomes a *bricoleur*, the craftsman/-woman piecing together various methods, data, concepts and narratives into a meaningful whole. It allows researchers to combine methodological practices and empirical materials and perspectives, in a way that adds depth, complexity and rigor to any research (Denzin and Lincoln 2011). Kara (2015, 28) points out that some may find this too haphazard, while others suggest that this method provides "a greater opportunity for sense making"

than other methods do (Warne and McAndrew 2009, 857). This method encourages researchers to complement with more perspectives in order to generate analytically "thick descriptions" (Geertz 1973).

The concept of bricolage was originally coined by Claude Lévi-Strauss (1966) as a metaphor for how meaning and knowledge is created. In his book, *A Savage Mind,* Lévi-Strauss (1966) elevated so-called "primitive" knowledge or "mythical thought" as valid knowledge. According to him, indigenous knowledge systems were based on discoveries "no less scientific and its results no less genuine" than those of natural sciences (1966, 16). Both scientific and "mythical" knowledge was created through the piecing together of information into a bricolage. Lévi-Strauss developed *bricolage* from the French expression *bricoleur*. A bricoleur is a craftsman, or jack-of-all-trades, who creatively uses "whatever is at hand" in order to construct something new (Lévi-Strauss 1966, 17).

Since its inception, the concept has been developed and integrated into various disciplines, but within social sciences the concept is most commonly understood as a qualitative methodology (Denzin and Lincoln 1999; Kincheloe and Berry 2004; Denzin and Lincoln 2011; Kara 2015; Ehn, Löfgren, and Wilk 2016; Kincheloe 2011)

Ethnography

The research I conducted can be seen as an ethnographic bricolage of the regenerative field in South-Eastern Norway between the spring of 2021 and the spring of 2023 with farmers from the networks of VitalAnalyse and Regenerativt Norge. Ehn, Löfgren and Wilk (2016) describe ethnography as "collecting or producing material on social life in different settings through interviews, observations, and other fieldwork procedures where the researcher is personally in 'the field" of study" (2). Because I am also inspired by phenomenology, which aims to understand someone's lived experience (O'Leary 2017), my main data has been gathered through interviewing farmers. They have shared their subjective experiences and viewpoints, helping me understand how they "make things meaningful" (Seale 2018, 15).

In addition, I have participated and assisted in courses on regenerative agriculture, joined field-days and soil-health meetings where I have had informal

conversations with farmers. I have also interviewed consultants and a representative of the largest farmer union in Norway, Norges Bondelag. I have supplemented this "in field" data with articles, podcasts and other public media where I am "outside" of the field, "collecting whatever data are available to throw light on the issues that are the emerging focus of inquiry" (Hammersly and Atkinson in Walsh and Seale 2018, 258).

3.3 Field Work

I began this masters' program 7 weeks after becoming a mother, and have therefore been studying part-time. Thanks to this, I have been able to follow farmers and development of RA in Norway for almost three years – an "extended period of time" which is important in ethnography (D. Walsh and Seale 2018, 258). Because I had a small child to return home to each day, I limited interviews and participant observations to farmers and events within a 2-hour car drive from my home in Oslo.

In this section, I will describe how I conducted interviews, participant observations, and used supplementary data. Interviews have been my main source of information and basis for analysis. However, by combining different data sources and materials in my "methodological bricolage" I could paint a better picture of the experiences of these regenerative farmers (Ehn, Löfgren, and Wilk 2016, 24).

Interviews with farmers

Before beginning my research, I thought it would be difficult to find regenerative farmers, but instead it was difficult to limit myself. Because there are diverging views of what makes a farm regenerative, I decided to interview both those who self-identified as regenerative farmers (9 farmers), and those who don't yet call themselves regenerative but strive to follow regenerative principles (5 farmers).

In total, I interviewed 14 farmers. I interviewed each farmer once, while speaking the key informant and door opener Bjørn several times. Each interview took between 1-3 hours. Interviewing other relevant actors in addition to farmers enabled triangulation. This allowed me to "compare the results produced by one method or source of data with another to see if they agree", or if they "introduce a different perspective" (D. Walsh and Seale 2018, 270–71).

I interviewed all farmers at their farms, with two exceptions where we spoke online via Zoom. One farmer I interviewed during the COVID-19 lockdown, and the other was a couple on the west coast of Norway which was too far to travel to. Interviewing farmers at their farms awarded many benefits. We were able to speak in a setting in which they were familiar, safe and comfortable. We could also look at their farm and walk around in order to look at the land, crops, soil, animals and tools. This allowed their own farm landscape to trigger conversation - a method Karen Lykke Syse developed while doing ethnographic fieldwork among foresters, farmers and people who had a working relationship with the land. The method was later coined "walk-about ethnography" (Syse 2001; 2014, 21).

The interviews were conducted in a semi-structured, informal manner, conversation-like. I used my interview guide (Appendix II) more as a tool to make sure we had covered the most important topics, rather than follow it meticulously. This allowed for free and interesting conversations, where the farmers themselves could zoom in on topics that were important to them. I could also dig deeper into things that were said in passing that I became more curious about. I also adapted this guide for when I interviewed regenerative consultants or other representatives in the field, although I have not used these interviews in the analysis.

I asked each farmer if I could interview them using a hand-held recorder to allow for transcription. Most said yes, while some felt more comfortable with the recorder turned off. Some farmers wanted me to turn off the recorder at certain times during our conversation. During each interview, I also took notes in my field notebook. I took time to write down my thoughts and impressions directly after each interview. These helped me remember non-verbal cues, what the farm looked like, thoughts I had during the conversation, as well as giving myself feedback and questions for future interviews. I incorporated interview transcripts with my field notes in the analysis.

I have used the snowball method in order to sample my interviewees. My supervisor put me in touch with Bjørn and an agricultural consultant from VitalAnalyse (VA). They both gave me several more contacts, as well as an invitation to the Soil Fertility Course, where I gained more contacts. Because of this, the farmers I

interviewed are not necessarily representative of the entire regenerative mileu in Norway[28].

Eight farmers were from VitalAnalyse (VA), three farmers were in Regenerativt Norge's (RN) network, and two farmers combined approaches from VA and RN. Three did not identify with either network when I interviewed them. Most of my interviews focused on farmers' experiences with arable farming (vegetable and/or grain production) rather than their experiences grazing, which has shaped my analysis as well. This is not because farmers from VA's network have a "better" approach than farmers from the network of RN. However, my snowballing began with farmers in VA, who also happened to be very welcoming and easy to get in touch with. Nevertheless, I was curious to see if farmers' experiences with arable production was comparable to farmers experiences with exclusively grazing animals. Therefore, I found a farmer couple on the west-coast of Norway who were in RN's network. I also interviewed two representatives from RN who were farmers as well.

The 14 farmers I interviewed were a diverse group of people. I interviewed both men and women, and twice I interviewed a farming couple together. Most were farmers who owned their farm, while two were employed as the main farmer. Some were young and at the start of their farming career, while some were nearing retirement. Some were full-time farmers and others worked a job on the side. They did however share similar characteristics. They were curious, stubborn, resilient, positive, enthusiastic, independent thinkers, and they cared about the environment.

No two farms looked alike. Productions included grain, vegetables, eggs, grazing animals, forestry. Some produced mainly one crop, while others had a diverse production including all of the above. Ten farms were organic, three were organic but not certified, and one was conventional.

Participant observation

An important part of my field work was participant observation at courses and field days on regenerative agriculture. In the spring and autumn on 2021 I assisted at two

[28] As outlined in Chapter 2, there are different networks of regenerative farmers in Norway. The main ones are those who are more influenced by Vital Analyse, and those that are more influenced by the organisation Regenerativt Norge. There are also those that seek knowledge and inspiration from both.

courses on “soil fertility” hosted by VitalAnalyse where they teach methods to increase soil health, and promote regenerative agriculture. At these courses I served coffee and refreshments to the participants. I also attended one field-day in the autumn of 2022 which demonstrated regenerative agriculture to curious farmers. I participated at a three-day course on Ecological Outcome Verification hosted by Regenerativt Norge in the autumn of 2022 in order to understand their perspective on regenerative agriculture better. At the start of each course, I was introduced to make sure everyone knew I was collecting data for my thesis.

These courses/events were very helpful in collecting data but also in getting contacts for future interviews. First of all, I could learn what farmers learned about soil health and regenerative agriculture from Vital Analyse and Regenerativt Norge. I was able to chat informally with farmers about their thoughts and experiences. I listened to what questions were asked by farmers, and listen to them share their successes and struggles through using these new methods. I also became acquainted with agricultural jargon that helped me both understand farmers during our interviews better and ask relevant questions.

I did not want to make anyone feel uncomfortable by introducing a recorder at these courses, so when I spoke to someone I simply took hand-written notes after asking for their permission.

Supplementary interviews

After a few interviews, I felt the need to understand how actors within the larger agricultural context understood the recent emergence regenerative agriculture. As Rogers (2012) points out, bricoleurs “seek out ways that phenomena are interconnected with other phenomena, and socially constructed in a dialogue between culture, institutions, and historical contexts” (10). Therefore, I chose to conduct semi-structured interviews with a representative from the Norwegian Agrarian Association, *Norges Bondelag*, a consultant from Vital Analyse and two representative from Regenerativt Norge. The representatives from Regenerativt Norge were farmers, and I count them in my 14 farmers as well. During the EOV course I attended, I also had informal conversations with the other participants and the course holder. These conversations helped me understand the structures’ influence which shape farmers’ possibilities and

choices, as well as better understand the two branches of regenerative agriculture. The interviews also confirmed hunches I had about the ongoing negotiation of how to define regenerative agriculture, that had been hinted to during farmer interviews but not explicitly said.

I contacted consultants from the main agricultural consultancy in Norway, NRL, and asked for interviews multiple times, but did not receive an answer.

I created an interview guide for each of these supplementary interviews as well, although the interviews were more conversational just like the interviews I conducted with farmers. I recorded the interviews and took handwritten notes.

Interview	**Profession**	**Gender**	**Organic or conventional**	**Production**	**Informed by**
1	Farmer	Male	Organic	Grain and eggs	VA
2	Farmer	Female	Organic but not certified	Vegetables, grain	Independent
3	Farmer	Male	Organic but not certified	Vegetables, animals	Independent
4	Farmer	Female	Organic	Vegetables	VA
5	Farmer	Male	Organic	Grain, animals	VA
6	Farmer	Female	Organic	Grain, animals, forest	VA / RA / Independent
7	Farmers	Couple	Organic	Grain	VA
8	Farmer	Male	Organic	Grain, animals, vegetables, forest	VA
9	Farmer	Male	Organic	Grain, animals	VA
10	Farmer	Male	Conventional	Grain	Independent
11	Farmers	Couple	Organic but not certified	Animals	RA
12	Farmer	Female	Organic	Animals and vegetables	VA /RA
13	Farmer / Representative of RN	Male	Organic	Grain and animals	RN
14	Farmer/ Representative of RN	Male	Organic	Animals and vegetables	RN
15	Consultant from VitalAnalyse				
15	Representative from Norges Bondelag				

Table 1: Overview of interviews

Media

Throughout my three years of doing field work, I continuously kept up to date on articles written about regenerative agriculture in Norwegian newspapers, listened to podcasts or radio programs where regenerative farmers were interviewed. Sometimes "my" farmers were in a podcast, and it gave new insights when comparing what they told me to how they described their experiences in the podcast.

Reading and listening to what others were saying about regenerative agriculture, and how farmers portrayed their experiences publicly was useful in several way. It allowed me to include relevant information and ask relevant questions in my interviews. It also allowed me to triangulate what farmers were telling me, to see if the same sentiments were appearing in public media as well.

Handling my data

I stored all data on protected UiO servers. In order to anonymize the interviewees, everyone was given a pseudonym. The document containing contact information and matching pseudonyms to their real names was password protected. Interviews were recorded on a small hand-held Olympus recorder. As soon as I returned from the interview, I transferred the recordings to the UiO server, and deleted them from the recorder. The recorded interviews were transcribed using the program F4. The interviews not recorded, were manually digitalized as field notes.

3.4 Analysis

My data analysis began as soon as I began gathering it and was a continual and reiterative process throughout the almost three years of writing this thesis. There were many things that sparked my interest during my very first interview. For example, I noted how he described his pre-regenerative farming as "conventional organic", how he was learning to "read" the weeds, the relational way he spoke about nature, and reactions he received from others. These elements sparked my curiosity, and I had a hunch that they would be relevant. However, I did not understand exactly why until I saw these themes appear in both future interviews and in media. Then I could connect them with existing concepts and literature. I tested out coding in NVivo. However, I

found that an analog and tactile method of analyzing worked better for me done using pen and paper, colored markers, and mind maps.

I began my research thinking I would use O'Brien and Sygna's (2013) heuristic Three Spheres of Transformation to deductively organize and analyze my data. In retrospect, this could have worked. However, as I began interviewing, I felt like I had to "force" some of the data into each of the three personal, political and practical spheres. . Instead, I decided to use grounded theory as a method to inductively analyze my data (Seale 2018) to allow my farmer's stories to speak for themselves. The themes that emerged during my analysis are found in every interview. However, different parts of the analysis highlight certain farmers more than others, and some farmers are quoted more than others. Sometimes one farmer would say something that would perfectly sum up the general sentiment. Occasionally I have used quotes from a farmer who I have spoken to informally, if the quote is well suited and reflects the other farmers. Various farmers spoke more detailed about certain topics than others. I pick out illustrative quotes and examples throughout the analysis that shed light on these themes.

O'Leary describes generating grounded theory as a "rigorous and iterative process of data collection and 'constant comparative' analysis that finds raw data brought to increasingly higher levels of abstraction until theory is generated" (O'Leary 2017, 330). Grounded theory is an inductive process, but engages with established theory and literature in a reiterative process until you are not just "taking from the literature, but are ready to contribute back" (O'Leary 2017, 335). Importantly, I am not attempting to synthesize a new formal grounded theory that is completely "abstract of time, place and people" and that have an "enduring grab" (Glaser 2007 in Klag and Langley 2013, 150). Instead, with my small group of farmers I am illuminating what Tsoukas (2018) calls the "epistemic significance of the particular" (2018, 384).

I combined grounded theory with conceptual bricolage (Denzin and Lincoln 2011) in order to use various concepts to highlight and understand various themes in my data. During one of the re-organizations of my data, I began reading the classic texts on reciprocity (Mauss 1990; Sahlins 1972), paradigm shifts (Kuhn 1962) and cultural boundaries of knowledge (Gieryn 1999). These made immediate sense, and I decided to use these concepts to illuminate various different parts that were emerging in my research. I was able to discuss Gieryn's cultural boundaries of knowledge with the

farmers and a consultant at the last course I attended, and received positive feedback and confirmation that the farmers themselves identified with this perspective.

Theory or Myth?

One reason why I decided to employ the concept of bricolage, instead of "mixed methods", is that it gives depth to grounded theory.

Claude Lévi-Strauss (1966) argued that the process of scientific discovery, and the development of indigenous knowledge systems or myths were based in the same process of "intellectual bricolage". Building on this, Christopher Johnson (2012) invites us to "appreciate more fully the value of bricolage as a universal concept" where mythical, scientific and technological development is "is always a two-way (retroactive, feedback) process of projection and retrospection, thought and action, abstraction and application" (2012, 368). This can be applied to social sciences as well.

A myth is comparable to a theory because it is an abstraction that is meant to explain a phenomenon in the world. Above I quote O'Leary who understands grounded theory to be "raw data brought to increasingly higher levels of abstraction" (O'Leary 2017, 330). As social scientists attempt to understand parts of the world, they are bricoleurs who piece together a "closed set of elements which are already at hand, and to deal aporetically[29], with the resistances inherent in these elements" (Johnson 2012, 367). As bricoleour researchers, we acknowledge that the information we have is limited, and do not lay claim to any "truth," but use what we have to explain small pieces of the world.

3.5 Ethical considerations

Before conducting field work, I registered my research at the Norwegian Centre for Research Data (NSD). They approved the research project, my consent form (Appendix I) and my interview guidelines (Appendix II). This is done to ensure ethical obligations towards participant (O'Leary 2017).

[29] Doubtfully, sceptically

Before each interview I would send the farmer an email with information about the research plan, goals, and purpose about the interview, as well as the consent form so that they could read it at their own pace and had time to ask questions beforehand. I brought a printed version to the interview which they then signed. In the consent form they could see what the goal of the research was, how their data was going to be transcribed (if recorded) and stored, contact information, their right to anonymity as well as their right to drop out at any time. I asked if they wanted to be recorded, and emphasized that we could stop the recording at any time – which some farmers made use of.

Although everyone I interviewed received a pseudonym, this is not enough to preserve anonymity as there are other ways of finding out someone's identity. Because there are not too many farmers who are using regenerative principles, I have been careful not to describe the farms in too much detail, in order to avoid identification. The analysis is not affected much by this, because the focus of this thesis is on the farmers' experiences and reflections. What they are actually farming is secondary.

While I was supposed to conduct fieldwork the COVID-19 pandemic hit, and the country went into lockdown. I conducted one interview on zoom during this time, but felt that the interviews I had conducted on farms up until then were much richer than the one on screen. For the sake of the health of both participants and my family, as well as for the sake of my thesis, I decided to take a partial parental leave during this time and save my interviews for a time when I could rent a car and drive to the farmers in person.

3.6 Reflections on limitations and positionality

As a researcher within social sciences, I am aware of the multiple perspectives influencing and interpreting any one phenomena. I do not aim to capture some "truth" but rather provide an "authentic" analysis, where conclusions are "justified, credible and trustworthy even when truth is dependent on perspective" (O'Leary 2017, 60). One way to make the research I am doing credible and authentic is to be open about the limitations of the research as well as my own bias.

Limitations

Generalizability is often cited as a limitation in qualitative research. However, in a study informed by ethnography, phenomenology and grounded theory, generalizability is not an aim (O'Leary 2017). Instead, I seek to "explore the specific and subjective nature of an experience rather than produce generalizable explanations of objective phenomena" (Griffin and May 2018, 519). Therefore, this thesis does not aim to explain how *all* farmers who begin with regenerative agriculture experience the process, but to provide a credible account of the experience of the 14 farmers with whom I have interviewed. Instead of a map, I am providing a "portrait of the world that acts as an aid to perception" (Shotter and Tsoukas 2007 in Tsoukas 2018, 404).

There were some practical limitations to my fieldwork. Staying at some farms for a few days would have given a richer experience and more informal conversations than my semi-structured interviews. I did my best to include farm-walk with the farmers when possible in order to mitigate this limitation. I also made the choice to interview many farmers instead of returning to the same ones – except for Bjørn, who was my first interview and door-opener. It would have been beneficial to the thesis if I had returned to more farms, but time and the costs for a car hire did not make this possible.

My fieldwork was exploratory. The concept of RA was even newer in 2020 than it is today, and I began interviewing farmers about how they understood the concept, why they began with RA and their experiences. In retrospect, I wish I had asked more specific questions regarding input/output on farms, for example how much compost farmers spread per hectare compared to how much uncomposted manure they would plow into the ground before "going regenerative". This would have made the analysis more concise and concrete. As someone coming from a background of psychology, interested in perceptions and experiences, I did not understand how important numbers were in agriculture. I also wish I had asked more explicit questions about the farmers' thoughts on RA as a paradigm shift.

Due to the scope of this thesis, I regretfully have not been able to include perspectives and experiences from regenerative consultants and other experts I have spoken to into the analysis. Their experiences with regenerative agriculture and boundary-work deserves more research than this thesis allows for.

I also wish I had spoken to soil scientists and consultants who represent what I in the analysis call the "dominant agricultural paradigm," to understand their approaches more. I write about how farmers challenge established paradigms, which scientists have spent years confirming though meticulous research. Adding their perspectives would have been a bonus. I am no expert on agriculture, plant and soil health, yet I take a stance towards agricultural paradigms and show how farmers are challenging these. Through doing so, I have felt insecure. I cannot imagine how farmers feel who actually put their whole livelihood at risk while doing this! Another theme I wish I had included in interviews is how farmers think about the global food system; this would have been interesting to include more of in my final chapter.

I conducted the interviews in Norwegian and translated the relevant quotes into English. I have made an effort to keep the sentiments of the farmers in the quotes. If a farmer used a Norwegian saying or phrase, I have not translated this word for word, but translated into an English phrase that relays the same meaning.

Positionality

All research is shaped by the researcher. Competing epistemologies and ontologies abound, requiring "researchers to consider their own orientation to knowledge and truth" (O'Leary 2017, 6). I take an interpretivist and constructivist approach, recognizing that knowledge is historically and culturally situated. Furthermore, my research is inextricably affected by my own biases, assumptions, interests, experiences and personality. Byrne (2018) emphasizes the importance of reflexivity which involves "acknowledging that the researcher approaches the research from a specific position and that this affects the approach taken, the questions asked and the analysis produced" (224).

Before beginning the research generating process, I took time to write down my prejudices, assumptions and biases (of which I was aware) regarding conventional-, organic-, and regenerative farmers and the food system. Looking back now, I see that several of my assumptions about farmers – both conventional and organic – have become more nuanced over the course of my field work.

I am a young white Swedish woman with a BA in Cultural and Social Psychology. I do not have a farming background although I have many interests connected to food production and am engaged in multiple urban gardening projects in Oslo. Other than my interest in food and soil, there are few contact points between myself and a typical farmer who is male and has grown up on the farm (Bjørkhaug 2006). I was therefore mindful of potential tensions between farmers, who are the least paid profession in Norway despite their life-giving work, and myself as an aspiring academic. These worries deemed to be unfounded as every farmer I spoke with was incredibly warm and friendly, and interested in the research I was conducting. At first, I was also quite self-conscious about being an "outsider". However, as I later experienced, being an outsider can be turned into an important tool in ethnographic research (Ehn, Löfgren, and Wilk 2016). It allowed me to ask questions about the so called "obvious", which then became analytically interesting.

In conclusion, being transparent and reflective about my research process and positionality allows others to both understand the research better, as well as conduct similar research at another field. It also allows for easier comparison of other ethnographic research on Norwegian farmer's experiences.

4. Conceptual frameworks

In this thesis, I will use the concepts of land literacy, reciprocity, cultural boundaries of knowledge, and paradigm shifts. Although I will use grounded theory to analyze my data to let it speak for itself, the following theories support and illuminate my findings in various ways.

4.1 Cultural boundaries of knowledge

The sociologist Thomas Gieryn (1999) sees science as a particular "cultural space" (5). He does so in a vein similar to that of Lévi-Strauss, who conceptualized both mythical and scientific knowledge as "two distinct modes of scientific thought" (1966, 15) – or two cultures, if you will. However, while they may exist in parallel, they are not valued equally. For the non-scientific knowledge to be valued, it must be "translated" into science (Gieryn, 1999).

In his book *Cultural Boundaries of Science: Credibility on the Line*, Gieryn (1999) explores how people justify and negotiate various ways of knowing. "Science" represents the kind of knowledge most often equated with "credibility, legitimate knowledge, for reliable and useful predictions and for a trustable reality" (1999, 1). It has gained *epistemic authority*, "the legitimate power to define, describe, and explain bounded domains of reality" (1999, 1) and is therefore under constant negotiation. The epistemic authority of science, Gieryn (1999, 4-5) argues, is maintained through *boundary-work*, which involves ascribing certain qualities to scientists and their methods, where their attempted value-free and objective way of measuring the world is seen as more "true" than ways of understanding the world that engage with subjectivities.

According to Eileen Das (2020), western science monopolizes the "power to act as a believed and trusted interpreter of natural reality, and the symbolic and economic capital that goes with it" (2020, 12). As the epistemic authority is "chronically reproduced" through countless "credibility contests" (Gieryn 1999, 7), "rival authorities variously constrict or expand 'scientific' knowledge to include themselves or deny access to the privileged space of science" (Das 2020, 12). When science is seen as a "cultural space constructed in boundary-work, science becomes local and episodic rather than universal; pragmatic and strategic rather than analytic or legislative; contingent rather than principled; constructed rather than essential" (Gieryn 1999, 27).

Gieryn uses maps and cartography (the process of drawing up a representation of reality) as a metaphor of how boundaries are drawn between different kinds of sciences and between sciences and non-science (1999, 5-7). These cultural cartographies are used actively by people and organizations in order to navigate the world and can greatly influence choices people make (1999, 12). Boundary-work is the process of redrawing borders and updating the cultural cartographic representation of reality.

Gieryn (1999) organizes boundary-work into three main genres: *expulsion*, *expansion* and *protection of autonomy* (1999, 15). *Expulsion* defines a contest between rival authorities, each claiming to be scientific and legitimize their claims about the nature of reality as scientifically constructed. Neither side challenges the epistemic authority of science itself. *Expansion* takes place when "rival epistemic authorities square off for jurisdictional control over a contested ontological domain", such as when proponents of folk knowledge challenging the exclusive right of science to judge truth (Gieryn 1999, 16). The final genre of boundary-work is *protection of autonomy*, which is what scientists do as they "draw boundaries between what they do and consequences far downstream" often due to the exploitation of those in power to use science for their own vested interests (1999, 17).

Agricultural knowledge is culturally and historically situated. There are many existing and ongoing credibility contests in this field, such as the one between organic and conventional agriculture that can be seen to operate from different "maps". As an example of this, Gieryn (1999, 233-335) charts out the boundary-work that botanists Albert and Gabrielle Howard did in developing organic agriculture as a science. Between 1905-1930 they worked in India as Imperial Economic Botanists charged with the task of improving yields in India. Over the course of decades their approach to botany and agriculture evolved, "hybridizing" (1999, 235) their conventional scientific positivist science with indigenous wisdom. The Howards extended the zone of science to include indigenous wisdom, traditional practices, and observing nature itself. They grafted what Gieryn calls a "touchy-feely science onto the very different rootstock they brought from Cambridge", and saw both the laboratory and field "as sites of truth making" (1999, 266–67).

So, how does all of this relate to regenerative agriculture? As we have seen in the literature review, researchers and practitioners cannot agree on the specifics of

regenerative agriculture is. Is it more than organic, agroecology, permaculture, or an evolved version of conventional agriculture? These various approaches spring from different understandings of what "science" is, and value situated, experiential and experimental knowledge differently. They engage with different pieces of the natural world, and at various levels. It seems as if "everyone" is trying to place regenerative agriculture within their own cultural boundaries of science.

I adapt Gieryn's "cultural boundaries of *science*" to "cultural boundaries of *knowledge.*" The farmers I have interviewed do not claim to be conducting positivist "science", but they do create knowledge – whether this knowledge is acknowledged or not by those who hold boundaries in place.

4.2 Reciprocity

Cultural boundaries of science or knowledge affects and is affected by one's relationship with that which is researched or "known". Reciprocity is generally understood as the practice of exchanging things with others for mutual benefit. How one perceives "others" as well as how knowledge about these "others" is generated affects the exchange. In this section I will explore the anthropological concept of reciprocity in relation to cultural boundaries of science and farming.

Marcel Mauss wrote his essay *The Gift: the Form and Reason for Exchange in Archaic Societies* in 1925, but it was first published in 1950 (Caillé 2001). During this time, humans were increasingly thought about in economic and rational terms. Criticizing utilitarianism, Mauss (1990) posited that *all* political, economic and social life – not just primitive or archaic societies – is based on gift relations. Mauss found that there are three social obligations connected to the gift: to give, to receive and to reciprocate (1990, 39). For society to function, these three obligations need to circulate perpetually in an atmosphere where "obligation and liberty intermingle" (Mauss 1990, 65). Though gifts are exchanged without money, they are not free. As Kimmerer (2013) puts it, gifts come with "a bundle of responsibilities" (2013, 28).

Marshall Sahlins (1972), who further developed Mauss' concept of reciprocity, outlines three different modes of reciprocity: generalized, balance and negative. Generalized reciprocity is the most altruistic, where help, sharing and hospitality is given freely. Balanced reciprocity refers to direct exchange, seeking a balance of

exchanged material value. It is less personal and more economic than generalized reciprocity. Negative reciprocity is when one attempts to get something for nothing – the most impersonal sort of exchange where each participant is looking to maximize their own gain at the others expense (Sahlins 1972, 194–95). The mode of reciprocity is determined by "the span of social distance between those who exchange" (1972, 196) and exist on a continuum, where "reciprocity is inclined toward the generalized pole by close kinship, toward the negative extreme in proportion to kinship distance" (1972, 196). The closer one feels to someone (or something?) the more generously we reciprocate. This reasoning, which is "nearly syllogistic[30]" (1972, 196), can be applied to our relationship with the natural world as well.

Ecosystems are composed of complex entanglements of relations, but it is only recently that we have begun to see soil this way as well. The mainstream agricultural practice, science and education reduces soil to a substrate defined mainly by its chemical and physical properties (Wauters et al. 2010; Vankeerberghen and Stassart 2016). However, an increasing body of research is confirming, and farmers I have interveiwed are experiencing, that soil is in fact inseparable from the organisms who both live in and create it (Fierer 2017), with implications to how we relate to it/them.

As farmers gain an increased land literacy, they also see their own role in shaping the land differently. In my analysis I will use Sahlin's modes of reciprocity to explore how farmers relate to their soil and their land compared to how they did before they transitioned to regenerative agriculture.

4.3 Paradigm shifts

When cultural boundaries of knowledge and tradition shift, so do paradigms. Regenerative agriculture is often portrayed as a potential "paradigm shift" in agriculture (Gosnell, Gill, and Voyer 2019; Burns 2020; Krzywoszynska et al. 2023), and this sentiment is also found in proponents of regenerative agriculture in Norway through conversations with farmers, consultant and agricultural educators. Giuseppe Feola (2015) points out that the word "transformation" is often used as a metaphor for

[30] Syllogistic means "the formal analysis of logical terms and operators and the structures that make it possible to infer true conclusions from given premises… syllogistic represents the earliest branch of formal logic" (Encyclopædia Britannica 1998).

fundamental change, but that it is more useful as an analytical concept. The same might be said for "paradigm shift", which when used analytically allows us to engage rigorously with literature and farmers who use this term, as well as contributes to further understanding the concepts discussed above.

Thomas Kuhn's (1962) coined the concept "paradigm shift" in his seminal work *The Structure of Scientific Revolutions.* Here he challenged the general assumption that scientific development was the "piecemeal process" by which new knowledge was "added, singly and in combination, to the ever growing stockpile that constitute scientific technique and knowledge" (Kuhn 1962, 1–2). Instead, he argues that science operates within paradigms. He defines a paradigm as "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (viii).

Kuhn (1962) sees science as historically and culturally situated, much like Gieryn (1999). He outlined the historical pattern for theory change in the development of science. First, there exists a paradigm in which *normal science* can be conducted. Then, an *anomaly* is discovered. This can lead to *crises*, resistance to change, emergence of new scientific theories and finally a *revolution*. After this, a *new paradigm* emerges that allows for a period of new normal science until the cycle repeats itself.

Importantly, the normal scientific paradigms affect not only science but shape and are shaped by society in a reiterative process. Systems thinker Donella Meadows (1999) draws on Kuhn (1962) when she argues that changing paradigms is one of the most impactful leverage points in changing systems. She describes paradigms as "the shared idea in the minds of society, the great big unstated assumptions – unstated because unnecessary to state; everyone already knows them – constitute that society's paradigm, or deepest set of beliefs about how the world works" (17).

Paradigms have a historical context. Throughout the analysis, we will see how farmers engage with science and practice that has traditionally been kept outside the dominant paradigms that agriculture at large attends to. We will explore how the anomalies they discover affect how they think about their farm and ultimately what they do, breaking with established "truths" in agriculture that have existed since the industrial revolution.

4.4 Cognitive dissonance

Social psychologist Leon Festinger's (1957) concept of *cognitive dissonance* help us understand why discovering and shifting paradigms is difficult for farmers. Cognitive dissonance is a psychologically uncomfortable state that results from an inconsistency between two or more cognitions[31]. Cognitions can include behaviors, perceptions, attitudes, beliefs and feelings (Harmon-Jones and Mills 2019, 5) – what paradigms to a large extent are made up of. The larger the ratio of cognitive inconsistencies, the more difficult it is to reconcile them – which results in more discomfort. There are four main strategies we employ in order to reduce cognitive dissonance, all which are based on changing our minds or our actions to render our cognitions consonant. We can choose to remove ourselves from the dissonant cognitions or we can reduce their importance. We can also add new cognitions that are in agreement, or increase the importance of existing consonant cognitions (Festinger 1957).

Some behaviors, beliefs, perceptions, feelings and attitudes are more important to us than others, and have a greater resistance to change. Importantly, behavioral resistance to change is based on how well cognitions correspond with our view of "reality" and how much discomfort and pain these changes induce. There are three main circumstances that make behavioral change difficult. These are: if a change is painful or involve loss, if the present behavior is otherwise satisfying (other than that irritating cognitive dissonance it induces), or if making a change simply is not possible (Festinger, 1957).

Although Festinger's theory has been added to and nuanced over the past 50+ years, "dissonance theories agree that *genuine cognitive changes* occur because of dissonance processes. They also agree that these cognitive changes are motivated in nature and that the source of this motivation is a form of psychological discomfort" (Harmon-Jones and Mills 2019, 17 my italics). In the analysis we will see farmers'

[31] Festinger used the same term, dissonance, to refer to the discrepancy between cognitions and to psychological discomfort. These two concepts are distinct, and now irst is now referred to as cognitive inconsistency ; whereas the second is referred to as dissonance (Harmon-Jones and Mills 2019, 3–4).

genuine cognitive and behavioral changes compared to how they approached farming before learning about regenerative agriculture, and how these changes are related to the paradigm shifts I will argue is happening in agriculture.

4.5 Summary

The four concepts outlined above supplement each other, and I will weave them into one another throughout the text, at times focusing more on one or the other where relevant. Kuhn's (1962) structure of scientific revolutions help us see what "anomalies" in the current agricultural paradigm that regenerative farmers discover. Festinger's (1957) *cognitive dissonance* illuminates why paradigm shifts are difficult. I see Gieryn's (1999) cultural boundaries of knowledge as the boundaries that hold a dominant paradigm in place. Therefore, I will sometimes use the two interchangeably. Cultural boundaries then allows me to explore how farmers hybridize new knowledge with observations and experience, as well how they understand and respond to the resistance they are met with by paradigm gatekeepers. Cultural boundaries also help see whether and at what scale RA contributes to paradigm shifts in agriculture. Mauss' (1990) and Sahlin's *reciprocity* help explain why farmers allow new knowledge about their soil and plants to affect their practices and approaches to farming.

5. We're improving the soil, to simplify it a lot

Like we saw in Chapter 2, there are many diverging opinions of what regenerative agriculture is and should be. This thesis is *not* about what regenerative agriculture actually is, or how it should be defined. Instead, I am exploring how farmers – both those who self-identify as "regenerative farmers" and those who do not, but strive to follow regenerative principles – challenge long held paradigms in agriculture, and the boundary-work they engage in. However, it is still useful to understand how the farmers I interviewed understand RA before delving into the analysis, which I will give a short overview of here.

5.1 A pragmatic approach

Despite their differences, all interviewed farmers agreed that RA necessitates ecological improvement on the farm, beginning with their soil and scaling up from there. A healthy soil was described as one that was alive, with rich microbial biodiversity. Farmers also saw carbon sequestration as an important part of RA, but it seemed like soil life was a more defining factor. Ingrid summed it up like this:

> Well, we're trying to improve the soil and we care about soil health and soil life. I guess that's the main point when it comes to regenerative agriculture – to simplify it a *lot*. (Ingrid)

Exactly *how* to improve soil health less important. Like many I spoke to said, "regenerative agriculture is not a method, it is a result" or a "process." Some farmers were even aversive towards the word "methods". On the other hand, some farmers described RA by their new practices. However, none of the "methods" advocated for by any informants were set in stone and were adapted to the local settings on each farm. Anything done on the farm was continually evaluated through the lens of improvement, reflecting Newton et al.'s (2020) outcome-based understanding of RA. This approach also mirrors what James Morgan said in a workshop about RA almost thirty years ago, "purity of concept is far less important than pragmatic effect" (1985, 134).

Farmers also saw their soil as intrinsically connected to and able to affect local ecosystems, climate change and local communities. Regeneration began with the soil and had beneficial ripple effects to higher parts in the ecosystem. Biodiversity and balance were key words used to describe regeneration and health at all levels.

> Well… [Regenerative agriculture is] something that is restorative, actually. And when that's said, that sustainability isn't enough. It ends up being status quo. When we see that ecosystems aren't in balance and the diversity isn't there, we have to rebuild it again. So that's why we chose to take it a step further…We needed to increase diversity in the soil to regain the soil fertility, and we need to increase diversity in the ecosystem above the soil as well, in insects and plants, all the way. (Helena)

Farmers connected to Regenerativt Norge (RN) gave the organization's definition when I asked how they defined RA. Here, the focus was the ecosystem: "Enabling the highest thinkable vitality in ecosystems at the same time as efficiently satisfying human needs" (Regenerativt Norge, 2023). Farmers from RN's network also focused on integrating grazing animals into a farm, and emphasized the importance of actually measuring regeneration by conducting an Ecological Outcome Verification (EOV)[32]. An EOV is both a tool that farmers themselves can use for measuring the ecological health of a landscape, as well as Savory Institute's regenerative label. Farmers in VitalAnalyse's network gave their own personal definitions of RA. They also measured improvement of their soil but used methods such as soil tests, microbiometers[33], penetrometers[34], leaf sap analyses[35] and their own observations.

Farmers differed in their views towards carbon sequestration – or more specifically, getting paid for this. Some farmers were enthusiastic about receiving financial acknowledgement for the important work they were doing to improve their soils. Others saw it mostly as a beneficial side effect of repairing their soil, growing healthier food and supporting ecological systems and mentioned how difficult it was to actually measure soil carbon. Some were even skeptical, and found the narrative of carbon sequestration as too reductionist. Others questioned whether they would have to pay back the carbon credits if something happened on their farm that led to carbon loss.

The way farmers understand RA is very similar to the three themes that Richard Harwood (1983) outlined as key in a regenerative philosophy, which I will reiterate from the chapter 2. The first theme is the interrelatedness of all parts of a farming

[32] An EOV measures the short- and long-term improvements of five key outcomes: ground cover, water infiltration, biodiversity, primary productivity, and soil carbon and health (Savory Institute 2021).
[33] A microbiometer measures the microbial activity in a soil.
[34] A penetrometer measures soil compaction.
[35] A leaf sap analysis measures the nutritional and mineral composition of leaf sap.

system, including the farmer and his (sic) family. The second theme is the importance of the innumerable biological balances in the system. The third theme is the need to maximize desired biological relationships in the system, and minimize use of materials and practices which disrupt those relationships (Harwood 1983, 24). In conclusion, based on interviews with 14 farmers, regenerative agriculture is a farming system where growing food improves soil health and has positive effects on the diversity and balance in both ecosystems and communities.

5.2 More or less than organic?

Throughout the process of writing this thesis, many have asked me (and I have asked farmers) what the difference between regenerative and organic agriculture is.

Organic farmers felt RA was *more than* organic because of RA's increased focus on soil health, balance and diversity above and below ground, and getting natural processes to work. It also gave them some much-needed tools in order to be able to quit or move towards reduced plowing. This idea of regenerative agriculture taking it a "notch higher" (Helena) than organic agriculture, was also a core idea in Robert Rodale's first influential article (1983) as well as the other early regenerative voices (Harwood 1983; C. A. Francis and Harwood 1985; Rodale Institute 1985). Several of the organic farmers I interviewed described their previous production as "conventional-organic" or "organic farming in a conventional way", echoing what Guthman (2004) has labelled "organic lite" or the "conventionalization" of organic agriculture. We will see what this "conventional organic" agriculture was composed of in the upcoming chapters. Organic farmers now describe their current production as "regenerative organic".

I only interviewed one conventional farmer, and spoke to others informally, but they felt that RA was *less than* organic. Regenerative agriculture allowed them to farm in a more "environmentally friendly way" (Pål), and to take soil life into account without having to "go organic" (Pål). They saw RA as a tool to reduce spraying (herbicides, pesticides and fungicides), fertilizers and diesel. They also saw RA as a tool to preserve the basis of their livelihood – their soil. One farmer described the soil that washed out with spring rains. Another, of the dust-clouds that plowing would create, and how their soil just blew away with the wind.

A few small-scale farmers I interviewed also fell *in between* the organic/conventional dichotomy. They aimed to farm based on organic (and regenerative) principles, but found the Debio[36] organic label too costly, and regulations too rigid or even hindering them from running an environmentally friendly farm. Therefore, they found RA to be a useful term to describe their farm.

Perhaps there are more fitting ways than using organic agriculture as a metric to speak about regenerative agriculture. Recent research is also realizing that the distinction between organic and conventional agriculture may not even be as useful as previously thought. Comparisons between food grown using organic-, conventional- and conservation agriculture suggests that "*soil health* [is] a more pertinent metric for assessing the impact of farming practices… than the usual distinction of organic and conventional practices" (Montgomery and Biklé 2021; Montgomery et al. 2022, 2).

An important distinction between organic and conventional agriculture is animal welfare. All interviewed farmers saw high animal welfare as a fundamental part of RA. Animals' natural instincts such as grazing and rooting were seen as important tools on the farm. They contributed to healthy and diverse farm ecosystems, as well as alleviated farmers of work which they would otherwise had done with machinery. This resulted in a win-win situation for both animals and farmers.

A note on my use of "method" and "begin"

In a conversation with a representative in Regenerativt Norge, I explained that I was "researching why Norwegian farmers were beginning with regenerative agriculture". They replied that RA is not something one can "begin with", and then "be regenerative," emphasizing that RA is a *continual* process. There has to be actual measured improvement for a farm to be called regenerative. Also, whenever I used the word "method," I was corrected. Instead of methods, they follow "principles" which give direction, are broader and more open for the farmer to shape than "methods".

Despite this, I will still use the phrase "begin with" in this thesis because regenerative agriculture *is* a new concept in Norway, and it has inspired farmers to begin and develop new farming practices. I will also at times use the word "method" to

[36] Debio is the Norwegian organic regulation and labelling agency.

describe these practices, with the understanding that it is the "pragmatic effect" of these methods that is the most important (Morgan 1985, 134).

Furthermore, throughout the thesis I will describe the farmers as "regenerative farmers" as shorthand – encompassing both those who self-identify as such and those who follow regenerative principles. Regenerative principles that all agree on are minimizing soil disturbance, maximizing continuous living roots, maximizing diversity, and maximizing soil cover.

6. A journey between the ears

In this chapter, we will first examine what led the farmers I interviewed to begin with regenerative agriculture (RA) in the first place. Then we will explore the paradigm-shift, cognitive dissonance and possibilities that farmers experience as they learned about the dark universe that had been under their boots (and tractors) all along.

6.1 The path into regenerative agriculture

Farmers were introduced to the concept "regenerative agriculture" from a variety of sources – consultants, social media, trips abroad, books and articles. Most of those whom I spoke with heard about RA between 2016-2019, right around the time when RA's popularity began accelerating rapidly internationally. Norwegian farmers' paths leading up to regenerative agriculture was guided by the *search for improvement*, which culminated in a *shift in mindset*.

Before hearing about RA, farmers were actively searching for ecological and financial improvements at their farm. Some of the farmers I interviewed had experienced a personal, financial or soil-degradation related crisis. However, these crises catalyzed a search for improvement rather than the shift to regenerative agriculture. Many farmers had always been the entrepreneurial type, developing and testing out new ways of farming. Some had also pioneered improvements and developments at a structural scale regarding animal welfare, local production, food waste and pathways for direct sale of food between producers and consumers. In the search for improvement, many farmers had transitioned from conventional to organic, but they were not quite content.

> I am always trying to make things better if I can. Like I said, farming organically was fine, but I felt a little… frustration about not moving forward from year to year. (Frode)

Farmers (and consultants) often found inspiration and sources of improvement outside of Norway – beyond their national and cultural boundaries of knowledge. Consultants and farmers had travelled abroad to the U.S, Australia, European countries and Asia and been inspired by other agricultural practices and knowledge they learned there. Farmers who didn't mention specific trips abroad, still followed international agricultural

developments and trends, and followed innovative farmers on podcasts and social media.

> I always look outside of Norway when I want to be creative and run the farm. Never in Norway. You have to look to other countries, to the ones who manage to survive despite climate change, despite support from the state. It's a lot tougher than surviving in Norway. (Jan)

Jan attributed Norwegian state subsidies as a reason for the relatively little innovation in Norwegian agriculture compared to farmers in other countries, and looked to those who were forced to think outside the box. It seems that the farmers I spoke with had already begun doing the mental work of looking beyond the traditional arenas for agricultural knowledge in Norway – such as Norway's largest consultancy organization *Norsk Landbruksrådgivning* (NLR) that consults both conventional and organic farmers. Because of the farmers' previous search for improvement outside of the traditional venues of knowledge, they were open to the new research that followed the discovery of RA.

Interestingly, Gosnell, Gill and Voyer (2019) found almost identical reasons for why Australian farmers began with RA and Holistic Management (HM). They were "triggered by crises, epiphany and exposure to alternative pathways" (Gosnell, Gill and Voyer 2019, 11). An important difference between Gosnell et al.'s (2019) *exposure to alternative pathways* and my theme of *search for improvement* is the aspect of agency. The word "exposure" implies a passiveness. RA and HM are more widespread in Australia than in Norway, so farmers in Australia could be exposed to regenerative agriculture without actively seeking it out. In contrast, the farmers I have interviewed are among the very first to begin with RA in Norway. The Norwegian farmers' search for improvement eventually led them to RA and culminated in a *shift in mindset*, which is identical to what Gosnell. et al. (2019) name *epiphany*. However, I describe this as a shift in mindset because this reflects the Norwegian farmers' own language.

6.2 Something in my head said *bang*

One of the most salient narratives throughout interviews and conversations was the shift in mindset farmers experienced when they were first introduced to RA. This included a general shift in focus from above to below ground, but more specifically a shift from

seeing the soil as an inert medium for plant growth, to a living entity. Arne described this defining experience.

> He[37] began talking about soil health. It was the first time I heard about it. And it was like a complete *bang* that went off up in my head… which catalyzed a lot of projects and thought processes. When you have one way of looking at what you're doing, and then something else comes along that breaks with it… it hurts your head a little. It's a huge transition process.
>
> Elin: Can you say a bit more about what said *bang* and why?
>
> It was the way… I had never thought about the soil as… an ecosystem of itself that was in symbiosis with the plants. I had never thought the thought that it was so important with all that microlife and those things. (Arne[38])

Farmers like Arne had always valued their soil. Nevertheless, it had been the background to their farming operation, reduced to a "growing medium" (Frode, Bjørn, Stein) for their plants. This is a common perception in agricultural and soil sciences as well (Hartemink 2016).

Because of this, farmers experienced what I describe as a personal paradigm shift when they discovered that soil was in fact *alive* with microbes in mutually symbiotic relationships with the plants growing in the soil. They learned that soil microbes could digest organic material, mine for minerals in rock, even collect water, and then give these nutrients to plants. In exchange, plants photosynthesize and transform sunlight and carbon dioxide into *root exudates,* a sugary liquid that is the main energy source for symbiotic bacteria and fungi. This was completely new information and broke with what the farmers had been taught their whole lives about what plants and soil essentially are. What they were encountering was an anomaly, something that did not fit into their framework, what I call the "microbial anomaly." Interestingly, it was the farmers who heard about this from consultants, and not the farmers who had discovered RA themselves who described the paradigm shift in the most vivid terms – as if they had not expected to hear this at all. Farmers who had already been looking outside of the

[37] Arne is referring to Gabe Brow speaking in a YouTube video. Gabe Brown is an influential regenerative farmer from the USA who wrote the book Dirt to Soil: One Family's Journey into Regenerative Agriculture (Brown 2018).
[38] Arne doesn't describe himself as a regenerative farmer, but aims to farm after regenerative principles.

cultural boundaries of knowledge for inspiration and improvement described regenerative agriculture as simply "making sense", or "jigsaw pieces falling into place".

Thomas Kuhn (1962) defined paradigms as "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (1962, viii). Importantly, the discovery of "anomalies" catalyze paradigm shifts because "normal" science cannot explain them (Kuhn 1962, 52). Normal science can even attempt to suppress anomalies because "they are necessarily subversive of its basic commitments" (Kuhn 1962, 5). While paradigm-shifts in a field of science or in society is a slow process, Donella Meadows (1999, 18) points out that "in a single individual it can happen in a millisecond. All it takes is a click in the mind, a falling of scales from eyes, a new way of seeing".

From minerals to microbes

Throughout most of agricultural history, it has been vital to care for the soil through returning organic material, composted waste, rotating crops or leaving land fallow. Up until the mid-1800's there was general consensus that humus provided the main nutrients for plants, and agricultural practices aimed to increase soil humus was widespread (Marchesi 2020). Then, 183 years ago, while the industrial revolution was in full swing through Europe, a scientific discovery catalyzed a paradigm shift that is still dominant in agriculture today. Farmers I spoke with described this paradigm as a plant-centered, one that sees soil as a growth medium, and approaches nutrition with a "nitrogen in, yield out" equation.

In 1840, Justus von Liebig identified an anomaly in the agricultural science of his time when he discovered[39] that it was not the "nutritive juices" of humus, but mineral elements that made a plant able to grow. He developed a formula of elements needed for plant growth[40], and famously posited that a plant's growth is limited by the mineral[41] that is least available (Marchesi 2020). This is now known as "Liebig's Law of the Minimum,"

[39] Leibig made these discoveries based on the groundbreaking work of Carl Sprengel (Marchesi 2020).
[40] Many of Liebig's formulas and recommendations for mineral plant nutrition have since been disregarded
[41] The word "mineral" has since been updated to "resources" (Kvalbein and Eldhuset 2017)..

is considered basic agronomy, and is explained in all agricultural text-books today (Kvalbein and Eldhuset 2017).

The notion that "plant growth was reducible to measurable chemical interactions was revolutionary," because it made it possible for farmers to "dispense with the inefficiencies of traditional crop-and-fallow systems and instead collect consecutive, maximized harvests from the same fields" (Marchesi 2020, 206, 214). The smoothing out of the intricate complexities of soil also fit well into the capitalist, industrial zeitgeist that was coming to bloom. As Albert Howard described this era:

> During this period (1840-1900), agricultural science was a branch of chemistry; the use of artificial manures became firmly welded into the work and outlook of the Experiment Stations; the great importance of nitrogen (N), phosphorus (P), and potash (K) in the soil solution was established; what may briefly be described as the NPK mentality was born. (Howard 1943, 182)

The science and agricultural practice that followed has resulted in "an excessive focus on the interface processes between nutrients and the soil mineral matrix, at the expense of the study of the dynamics of organic and microbial fractions" (Lemaire et al. 2021, 3).

Soil microbiology emerged as a science at the end of the 19th century, around the same time as Liebig's Law of the Minimum was making waves across the world (Paul 2007). Organic pioneers of the early 20th century like Albert Howard (1943) warned that agriculture based on mineral fertilizers were based on a "complete misconception of plant nutrition" (Howard 1943, 37). Although "deficiencies in the soil solution can be made up by the addition of suitable chemicals […] It takes no account of the life of the soil" (Howard 1943, 37). Despite the budding scientific field and organic proponents, the complexity of soil microbiology made it much more difficult to both research and put into practice than the new mineral agronomy (Waksman 1925; Jacoby et al. 2017). Mineral plant nutrition was also easier to capitalize on. Already in 1940, Lord Northbourne, another organic pioneer, pointed this out along with a forewarning of the agriculturally driven ecological crisis of our time.

> In the long run, the results of attempting to substitute chemical farming for organic farming will very probably prove far more deleterious than has yet become clear. And it is perhaps worth pointing out that the artificial manure

> industry is very large and well organized. Its propaganda is subtle, and artificials will die hard. (Northbourne, 1940, p. 103)

Technological breakthroughs the past 30 years have enabled scientists to research soil biota through for example DNA sequencing, understand plant-microbe interactions and gain a better understanding of the importance of a living soil for plant, human and planetary health (Paul 2007). For example, as much as 20% of a plant's photosynthesized carbon is consumed by mycorrhiza, estimated to be about 5 billion tons of carbon per year (Bago, Pfeffer, and Shachar-Hill 2000). In return, mycorrhiza mines for nutrients such as phosphate in return (Hallama et al. 2019). Consequently, a functioning plant-mycorrhizal system contributes to solving both climate change, and the negative impacts of phosphorus mining (Hallama et al. 2019; Daneshgar et al. 2018)]. Bjørn, who got very excited about his microbes at one point exclaimed, "and did you know, grain is actually a carnivore!" He explained how recent research reveals that plants actually "eat" bacteria. Plants take up bacteria into the root, strip them of nutrients and release them into the soil so the bacteria can forage for more nutrients. This process is called *rhizophagy*, and was discovered as recently as 2010 by Paungfoo-Lonhienne et al. (2010).

This new understanding of plant-soil interactions renders the traditional "input-output logic" (Wakefield-Rann and Lee 2022, 273) of the dominant agricultural system redundant and outdated. Before beginning with RA, Frode had farmed (organically) based on a "recipe, where you buy in and receive an expected yield." He described it as an "eye-opener" when he realized that he could farm "together with the natural processes that are happening every day, and get a better result working with them than working against them." Research confirms that working with soil biota can improve crop yield, nutrient uptake and reduce nitrogen from leaching out from soil (Bender and van der Heijden 2015).

Importantly, learning about soil biology did not reduce how much the farmers valued soil chemistry and minerals. On the contrary, many farmers who had received consultancy from Vital Analyse also took an extensive soil test called the Albrecht soil analysis[42]. Regular soil tests measure sufficiency levels of the least available nutrient –

[42] The Albrecht Analysis was developed by William Albrecth in the 1930's. Another name for this soil test is the Base Cation Saturation Rations (BCSR). A cation is a positively charged atom or molecule. The

following Liebig's logic. However, the Albrecht soil analysis measures minerals in ratio to each other, and also measures a wider range of micro- and macro minerals, which gave the farmers new information about their soils. Based on this knowledge farmers could add certain minerals to the soil which make other nutrients more available to plants, as well as create a physical soil structure that is more hospitable for soil microbes. Interestingly, this Albrecht soil analysis has also been "suppressed" by dominant agricultural science, although recent research and practice shows that it is a beneficial supplement to traditional soil tests (Culman et al. 2021). Farmers in VitalAnalyse's network therefore stated that they learned a deeper and nuanced soil chemistry at the courses they take, and that this is a very important part of their regenerative journey.

Farmers do not discard the entire mineral paradigm, but are opening up its boundaries to include the most recent scientific discoveries that include soil biota as a vital part in the plant's system. These plant-soil systems have a "high capacity of self-regulation and auto-adaption leading to emergent properties that *are not identified* when the system is reduced to a simplified linear supply-response approach" (Lemaire et al. 2021, 4 my italics).

Gatekeepers

Because of this, soil microbiology remains eclipsed by Liebig's paradigm. Research projects with an alternative approach[43] than the conventional one have historically received a fraction of the funding that conventional agriculture does (Vanloqueren and Baret 2009; DeLonge, Miles, and Carlisle 2016). Furthermore, alternative approaches to conventional agriculture have been accused of being ideological, unscientific and unreasonable for their stance against pesticides and synthetic fertilizers (McGuire 2017; Connor 2018). The scientific discoveries of the mineral paradigm have indeed increased food production and have an important place in agriculture. However, it seems

"base cations" measured are calcium, magnesium, potassium and sodium. It gives a different kind of information about soil chemistry and nutrients than traditional soil tests that measure sufficiency levels of available nutrients (SLAN) (Culman et al. 2021).

[43] By alternative approaches I mean organic agriculture and agroecology. Although these frameworks do not equate an agriculture that takes into account soil microbiology specifically, they represent a more holistic approach than the mechanistic mineral paradigm that agriculture at large operates within (Keller and Brummer 2002, 264).

gatekeepers themselves have not recognized the limits of the epistemological landscape in which this knowledge is created (Alrøe and Kristensen 2002).

Even agricultural scientists who acknowledge the symbiotic relationships between plants, bacteria and mycorrhiza recommend direct mineral fertilization. An example of this is can be found in the short book published by NIBIO[44], *Optimal Plant Fertilization*:

> Organic agriculture builds on the idea that the soil should be fertilized and that microorganisms should transform organic material to plant nutrition. We recommend that the plants' nutritional needs should be satisfied directly. In this way, *our basic approaches are completely different*. (Kvalbein and Eldhuset 2017, 18 my translation and italics)

When researchers acknowledge the existence of both the mineral and microbial approaches, but reject the microbial approach, they become gatekeepers of the mineral paradigm[45]. They hold the cultural boundaries of what constitutes "agricultural science," and are holding Liebig's paradigm in place. Importantly, the agrichemical companies who profit enormously from this mineral model of plant nutrition also finance research within this paradigm are also gatekeepers. Bjørn recognized this:

> And then you have Yara and Bayer and Monsanto who want the opposite. They loose money on *every* farmer who begins with regenerative agriculture. (Bjørn)

Research on what makes soil *soil*, has therefore not been communicated to farmers, neither through agricultural schools nor by consultants – the main institutions society has put in place for mediating this expert knowledge to practitioners. The cartography of dominant agricultural science has not included microbes on the map. This is an important reason for why farmers experienced such a momentous shift in mindset when gained this knowledge.

> Everything I learned at agricultural school had a conventional touch. 90 % of what we learned was about what happened above the soil, and 5% of what happened below the soil – which I thought was dead boring. The course [with

[44] The Norwegian Institute of Bioeconomy Research, one of Norway's largest research institutes.
[45] In their book, Kvalbein and Eldhuset (2017) argue for a judicious and timely use of mineral fertilizers, which is better for crop and plant health, and reduces environmental pollution than excessive fertilizing. However, it is interesting that they advocate for this despite acknowledging the symbiotic relationship between plants and microbes, and that fertilizing disrupts these processes (2017, 19).

> VitalAnalyse] turned upside down on everything you had learned and practiced. (Stein)

To be fair, many of the breakthroughs in soil microbiology have happened after farmers who are nearing retirement were formally or informally educated into the agricultural profession. However, this is where the consultancy organizations come in. The largest consultancy organization in Norway is *Norsk Landbruksrådgivning* (NRL) a trusted organisation with whom a majority of Norwegian farmers hold a membership[46]. NRL writes that they are the "link between research and agriculture, and collect, develop and coordinate knowledge that consultants convey to practitioners in agriculture" (NRL n.d., my translation). Although one farmer was introduced to the concept of soil health and soil microbes by an organic consultant from NRL, several other farmers mentioned how NRL was very "traditional", and "lacked the most recent research". Even the conventional farmer I interviewed mentioned this. One conventional grain farmer said that he learned more about agriculture from the Soil Fertility Course than he had done during his twenty years as a farmer.

Gatekeepers, such as consultants, have held an important role (perhaps unknowingly so) in keeping the mineral paradigm in place, and we will return to how farmers interact with them in the upcoming chapters. However, farmers are not the only ones who are coming up against the boundaries and gatekeepers of Liebig's paradigm. Throughout my three years of fieldwork I have seen interest for RA and microbiology growing in several arenas in Norway – agriculture, academia, municipal administrations and policy. As one bureaucrat said with excitement, "the techno-chemical revolution is living on borrowed time – we are on the cusp of a biological revolution!" With interest in regenerative agriculture surging internationally and in Norway, farmers are not alone in discovering the importance of a living, microbially active soil. Importantly, even gatekeeper institutions like NIBIO and NRL are not homogenous. There are innovative consultants and scientists who are also daring to engage with these "anomalies." For example, it was an organic consultant from NRL Østafjells who shared the YouTube video that made Arne's head "explode". As Kuhn (1962) points out, a sign that a paradigm shift is emerging is the simultaneous discovery or interest in anomalies in

[46] According to SSB (2023) there were 37 682 registered farms in 2022, and according to NRL (2023) they have 24 000 members.

different places. Nevertheless, it is farmers who are doing the nitty gritty and risky boundary-work of shifting paradigms, from the bottom up, beginning with themselves.

Despair, wonder and possibilities

When we encounter an anomaly, we experience *cognitive dissonance*. This psychologically uncomfortable state results from an inconsistency between two or more cognitions (Festinger 1957). The more fundamental these cognitions are, the greater the discomfort. In the farmers' case, the new science that they were introduced to was discordant with both their previous knowledge about how the soil and plants function, as well as their own agricultural practices. For example, previously, farmers had spent their whole lives plowing the soil for the sake of their plants, not knowing that they were turning "the house of the microlife upside down" (Frode) and in fact harming organisms that could support their plants. Wrapping their minds around the new knowledge and the implications it had for their work was, as Arne described it above, "hurting your head." Stein confirms this.

> It was difficult. I experienced despair, had to breathe deep, and empty my mind in order to take in new information. (Stein)

Stein is a farmer nearing retirement who had already made the shift from conventional to organic agriculture, but he explained that RA was something completely different. In the quote above, he actually puts words to cognitive dissonance and the process of solving it. First Stein describes the discrepancy between knowledge (turned upside down on everything you had learned and practiced). Then he tells of the psychological discomfort that ensued (despair), and finally how he reduced the dissonance (empty my mind in order to take in new information). He managed to change a core cognition despite the despair it induced – a difficult thing to do (Festinger 1957).

What may have made the shift possible for Stein and other farmers was the experience of awe and wonder. As one farmer I informally spoke to said, describing her and her neighbor's first attendance to a course with Vital Analyse, "we just looked at each other, and said… what on earth *is* this?" Or as Stein put it,

> Understanding what is happening underneath the soil is like getting into a rowboat and rowing to South Africa. It's unconceivably large. (Stein)

Keltner and Haidt (2003) conceptualize awe as the simultaneous experience of *vastness*, something larger than the self or one's ordinary level of experience; and *accommodation*, which means adjusting mental structures that cannot assimilate to a new experience. It seems that all farmers I have interviewed have been able to accommodate to the new knowledge about the importance of the symbiosis between soil microbes and plants. For some, this accommodation happened quickly, while others needed more time.

The flip side of cognitive dissonance is that once it is resolved, new ways of seeing also enable new possibilities. Farmers choose to test regenerative principles because they see the opportunities for reducing expensive external input (fertilizer, pesticides and diesel), increasing yield and the resilience of their farms against extreme weather events. They also see that they can actively contribute to both the problems of climate change and environmental degradation, such as by sequestering carbon and reducing runoff of nitrogen pollution to the Oslo fjord. Although a few farmers I have spoken to identify as "idealists," most of the farmers choose this path because they believe that it is best for both their environment *and* their wallets.

Ingrid and Ole, a young couple who raise animals as their main production, included another important dimension: free thought. They spoke enthusiastically about how learning about regenerative agriculture and holistic management enabled them to think outside the box.

> I've taken such a long journey up here between my ears regarding quite a lot actually… just, what is possible. You see the world in a completely different way compared to how I did when I was part of the "normal Norwegian society" if I can put it that way… that's maybe the biggest surprise for me, how free-thinking you can become. I mean, the equipment for horses has become so good, so if I wanted to and had the time maybe I'll begin with horses to harvest instead. That is what is so fun with the brain opening up, you dare to see those things. Five years ago I would have laughed myself to death if I had thought of beginning to harvest with a horse *laughs* are you crazy? Right? But now it's like, "yeah, it's possible". (Ole)

The journey that Ole took brought him up to the cultural boundaries that hold the dominant agricultural paradigm in place, and even beyond to the extent that he stands

outside “normal Norwegian society.” Thinking freely means not feeling restrained by the cultural boundaries of knowledge that are in place. They still exist, but Ole is not restricted by them. He can peer beyond. This ability to think freely is essential if we wish to solve our global and interconnected problems using different frameworks than the ones that created the problems in the first place.

6.3 Summary

In this chapter we have seen how the farmers I have interviewed are shifting mindsets and are adopting a new microbial paradigm, that has long been eclipsed by the dominant agricultural paradigm stemming from Liebig’s mineral model of plant nutrition. Learning that their soil was not just an inert growing medium for plants, but an ecosystem in symbiosis with plants, induced cognitive dissonance – feelings of discomfort because it didn’t match with what they had learned nor what they had practiced their whole lives. The cognitive dissonance led to experiences of despair, and long mental journeys where they needed to re-evaluate the boundaries of knowledge that experts had set in place for them. It also led to enthusiasm, excitement and seeing new possibilities. These farmers are pioneers.

In the next chapter, I will show how farmers’ discovery of the microbial anomaly is put into practice, and also how it is connected to several key agricultural traditions and “truths.” Importantly, shifting one’s mindset is both an *event*, as well as a continuous *process*.

7. A relational approach

In this chapter, I will show how the shift in mindset also catalyzed a shift in the farmers' relationship with their soil and their land. This also had implications for how farmers learned about their land as well.

7.1 Friends and farmworkers

A key narrative that emerged from the interviews was the relational way that farmers spoke about the soil once they discovered the microbial "anomaly". It is difficult to have a relationship with dirt, but perhaps easier with a living soil?

> We didn't think about the microorganisms in the soil, they're the ones you should be friends with! (Stein)

> Remember, it's those little guys under the soil who are working for free for us! (Course participant)

When soil is transformed from *substrate* to *subject*, the relationship changes. The farmers had previously not "thought about" microbes because this knowledge had not been regarded as important by agricultural schools and consultants.

> According to conventional agriculture, "one can in practice *disregard* most soil chemical properties that lock in nutrients and make them unavailable for plants. Nutrients are applied in line with the plants' needs, *not to make the soil more nutritious* (Kvalbein and Eldhuset 2017, 17 my italics).

Disregarding soil properties means disregarding microbes, because soil microbes are both affected by chemical properties in soil and they are able to "mine" minerals that would otherwise be inaccessible to plants (Dasgupta and Brahmaprakash 2021; Hallama et al. 2019). This mineral, mechanistic and utilitarian approach to agriculture fosters a relational and practical divide, a disregard, between the farm and its surrounding ecosystem.

As previously mentioned, when Mauss (1990) wrote *The Gift*, it was a critique to the utilitarian understanding of political, economic and social life of the early 1900's. Mauss argued that these fundamental processes were based on gift relations through the

cycle of giving, receiving and reciprocating (Mauss 1990, 39). The same can be said for agriculture.

All farmers practice some kind of reciprocity with the soil. Even when soil is a mere substrate, farmers return nutrients in exchange for plants. There is a transactional quality to this kind of agriculture, which is similar to Sahlin's "balanced reciprocity" of direct exchange, seeking a balance of exchanged material value (Sahlins 1972, 194). This would correspond to the "input-output" logic discussed earlier. Others might even describe it as a "negative reciprocity", due to the severe soil degradation happening on conventional farms the world over (FAO and ITPS 2015). Albert Howard certainly took this approach when he accused that conventional agricultural research promoting synthetic fertilizers. The conventional approach, he held, had made the farmer "not a better producer of food, but a more expert bandit" who had been taught "how to transfer capital in the shape of soil fertility and the reserves of his live stock to his profit and loss account" (Howard 1943, 199).

When farmers discovered that their soil is teeming with microbes that can support their crops if given the correct conditions, farmers began seeing these microbes as "friends" and "workers". This kind of reciprocity is closer towards Sahlins' (1972) pole of "generalized reciprocity," which, according to Sahlins is the closest kind of reciprocity, like the one that exists between family, which is kinship.

Although my informants did not see microbes as "kin", they welcomed these previously unknown microbes as important members on the farm – growing plants and repairing soil. I asked one farmer if he was just as much of a microbe farmer as a grain farmer, to which he chuckled and replied, "Yes, I want as many microbes as possible!" Richard Teague (2017) points out that "microbes mediate 90 % of soil function and form a mutual dependency with plants and the animals feeding on the plants" (Teague 2017, 334). With their new knowledge of microbial functions, farmers began supporting (reciprocating) the actual *microbes* in the soil – trusting their new friends and farmworkers to (among other things) feed their plants.

> It's actually a collaboration, that you try to do your best to support the collaboration between plant and soil life to get a healthy and strong plant. (Frode)

By understanding the economically free labor that soil microbes provide for farmers, farmers are inspired to "befriend" (Stein) or *reciprocate* their labor by caring for them

in return. As farmers "collaborate" (Frode) with their soil microbes to help them support their plants, these farmers can be seen as "participant 'members' of the soil community rather than merely consumers of its produce or beneficiaries of its services" (Puig de la Bellacasa 2017, 192). Being members of the soil community means working together and support each other in a cycle of giving, receiving and reciprocating (Mauss 1990).

Conversely, these farmers also have also used soil metaphors describing their microbes as "the bank", "soil-motor" and "free factory" – terminology that is closer again to Sahlin's balanced reciprocity, which has a transactional quality to it, and signify the economic value that a soil with functioning microbes contribute to[47]. These differing ways of relating to the soil (generalized or balanced reciprocity) represents the balancing act it is to be a farmer – on the one hand support and sustain natural processes, and on the other grow high yields. However, it seems that the farmers I have interviewed feel that they do not have to choose either-or when they begin farming based on regenerative agriculture. Environmental sustainability and high yields for human consumption can go hand in hand. Furthermore, farmers also understood the connection between how the care for the soil as reciprocally connected to how they care for themselves.

> More and more studies show that there is a clear connection between the food we eat, how it is produced and our own health. It's like a mirror. We have a lack of microbes in our gut, and so does the soil. And we have a lack of diversity in the ecosystem generally. So I think that we need to get back that diversity, because then you also get a robustness in a different way. (Helena)

Soil scientists are coming to describe the bacteria that live around a plants' roots as their "external gut", mirroring our "internal gut" (Ramírez-Puebla et al. 2013). Nutrient deficiency, or "hidden hunger" is becoming a global epidemic, affecting half of preschool aged children worldwide (Stevens et al. 2022). While this is a problem with sociopolitical roots, we also know that degraded soil grows less nutritious plants. While 14 minerals are recognized as essential for plant growth, animals and humans need a range of other micronutrients and phytochemicals; these are more prevalent in plants that grow in a healthy soil (Oliver and Gregory 2015; Montgomery and Biklé 2021). Farmers like Helena move towards a generalized reciprocity, and are aware that as they

[47] See Anna Krzywozynska (2019a; 2020) for a discussion on soil as workers and laborers.

support their subterranean farm workers, they also support their own "gut buddies" (Lorimer 2016, 57; Singh et al. 2017), as well as planetary health. This is in line with Bruggen et al.'s (2019) argument "the health conditions of all organisms in an ecosystem are interconnected through the cycling of subsets of microbial communities from the environment (in particular the soil) to plants, animals and humans, and back into the environment" (927). Lorimer (2019) points out we are finally learning to see humans as "holobiont[s], composed of microbes and threatened by both microbial excess and microbial absence" (p.) The same can be said for plants and soil. They are threatened by microbial excess (such as pathogenic fungi) and microbial absence (such as the beneficial bacteria and fungi that provide protection from pests and support plants's immune systems).

Experiencing reciprocity with the land is a motivating factor to shift farming practices (Jax et al. 2018; Seymour and Connelly 2022), because relational ontologies "aim to overcome the bifurcation of nature/culture and various other dualisms (e.g. mind/matter, subjectivity/objectivity) shaping the modern worldview" (Z. Walsh, Böhme, and Wamsler 2021, 80). Gosnell et al. (2019) even argue that Australian regenerative "farmers' feelings of kinship with nature (animals, plants, microbes) resulting from learning about and working with soil are underappreciated drivers of behavioral change and powerful leverage points for larger-scale social-ecological transformation" (603).

So far, I have focused on microbes. However, farmers used relational language and showed a generalized reciprocity when speaking about all parts of their farm (weeds, animals, and nature in general). Furthermore, this new way of relating to their land has implications for how farmers learn about their land as well.

7.2 Embodied knowledge and land literacy

A closer sense of reciprocity also involved encouraged a more tactile and personal way of knowing, of reading the land.

> It's almost embarrassing to say, but we almost never dug in the soil before. Well, except for when we plowed it every year, I guess that is digging. But you didn't take any time to look at how the soil actually looked, how it smelled, what you found in it, and... Those kinds of things. (Frode)

The relational distance of seeing soil as an object, a "growth medium" had involved a physical distance between the farmer and their soil, since they mainly observed it from the seat of their tractors and learned about it from soil tests that were analyzed at a lab. When they saw soil as hosting beneficial microbes, both the relational distance *and* physical distance shrunk considerably, as they began actually digging in the soil.

Importantly, this closer reciprocity has implications for the cultural boundaries of knowledge that farmers are in and are stretching. This personal, embodied and observational way of knowing about one's land has remained on the edges of the dominant cultural boundaries of knowledge, deemed "unscientific". While farmers seek the expert knowledge of regenerative consultants, they also trust their own ability to interpret their land. The farmers I interviewed now dig in their soil – almost daily – because they trust that their own ability to deduce important information about soil themselves, instead of relying on conventional experts.

> I have more tools in my toolbox now, and more knowledge about why and what measures to take. I can take a shovel test and I'll have a better idea of what to do. I never dug in the ground before, but now I carry a shovel around everywhere! (Bjørn)

Both minerals and microbes are invisible, usually accessible only to scientists[48]. However, while soil tests that are analyzed in a laboratory are needed in order to know a soil's mineral composition, a simple shovel can tell the farmer quite a lot about the microbes in a soil by its structure, color, how it feels, smells and how much soil (microbes) cling to the roots[49]. This was knowledge that farmers had either not known of before, or had not been encouraged to implement. When operating from the paradigm that soil is but a substrate and farmers can provide their crops with what they need by plowing and fertilizing, it does not make much sense to go digging.

Furthermore, as farmers learn more about their land, they come to see their landscape in a whole new way, which was almost like learning a new language.

[48] Although there are initiatives to bring microscopes out of the laboratory, to help farmers and gardeners conduct their own "citizen science" (Solbakk 2020).

[49] By looking at plant roots, farmers could see how much symbiotic activity there is between their plants and soil. Plants that are producing a lot of root exudates are attracting lots of microbes that attach to the root zone, the rhizosphere. These roots are covered in soil, or what in Norwegian is called *rotpels*. In soils with less biological activity, roots will be "naked" and look white. Farmers can also look at soil structure, color, how it feels and smells.

> When we look at nature, its's like its written in Arabic. Then you don't know what is what, even if you look at it. But if you learn Arabic you can read the whole. If it was written in Norwegian, you could read everything. You could look at those leaves over there, and see "I need sulphur" or see a plant that says, "the soil is too compacted." (Bjørn)

As farmers engage with new sciences, they gain a new *land literacy*, which is the ability to "read and understand sources of health (and ill-health) in a landscape", and to understand the condition and of trends in the environment around them" (White in C. A. Campbell 1995, 5). Several informants compared beginning with regenerative agriculture as learning to play music, (which is perhaps also why many rather speak of RA as a process, instead of method).

> It's like… we're working with nature, but we don't yet know how to play the music in order to get the results we want. (Frode)

This makes agriculture into an art. It requires a different kind of skill than the quantitative, mechanic skills most often associated with agriculture (and which are also essential). Farmers like Frode recognize that nature has something like an agency of its own, which is not present in the dominant input-output logic of agriculture. When nature has agency, it cannot be completely controlled. When the farmers I interviewed made changes on their farm, they observed and listened to how nature "answered" (Frode), engaging in a reiterative learning process. This is very different to farming based on a "recipe." Likewise, as Landers et al. (2021) put it

> We are still learning to conduct this symphony. 'Think like a rhizosphere' is the new maxim extensionists are now adopting to convey to farmers the complexity of managing the living soil, and its rewards. (Landers et al. 2021, 11)

Nevertheless, the goal is to "get the results we want," a high yield and a healthy ecosystem all at once – which is imperative to feed a growing population in a world out of balance.

7.3 Summary

Paradigms, relationships to nature and knowledge are interconnected. When farmers learned about microbes, a whole new world opened up to them. Their soil transformed

from substrate, to full of tiny living subjects which the farmers began caring about – because the microbes could care for their crops in return. This also encouraged the farmers to get closer – not just relationally – but physically to the soil. As they learned about soil processes, they also began learning how to observe these themselves and gained a new land literacy. They learned to trust their own knowledge, as a supplement to the knowledge of experts.

8. Learning and unlearning

An anomaly will sometimes "clearly call into question explicit and fundamental generalizations of the paradigm" (Kuhn 1962, 82). As farmers discovered the "microbial anomaly", they discovered it was connected to several core paradigms in agriculture that they began questioning. These were practices that – like Liebig's paradigm – also sprung from a mechanistic worldview, the "belief that natural systems are understandable, predictable and manipulatable" (Keller and Brummer 2002, 264), which culminated with the industrial revolution. Scientific developments during the industrial revolution laid the foundation for not just a mineral model for fertilizing but also intensive plowing, chemical weed eradication, and monocultures. In this chapter, I will explore how farmers stretch cultural boundaries of knowledge and challenge paradigms as they approach these established practices in a new way. They engage not just with soil science, but the field of ecology and trusting their own observations and experiences as well.

Farming is a visible profession. Decisions that farmers make in the spring are observable all year long, and all work they do, such as plowing, planting, fertilizing and moving animals is visible. Therefore, farmers who wish to test out new things do this as the community observes – and watch they do. Burton (2020) has researched what he calls "the good farmer" for over two decades, and found farmers observe and judge each by smooth plowing, straight rows, "tidy" fields that are free of any vegetations except the crop, and of course high yields. Learning new skills, experimenting with previously untested knowledge, doing traditional practices differently – this too becomes a public affair, open to anyone who is critical or curious.

Because regenerative agriculture (RA) is completely new to Norway, this involves a process of trial and error, trust and doubt, learning and unlearning. This makes the starting phase a vulnerable period. The boundary-work that was previously limited farmers' own minds moves into the real world. Invisible microbes and eclipsed sciences are turned into visible practices that break with tradition – inevitably inviting reactions.

8.1 Subversive sciences

As previously explained, the farmers I interviewed engaged in the eclipsed science of soil microbiology. Microbes are invisible, and they are everywhere. Once farmers understood this, they also understood that all their farming practices in some way affected these microbes, and the whole ecological system of the farm. Van Bruggen et al. (2019) has even suggest that the "health conditions of organisms, communities and ecosystems are interconnected by microbial communities at different levels of integration in time and space" (2019, 928).

Perhaps it should not come as a surprise that one of the bodies of knowledge that regenerative farmers[50] had explored on the outskirts of the dominant boundaries of knowledge is *ecology*, which has been called the "subversive science" (Shepard and McKinley 1969). Ecology is the study of organisms and how they interact with the environment around them – how they are simultaneously shaped by and shape their habitat (Miller and Spoolman 2009, 7). Paul Sears (1964) who inspired the concept of subversive science with his article "Ecology: A Subversive Subject" wrote:

> By its very nature, ecology affords a continuing critique of man's operations within the ecosystem. The applications of other sciences are particulate, specialized, based on the solution of individual problems with little if any attention to side effects and practically uncontrolled by any thought of the larger whole. (Sears 1964, 12)

This mirrors Albert Howard's (1943) fierce frustration with what he saw as agricultural science's fragmentation of nature, focusing on plant nutrition based on mineral fertilizers instead of the importance of a healthy soil and its environment. Through engaging with science from the field of ecology, which has historically been separate from both agriculture *and* soil science[51] (Lavelle 2000; Bouma 2015), farmers were able to see connections to fundamental practices they previously treated as separate – such as plowing and weeding.

[50] Farmers both from the network of VitalAnalyse and Regenerativt Norge did this. Alan Savory drew heavily on ecology when he developed his grazing strategy and subsequently his framework of Holistic Management (Savory 1986; Savory and Parsons 1980; Savory and Butterfield 1999).

[51] Agroecology incorporates ecology, and is even defined as the "ecology of food systems," but it too has been niche compared to conventional agriculture (C. Francis et al. 2003; Wezel et al. 2009).

In their quest for an improved soil, farmers shift their practices based on science from soil microbiology and ecology[52]. They engaged in boundary-work and hybridizing new practices, challenging traditions and truths along the way. Gieryn (1999, 15-17) outlines three main genres of boundary-work: expulsion, expansion and protection of autonomy. Because the farmers I interviewed do not claim to be scientific experts themselves, the boundary-work they are doing does not fit neatly into either one of these categories. However, the genre that comes closest, is *expansion*. Expansion "takes place when two or more rival epistemic authorities square off for jurisdictional control over a contested ontological domain", where non-scientists "challenge the exclusive right of science to judge truths" (Gieryn 1999, 16). Farmers expand the boundaries of knowledge that hold traditional "agricultural science" by incorporating eclipsed sciences into their knowledge base, as well as learning to trust their own capability to read the land.

8.2 Parking the plow

Plowing is perhaps the practice that is most strongly associated with growing food. Ever since the first plow was developed circa 8000 years ago in Mesopotamia it has been developed and refined with exponential acceleration, the most dramatic changes having been made since the industrial revolution (Rattan Lal, Reicosky, and Hanson 2007). A typical plow in Norway today plows 15-25cm deep and turns the soil upside down, burying organic matter and bringing lower soil strata to the top. Plowing is done to aerate the soil, prepare the soil for seeding, and is used to "fight" weeds (Johannessen 2022).

The method that VitalAnalyse advocates for and has taught several of the grain farmers I have interviewed, is "mulch-tilling" instead of plowing, which only disturbs the top 3-5cm of the soil instead of the usual 15-25cm. It requires that the farmer has a cover crop on their fields. To prepare the soil for planting, the cover crop is cut a few centimeters below the soil, and the plant is chopped up into small pieces and incorporated shallowly into the soil. This mulch is simultaneously sprayed with an herbal ferment that speeds up the mulch's decomposition, and steers the decomposition,

[52] They also engage in soil chemistry, as referenced to in chapter 6, but this is not within the scope of this thesis.

so that it composts rather than rots. After 4-7 days, the farmer can plant directly into this decomposed mulch. This process both keeps the soil structure intact, as well as inoculates the soil with beneficial bacteria. Just like kombucha, sauerkraut and sourdough bread is good for our internal human guts, farmers support their plant's external digestive system – the soil microbes – with beneficial probiotics. Not all grain farmers I interviewed follow this method exactly, but many are inspired by it, and at least test "mulch-tilling" instead of plowing. Unlearning the paradigm that *plowing is good* was key as farmers began farming based on regenerative principles.

> Soil tillage, to plow and that kind of thing, its's very damaging and that... it was a completely unknown thought to me before. (Arne)

> You can't destroy the microlife's house every year. It's actually very strange that you haven't thought in those paths before. (Frode)

Where farmers previously viewed plowing as something good and necessary, they began seeing that plowing was actually damaging the soil – a "very strange" thought, since it was outside of the traditional boundaries of knowledge and went against what they had practiced their whole lives.

The idea that plowing can be damaging to soil *completely* went against the dominant agricultural paradigm, where plowing has come to be seen as one of the most important symbols of good farming together with the straight lines and, importantly, the weed-free fields it facilitates (Burton et al. 2020, 48). The dominant plowing paradigm states (as illustrated by a report by AgriAnalyse) that:

> Plowing can be unfavorable for soil life, and the soil becomes more susceptible for erosion, and humus content is reduced in the upper part of the soil. These disadvantages are not considered to be important enough compared to the benefits that plowing gives. (Holmen 2020, 24)

Organic farmers' main tool for weed control is plowing, especially in grain fields[53]. So, what to do? Farmers like Lene who I spoke with felt this conundrum.

[53] Conservation agriculture (*Karbon Agro* in Norway) is an agricultural system that does not plow, but instead use the herbicide glyphosate to kill weeds instead, sweeping "nature's" space clean as well. The farmers I have spoken to did not want to apply this herbicide for fear that it would inhibit the microbial processes underground. Glyphosate is the most used herbicide in the world (Lemke et al. 2021). It has been shown to inhibit mycorrhizal colonization of plant roots and hinders population recovery; however,

> I've thought a lot about it… It's a little bit like, "yeah it sounds great, *but*.." And especially grain, you get a little… like okay how should you dare that? (Lene)

Lene felt she would have to choose between weeds and soil life or plowing and a decent yield. Her statement also demonstrates that breaking with this historically embodied practice and the science that supports plowing within the established paradigm can be *scary*. As Pål described it, the plow is "synonymous with safety."

> I use a lot of energy, time and money to try and work towards reduced soil tillage. (Arne)

Arne invests a *lot*, into something that goes against tradition and brings risk. Traditional agricultural research and practice has not developed a way in which one can prioritize both the soil microbes, the planted crop, and keep weeds at bay simultaneously.

> The challenge is trusting that you're doing the right thing. Especially when I started with a pure weed field, and then you're not going to plow and everyone is against you. Even the regenerative research group[54] that I was with meant that it was too bad here, we couldn't begin like that. But well, I stood my ground and today I'm glad I did. Otherwise I wouldn't have had that experience… (Frode)

In contrast to Holmen (2020), Frode, who is an organic grain farmer, found that the "disadvantages" of plowing were too important to ignore. Frode "jumped into it," and stopped plowing the same year he took VitalAnalyse's soil fertility course, despite having fields full of couch-grass, despite finding it challenging to trust himself when "everyone" was against him.

8.3 From weeds to pioneer plants

Keeping fields "tidy", and free of weeds is goes hand in hand with plowing, and is also an important sign of "good farming" (Burton et al. 2020, 48). They are by definition plants that are unwanted because they compete with the desired crop for light, space,

conventional tillage is even more detrimental to symbiotic mycorrhiza than glyphosate (Helander et al. 2018; Wilkes et al. 2020).

[54] The "regenerative research group" he is referring to is an innovative group of grain farmers who together with VitalAnalyse are the first in Norway to test out five new methods for growing grain based on regenerative principles.

water and nutrients. Weeds have followed agriculture ever since the neolithic period (Rösch 1998). However, the *ideal* of "clean" (Lars) fields can be traced back to 18th century Britain, when Jethro Tull developed a horse-drawn seed-drill making it possible to sow seeds in straight rows instead of broadcasting them[55]. In Robert Rodale's (1983) pivotal article on regenerative agriculture, he attributed much of the unsustainability of agriculture to Tull's legacy.

> [Jethro Tull] showed farmers how to place crop plants in their fields in such a way that the line between nature's area and that of the farmer was more clearly drawn. Nature's area was the space between the rows – and that was swept as clean of life as possible (Rodale 1983, 17)

To all farmers' chagrin, the industrialization and intensification of agriculture that followed seeding crops in straight rows and Liebig's mineral nutrition paradigm was followed by an increase in weeds and other pests (Storkey et al. 2021). In 1896 the agronomist and artist Emil Korsmo, who pioneered research on weeds in Norway, even portrayed weeds as the "enemies" of farmers (Korsmo 1896, 1). During this same time, research in chemistry, combined with the logic of the rapidly emerging mechanistic worldview made newly developed herbicides seem like the natural solution to the emerging weed problem. After WWII, the use of both herbicides and pesticides accelerated; today, chemically fighting unwanted "pests" is such an integral part of global agriculture that we operate from what some call the "herbicide paradigm" and "pesticide paradigm" (Ziska 2020; Zimdahl 2012).

Importantly, as historian Anne Jorunn Frøyen (2022) points out, a cultural shift was necessary for this paradigm to emerge in Norway. Up until the late 1800's the general attitude amongst both Norwegian farmers and scientists was that agriculture was dependent on nature to protect their crops. Pests were a sign that nature was out of balance, and usually humans were at fault[56]. Therefore, many farmers were skeptical of using chemicals[57]. Agricultural consultants or "development agents" as Frøyen calls them, actively promoted herbicides and therefore the shift from seeing agriculture as

[55] Tull also saw agricultural industrialization as part of a social agenda of minimizing reliance on an "unruly labor force" (Sayre 2010, 851).
[56] Frøyen (2022) bases this on her analysis of the state epidemiologist Wilhelm Maribo Schøyen's book *De for Ager, Eng og Have skadeligste Insekter og Smaakryb* (1875).
[57] Despite the fact that using poison to get rid of larger unwanted animals was common practice at the time (Nielsen and Seines 2019).

dependent on nature, to seeing it as separate from nature (Frøyen, 2022, 44). These development agents, who through boundary-work facilitated the emergence of the herbicide- and mineral nutrition paradigms, have become the ones who hold these cultural boundaries of knowledge in place and perpetuate Korsmo's warlike narrative.

The anomaly of the herbicide paradigm is that weeds continue to come – with ever greater force as they are becoming herbicide-resistant (Storkey et al. 2021). Ironically, viewing weeds as the "enemy" has become a self-fulfilling prophecy. Keeping them out of our fields by chemical force has actually made them a "greater inherent threat to crop production than before the advent of herbicides" (Storkey et al. 2021, 2416).

The paradigms that have shaped the plowing and weeding paradigms have developed in tandem, so when regenerative farmers want to plow less out of consideration for their microbes, they must rethink what to do about weeds as well. Instead of seeing weeds as "enemies" to be fought, they now see weeds as "workers" – just like their microbial farmhands.

> Weeds grow for a reason. It's because there is something wrong in the ground, so those weeds come to fix that. (Bjørn)

He saw weeds *messengers*, telling him that something wasn't right with his soil was. Furthermore, he saw weeds as actually *repairing* his soil. From the vantage point of the "herbicide paradigm," this sounds like squaring a circle. Not actively weeding by mechanical or chemical means can mean a great loss in yield – a loss for society at large, and potential financial ruin for farmers.

Ecological science reveals that weeds have adapted to be the first to colonize a disturbed environment – such as bare soil after a forest fire or a landslide (Smith 2015). When fields are plowed every year, this looks like "disturbance." Our arable crops like grain are domesticated grasses, and grasses grow at a later ecological succession with less soil disturbance. Therefore, they have different nutritional needs, and for symbiotic relationships with different microbial communities than weeds do. It is telling that weeds often form more positive connections with soil microbes in agricultural soils than crops do (Massenssini et al. 2014). As Smith (2015) points out, "despite their recognition as plant communities, it is apparent that many cropping systems, particularly annual crop production systems, are managed without explicit consideration

of the ecological and physical processes that regulate their functioning" (Smith 2015, 14).

Years before deciding to stop plowing, Frode had worked abroad and helped local farmers begin with agriculture based on local resources, and in the process, he had read and researched a lot about soil- and ecological processes. When Frode returned to Norway, he saw that his own fields were absolutely covered in *kveke* (couch-grass), worse than they had ever been, and attributed this development to intensive plowing. Apparently, the farmer who had rented Frode's land had seen the couch-grass problem, and asked advice from a consultant in NLR who subsequently had recommended deeper plowing.

> It was the first thing I discovered. Working the soil intensively each year means that you start each season at the pioneer stage, and then you get all the weed problems that follow because that is nature's way of repairing it. (Frode)

Frode realized that plowing, the tool that organic farmers have traditionally used to set back weeds, and which the consultant recommended had ironically "facilitated for the couch-grass*"*. While Emil Korsmo perhaps faultily portrayed weeds as "enemies," he did accurately point out the reason for why farmers struggle with weeds.

> An important reason for why farmers have not yet gotten control of the weeds is apparently a lack of knowledge about its appearance and how it lives, how it is maintained and proliferates. (Korsmo 1896, 1 my translation)

Importantly, Frode didn't take the "jump" only because of his observations, but a combination of his own observations and the new knowledge he had engaged with. Resistance to new information based on how well cognitions correspond with reality (Festinger 1957). When Frode returned after years abroad, the reality of the "weed-field" confirmed the boundary-stretching knowledge he had engaged with (Festinger 1952), which made it easier to actually change a safe and established behavior. However, his fellow farmers and consultants had not seen the radical difference in weed growth before and after the years of deep plowing, and therefore did not understand why Frode was so sure of parking the plow right away.

Through engaging with science from the field of ecology, which has historically been quite separate from both agriculture and soil science (Lavelle 2000; Bouma 2015),

the farmers I interviewed are crossing cultural boundaries of knowledge. This has allowed them to see the agricultural "truths" about weeds (weeds are bad) and plowing (plowing is good) in a completely different way[58].

Instead of seeing plowed soil as the first step to a productive field, farmers saw a soil that had experienced what only happens naturally during natural disasters such as landslides, which is a setback in ecological succession[59] (Crews et al. 2016). Because they had learned that different soil microbes live at different depths and have different functions (Naylor, McClure, and Jansson 2022), they saw the microbes "houses" turned upside down. Because they had learned that mycorrhiza and bacteria are dependent on exudates from living plant roots (Olanrewaju et al. 2019), when they looked out at "black" soils, they saw microbial communities without food. Since they had learned that weeds were nature's first tool for repairing disturbed soil, they saw weeds as repairing. Farmers were learning a new kind of *land literacy*, a foreign language.

As farmers challenge the dominant agricultural paradigms, it makes sense that they are learning from science that is at its core subversive to the compartmentalization of nature. Many farmers I spoke to even preferred to call weeds "pioneer plants", a subversive linguistic move that refuses to perpetuate the purely negative connotations the word "weed" has come to embody. However, it is important to point out that weeds are still *unwanted.* The farmers I spoke with in no way romanticize weeds, and understanding that weeds have an important role in an ecological system does not make them easier to control. Like Arne, who has yet to stop plowing, said,

> I have a book that's called *Weeds, Guardians of the Soil*, right? A ton of ideas, so you have weeds that are supposed to tell you what's wrong with your soil – but to get this to work in practice… That's where the challenge is. What works and what doesn't, and these are also usually American books and those things, a different climate. (Arne)

[58] Agroecology is an exception, but it is still a niche field compared to agricultural science and practice compared to conventional agriculture (Wezel et al. 2009).
[59] Ecological succession is the process which the structure of a biological community evolves and becomes more complex over time (Encyclopædia Britannica 2009).

Putting science and theory into practice on Norwegian farms (with all their specific localities, soil conditions, climates, and soil conditions) is an experiment and in some ways, an act of faith.

Grain farming without plowing nor using herbicides has never been done before in Norway. Hybridizing new ways of farming involves taking risks, and transitioning to regenerative agriculture is a learning experience. Unfortunately, mistakes in agriculture often come in the form of weeds. The first year Bjørn tested out mulch-tilling instead of plowing, he ended up with a field covered in mayweed, a white weedy flower. The weather had been exceptionally wet and the cover crop had drowned, so Bjørn ended up mulch-tilling "some stubble and weeds," into a waterlogged and compacted soil[60] – which he later regretted.

> If I had known it was going to be so damn wet, I would have chosen a different strategy. I would have actually plowed if I had known what the weather would have been like. My winter wheat... It was completely white with mayweed. But then I thought, 'alright', I thought. 'Terrible to look at, but that mayweed is doing some work…' (Bjørn)

He considered killing the mayweed, but decided to let it "work," despite neighbors and farmers all throughout the area commenting on the weeds. Importantly, he allowed his weedy field to become a tool for boundary-work. Bjørn knew people were talking about his field, but he also trusted that in future seasons, farming based on regenerative principles would help him control weeds and grow high yields. So, he allowed the weeds to stay. The next year, that same field was visibly much less compacted and waterlogged compared to most neighbor fields. Farmers even across municipality borders were discussing this – because they had remembered the mayweed the year before. The boundary-work that was previously limited farmers' own minds became very tangible in form of unplowed fields, weeds and conversations[61].

[60] Waterlogged and compacted soils provide conditions that are difficult for crops to grow in, but certain weeds thrive.

[61] The topic of weeds is a sensitive one, and one by which farmers judge each other by (Burton et al. 2020). Furthermore, because weeds spread easily, keeping weeds out has been not just an individual practice, but a collective one. Farmers who are testing novel ways of reducing them are not just breaking with tradition and traditional science, but they can even represent a threat to other farmers who fear the spread of weeds to their own farm. Because weeds can have a large impact on yield and quality, farmer

Shifting perspectives, practices, and farming on the "outside" of cultural boundaries is a process of trust and doubt. The farmers in this study are trusting a field of science that is new to them, and are trusting nature that it is possible to repair and evolve soils past the pioneer stage – even as new and different weed problems come along. They are also trusting their own ability to "read" their land even when "everyone" disagrees with what they see. Farmers have deep knowledge of their own land that is often undervalued and underacknowledged compared to the knowledge derived from natural sciences (Šūmane et al. 2018). Frode had been observing his own land for years, and seen the plowing-weed dynamic. When he learned that plowing is disturbance, and weeds are nature's pioneer plants, he was able to read why "nature had answered like it did" (Frode). Nevertheless, both repairing soil, learning a new way of farming, and boundary-work takes time.

> My father is still there that you should fight down everything you don't like, but I've come to the conclusion that you should rather work together, and help develop[62] the conditions that makes grain thrive – if that's what you want to grow there. (Frode)

Importantly, now that they know the role of weeds, they can approach them differently. Instead of perpetually fighting them down, they try to do the weeds "work" for them, making their function in the agricultural ecosystem redundant.

8.4 Fostering diversity

Based on their understanding on soil microbes and ecological succession, farmers who begin with regenerative agriculture strive to work with natural processes on their farms. This means facilitating for diversity, and actually inviting *more* of nature into their farms, instead of keeping it out. By seeing their farm as part of the larger ecosystem,

livelihoods are potentially negatively affected by those who do not take weed control as "seriously" as themselves.

[62] The original quote is more beautiful, where instead of "develop" conditions, Frode said he wants to *fremelske* conditions that makes grain thrive. *Fremelske* does not have an English equivalent, but directly translates to "forward-love."

they are returning to the pre-19th century idea of nature needing to be in "balance" or in "equilibrium" (Frøyen 2022).

> We try to counteract the monocultures, by having the largest possible diversity, collaboration, synergies and symbioses. Different animal groups after each other, largest possible crop rotation, largest possible diversity. Then I think nature will refind its balance itself. I can see that the pH is rising over there, even though I haven't put any lime on. When we began with organic, this field was a bit acidic, now it's perfect. It balances itself because we always have different plants, different animals. (Thomas)

Allowing nature to "find its balance" like Thomas has done requires both trust and patience as it took several years for the pH to rise – a temporality that is not often allowed in conventional agriculture (Puig de la Bellacasa 2017). Other farmers I have spoken to have added mineral lime and "sped up" natural processes, but this lime is mined from mountains (Franzefoss Minerals 2023). This requires large amounts of fossil fuel. Other times though, incorporating animals is enough. For example, when Frode stopped plowing, moles (which are considered a pest) moved into his fields.

> But I got my animals back, so with a fencing system I distribute them over the whole farm. Before, I just had them on the fields around here. And now the moles are declining – so it was kind of the earth's answer to a lack of animals. Because they contribute with manure, or "microbe-bombs" as I call it, and they simply trample the mole tunnels. (Frode)

Many farmers I interviewed actively used their animals in order to increase diversity and support natural processes. However, as we saw in the introduction, regulations[63] actively discourage farmers in the South-Eastern Norway from keeping animals (Johnsen and Smedshaug 2016).

One step that all farmers can do to increase both diversity and photosynthesis, with or without animals, is to plant a diverse *cover crop*. These are herbs, grasses and

[63] After WWII, politicians saw a need to increase food production in the country. Grain could only be grown in the fertile soils and mild climate of the eastern and southern Norway, while animals could graze grass throughout most of the country. Therefore, they implemented subsidies to encourage grain production where possible, and meat and milk production in the rest of the country. This was called *kanaliseringspolitikken* or "canalisation politics" and shapes agricultural landscapes still today (Johnsen and Smedshaug 2016).

flowers that grow in between the rows of their productive crop, to take the place of weeds that would have inevitably come. These cover crops become a meadow beneath the grain that both support diverse microbial communities below ground as well as diverse pollinators above ground, and help crops form symbiotic relationships with mycorrhiza themselves (Kabir and Koide 2000). They reduce erosion, reduce the need for fertilizer, and are also an important tool for reducing runoff and keeping groundwater and waterways clean (Bøe et al. 2019). They do the similar "work" as weeds, but they do not compete with the crops and even support them. They also add a second production to the same piece of land.

> After we harvest the grain, we cut the cover crop and make haylage with it. Then it grows back towards autumn, and we let [the animals] graze it until the snow comes. (Thomas)

One farmer without his own animals even invited neighbors to graze his cover crop after the grain harvest, in a win-win-win situation for both farmers and the soil. Establishing a diverse cover crop is the first step that regenerative consultants I have spoken with recommend farmers who wish to move in a regenerative direction. As we saw above, agriculture has always invited weeds, and farmers have become increasingly adept at keeping them out. However, beneficial plants have not been allowed into these spaces either – which has negatively affected soil health.

> A lack of diversity, that's actually a soil disturbance. You're supposed to minimize soil disturbance. That applies to physical, chemical *and* a lack of diversity, that's disturbing the soil because its unnatural. So I think we have a long way to go there! (Arne)

While plowing has been described as soil disturbance, a lack of diversity has not – even in texts advocating for cover crops (Holmen 2020).

The benefit of cover crops in arable systems is by no means new knowledge and have been part of the "canon of best practice" in organic and conventional agriculture for years (Giller et al. 2021, 13). Reduced plowing, seeing weeds as "workers", and a microbial paradigm all require a shift in mindset, but cover crops are accepted and recommended by organic and conventional agricultural consultants. Cover crops have even been subsidized since 1991 through state grants (with the main goal of reducing pollution to waterways) (Holmen 2020). However, the first farmers to test out cover

crops in Norway had negative experiences – reduced yield, and cover crops being difficult to end prior to seeding in the spring. These initial experiences shaped a lasting negative attitude towards cover crops in the agricultural community at large. Therefore, despite the grants, only a fraction of farms in Norway use cover crops today (Bye et al. 2020; Holmen 2020).

Regenerative farmers have decided to try again – this time with an improved approach. Traditionally only a few species of plants have been used as cover crops, and rarely mixed together. Ryegrass, which has high root exudation, and clover, which fixes nitrogen, have been the most common ones used (Bøe et al. 2019; Holmen 2020). As we recall from chapter 5, diversity and balance were key terms in describing RA. Although a field of grain with one or two species of plants is more diverse than a pure monoculture, it is not a diverse ecosystem. When Bjørn called his local seed supplier, and friend (let us call him Håvard), to order 5 tons of cover crop seeds with 12 species of herbs, grasses and flowers, Håvard could not believe what he was hearing.

> He said, "You want *twelve*!?" and even got a bit frustrated at me. It would be too expensive and his machines couldn't mix that many seeds so it would have to be done manually. At first, he said it wasn't possible. (Bjørn)

Planting a cover crop with this level of diversity had never been done before, and the supplier thought it was a crazy idea. Perhaps he experienced some level of cognitive dissonance at the thought of going through the trouble to plant twelve species in a cover crop. It took a few days of discussing, during which Bjørn explained how the different plants supported each other and the diversity of processes in the soil. Håvard was skeptical, but eventually made the seed mix. Once the cover crop was established, Bjørn (in a move of expert boundary-work) invited Håvard to his farm to look at the cover crop together with a consultant from VitalAnalyse.

> So we were all sitting up late talking. And Håvard knows a *ton* about cover crops and mycorrhiza, but he had never thought in those paths either you know. So then, he began to understand. And then the next day we went out on the field – he found all the plants he had sold to me. We were digging over there. Oh! he was so excited! (Bjørn)

The supplier ended up developing a new cover crop together with VitalAnalyse that is now sold from Strand og Vestfoldmøllene under the product name *Grønn Bro*[64], which means "green bridge". For paradigms to change, gatekeepers need to change. Several farmers I have spoken to help gatekeepers reduce their cognitive dissonance by inviting them into the process of hybridizing new knowledge – allowing them to see how these new cognitions "correspond" with the reality of a living soil (Festinger 1952).

Agricultural producers and suppliers like Håvard are also important gatekeepers of paradigms because they mediate what is possible to do. Farmers are dependent on a complex global value chain of seeds, fertilizers, agrichemicals, and tools. Importantly, gatekeepers themselves are also "caught" in this infrastructure, which makes it difficult to think outside of the box. When Håvard was invited both to a meaningful conversation about the ecology of cover crops, and could see the effects of them himself, he was invited to look past the existing cultural boundaries of knowledge, and to help hybridize new agricultural practices. And farmers continue to experiment. Like Thomas said,

> So when the grain is at the three-leaf stage, I use the harrow to weed and simultaneously seed the cover crop – my own mix. It's *Grønn bro*, but I add some more herbs and flowers, so I have 19 species, which I feel balances the mix even more, because some plants in *Grønn bro* grew a bit too big.

I have been fascinated by these farmers' striving for continuous improvement – even when they have already gone so far beyond what is "normal" agriculture.

Using diverse cover crops that overwinter in this way is perhaps the closest that arable agriculture based on annuals can get to Robert Rodale's original vision of regenerative agriculture, which was based on perennial grains[65]. Using cover crops as described above means that ground is only bare a few weeks in spring, compared to ground that is bare for half of the year. Perennial grain was only mentioned by one of the farmers I interviewed, who said "what we do now is okay, it's a start, but I think you can get further."

[64] *Grønn bro* is made up of diploid and tetraploid perennial ryegrass, Italian ryegrass, meadow fescue, timothy, white- red- and blood clover, birdfoot deervetch, camelina, chicory, caraway, burnet and lacy phacelia. The Norwegian names for these are: *diploid og tetraploid flerårig raigras, italiensk raigras, engsvingel, timotei, hvit-, rød- og blodkløver, tiriltunge, oljedodre, sikori, karve, pimpernell(urt)* and *honningurt.*

[65] At least until The Land Institute (2023) scales up their Kernza wheatgrass grain variety.

8.5 Feed your microbes

We have touched upon fertilizing in chapters 6-7 relating to a change of mindset and reciprocity. Before this chapter on paradigm shifts and practices comes to a close, I want to examine one more agricultural "truth" that regenerative farmers unlearned and are challenging as a consequence of the microbial anomaly: Plants degrade soil.

> It's a common understanding that you degrade the soil by growing plants without fertilizing them. But you don't, not in any way. (Frode)

We are used to thinking that plants grow from soil. Regenerative agriculture shows us that the inverse is also true – *soil grows from plants*. Up to 40% of the matter a plant creates through photosynthesis is converted to root exudates and fed to soil microbes (Lynch and Whipps 1990). Farmers who begin with RA reevaluate their framing practices thereafter.

To be clear, the farmers I have spoken to do fertilize, but with much less fertilizer than is normal, and in a way that supports both plant *and* soil health. Previously, some farmers plowed manure into the soil in order to fertilize their grain fields, which they described as "traditional fertilizing." Now, they add compost to the top of the soil, and in smaller amounts than before. The compost both fertilizes their plants and acts as a probiotic for the soil by adding more beneficial bacteria.

> I had so much manure that I could be organic and fertilize almost as much as in conventional … But now, I'm going to let the microlife fertilize my fields, and I'm just going to feed my microlife. (Bjørn)

Bjørn decided to do this even though it was "*double* the work!" Frode, on the other hand, buys his compost ready-made. As we saw with plowing, stepping out of cultural boundaries of knowledge and tradition can be scary. Both plowing and fertilizing provides farmers with a guarantee.

Therefore, when farmers "think outside the box" (Frode) – outside the cultural boundaries of knowledge – and support their soil-plant system with compost and cover crops, they are warned by those still "inside".

> Right, so everyone who argues against this says, "You're going to lack this and this" but that is not the case. Because you, well you start the *soil motor* as I call it. And it's a disappearingly small part of the soils' chemical composition that goes into a plant. Most of it comes from the air. In a plant there's mostly water, nitrogen and CO2. It's not a lot that comes from the soil. You don't find a huge crater next to a tree, but rather a little hill up. Why is that? (Frode)

In an opinion piece in the agricultural newspaper Nationen, soil scientist and microbiologist Erik Joner ends with a comment about the regenerative movement in Norway's approach to fertilizing. The piece was not about fertilizing per sé, and is written towards farmers with grazing animals. However, the quote still shows the difference in approach.

> And do not lull yourself into a romantic notion that plants and microoganisms can get (or "activate") what they need of nutrients from soil minerals. If you harvest a yield, you need to return the same amount of nutrients that were removed. There are very few of the most important plant nutrients in Norwegian mineral soil, and soil can only provide plants with micronutrients over time. (Joner 2023 my translation)

Frode sees most of the nutrients as coming from the air[66], while Joner (2023) sees most of the nutrients as coming from the soil, which are removed with the harvest. Completely natural systems and agricultural systems cannot be compared because of the amount of yield that is removed from fields each year. However, the farmers I interviewed saw the possibility of farming with less fertilizer, when approaching the concept of agriculture from a different vantage point.

The farmers I have interviewed seem to look to nature when deciding whether science is useful or not. Albert Howard (1943) did this as well. Thereby they are engaging in the boundary-work of *expansion* (Gieryn 1999) and the epistemological credibility of agricultural science is challenged – but not all science. They Frode closely analyzed his soil and plant health using "objective" measurements as well:

[66] Nitrogen is the nutrient that most affects yield (Norsk Landbruksrådgivning 2022). It is especially nitrogen that the farmers I have interviewed apply less of, as they outsource much of this fertilization to nitrogen-fixing bacteria.

> My leaf sap analysis shows that even though I don't fertilize traditionally, the plant nutrition has become more and more correct each year, and they definitely don't lack any nitrogen. (Frode)

As Holten (2021, 66) points out about leaf sap analysis, "we see there is a large difference between the nutrients in the soil and actual plant uptake of the same nutrients (i.e. plant availability). Soil microbiology and soil structure most likely play a large part in the availability of plant nutrients."

Furthermore, the regenerative farmers I interviewed have added micronutrients that, according to their Albrecht Analysis soil tests, have showed to be deficient. Frode in effect hybridizes scientific measurements with his own observations and understandings of nature. When these two are in agreement, concordant, the result is knowledge that he can trust. If not, if a scientific "truth" (a cognition) is discordant with observations or knowledge ecological processes happening in nature (another cognition), it will likely result in cognitive dissonance.

Not all interviewed farmers fertilized in this way, though. The conventional farmers I interviewed and spoke to informally still used synthetic fertilizer, but less than before. Adding fertilizer as the plants needed them – the optimal method of sustainable fertilization according to conventional agricultural science (Kvalbein and Eldhuset 2017, 18), means that the plants do not exude as many root exudates, which are their "signals" to bacteria to feed them nutrients. Farmers saw fertilizing plants with everything they need as putting a "band-aid" on plants, and hindering them of forming symbiotic relationships with soil microbes. This sentiment came up in several conversations. Farmers wanted their plants to be healthy, strong, robust and ideally as independent of them for nutrition and protection as possible.

> It's a quite different mindset than that you should like, fertilize the plant with everything it needs all the time. That is more like having to give first-aid every day instead of having a functioning soil that give the plant everything it needs every day… Nitrate, it's actually disease-inducing in the plant and difficult for the plant to take up. It lowers their immune system. And nitrate can be eaten by aphids, because nitrate is usually water soluble. But if the plant is fed with ammonium and more complex amino acids [mediated by nitrogen-fixing

> bacteria], aphids can't digest it, so then plants aren't attacked by them either. (Frode)

Farmers like Frode are discovering the underlying reasons for weeds, moles and aphids. They are discovering the underlying reasons for plant health and plant disease, and that everything is connected to soil health and invisible microbes. They are learning to farm in a way that takes this into account, even though they don't have all the answers, and are learning as they go.

8.6 Summary

In this chapter, I have shown how farmers both unlearned key agricultural "truths" and relearned new ones based on ecology, soil microbiology and their own experiences. The farmers in my study have fundamentally shifted approaches to plowing, weeding, and keeping "tidy" fields. They have dared to make several large in a short time, since they see soil microbes, crops, weeds, animals, and themselves as part of the same larger system. The relational approach, combined with a new understanding of the various organisms' roles in the ecosystem, allowed farmers to reframe their own role in the farm ecosystem.

They realized that they had been spending time and money doing the "work" that soil microbes do in natural system – fertilizing plants, plowing organic matter into the soil. Instead, they began feeding the microbes. They also realized that they had in fact invited weeds into their farms by plowing and bringing their soil back to a "pioneer stage" each year. When they realized the "work" that weeds were doing, they decided to do that work themselves, in order to make weeds redundant. The shift in mindset involves a shift in how to organize the workload of a farm. This journey along new paradigms and practices necessarily involved trial and error.

9. Into the unknown

Regenerative farmers do not only build soil, they have begun to rebuild something that is just as important for a sustainable society – bridging social divides, which may be the most important and difficult part of boundary-work. As Albert Howard wrote, "the discovery of the things that matter is three-quarters of the battle" (Howard 1943, 221).

9.1 Pioneers

Who would challenge established paradigms and leave the safety of the plow, dare to trust the work of weeds, and feed microbes just as much as their plants?

I conceptualize the farmers I have spoken to as *pioneers*, "a person or group that originates or helps open up a new line of thought or activity or a new method or technical development" (Merriam-Webster 2023). Rather than breaking new ground – an idiom that is often used to describe a pioneer – these Norwegian regenerative farmers actually *make* new ground and enjoy the process. Although I am hesitant to use the metaphor of weeds when I am describing a farmer, like "pioneer-plants", these farmers are the first to repair soil and create an environment that is more welcoming for those who follow.

> Many probably think it's interesting, from a nice distance. Some think we're doing a lot of weird things. It's a good mix, really. But I think many find it very interesting to follow our process and sort of watch as someone leads the way. Because then its not so dangerous to go after. (Helena)

> And it's fun to join from the start. To jump into a well-trodden path, being the last man to join when everyone already knows that's how it should be? I get *so* excited… When you stand and peer out over there and have no idea what you're headed towards – Well, you've thought and planned such and such, but still, it's unplowed ground, and ahhh… *content sigh*. (Bjørn)

The new knowledge and new possibilities that regenerative agriculture brings is motivating, despite the risks that challenging paradigms and practices brings. As several farmers have said, farming has become more "fun," "interesting," "meaningful," and "exciting."

Other farmers see those taking risks as pioneers as well, and acknowledge that what they are doing is incredibly important for others to dare to follow.

> It's important that we have people who are... a little tough, right? They have character and that aura and they dare to stand for what they believe in, and that's great… So I hope that those who are tough enough to be 'guinea pigs', who have come further in life and have more capital… to follow them and see how it goes. Because, like, those who have started with RA in Norway have only done this 4-5 years maximum, right? So I think it's exciting to follow their process. (Lars)

The regenerative farmers I have interviewed are spearheading this new field, they are engaging with new science, developing agricultural knowledge and practices, and inviting others along. They are treading into unknown territory, experimenting, and drawing up a roadmap as they go.

9.2 Navigating new maps

Figuring out how to shift paradigms and practices in order to incorporate the microbial "anomalies" involves testing out new knowledge. In lieu of scientific research on regenerative agriculture in arable production[67], farmers have begun conducting these experiments themselves, which inevitably involves making mistakes from which to learn, as well as taking financial and social risks.

As we have seen throughout chapter 6, 7 and 8, science is culturally and historically situated within paradigms (Kuhn 1962; Gieryn 1999). Farmers who began farming with regenerative principles, discovered that what they had always assumed was "true" was in fact based on a reductionist scientific approach to studying plants. They navigate based on a different "map" than those within the dominant agricultural paradigm, who base their decisions on conventional agricultural science. As Gieryn points out, "the problem is not that there is no 'real science' behind the cartographic representations, but that there are too many 'real sciences'… boundary-work is constrained by the several 'real sciences,' but not determined by any or all of them" (Gieryn 1999, 19). Rather than tossing the map of conventional agricultural science, the

[67] Compared to research on RA in arable fields, research on RA based on holistic management grazing is a more robust body of knowledge (Rasse et al. 2019; W. Richard Teague 2017) (refs like Teague et al, etc).

farmers I have interviewed are adding other layers to that map, allowing them to see how plowing, fertilizing, weeds and pests are connected.

> I really think I can do better, control weeds better, drought, flooding- I think this is a tool for making things better and to lift production. And when you first produce a lot, adding ferment and everything, once spring comes along its actually more to do than before. But once you're rolling, there will be less to do simultaneously as you get a more stable production. But… well, the thing that affects negatively is that Forsøksringen[68] doesn't have any faith in this, they say… well they warn against doing what we are doing." (Bjørn)

Farmers see the possibilities that farming using regenerative principles can bring, despite the extra time and effort it requires of them. However, the biggest challenge is that they do not feel supported by the main agricultural consultancy in Norway, who operates based on a different map with directions from "normal science." They do not understand why these regenerative farmers, who are looking at a different map, go where they go. While Gieryn (1999) uses the metaphor of maps, Kuhn (1962) sees those in different paradigms on completely different planets.

> When paradigms change, the world itself changes with them. Led by a new paradigm, scientists adopt new instruments and look in new places. Even more important, during revolutions scientists see new and different things when looking with familiar instruments in places they have looked before. It is rather as if the professional community had been suddenly transported to another planet where familiar objects are seen in a different light and are joined by unfamiliar ones as well." (Kuhn 1962, 111).

Regenerative farmers are looking in the same places – their farm, but see it with new eyes. Engaging with regenerative agriculture truly seems to have transported farmers to another planet, where the familiar place of their farm has transformed: the soil is alive, plants "eat" microbes, weeds repair soil, and the land "answers" back. Gatekeepers, like the NLR consultants that of the farmers in this study criticize, remain on the "old planet."

[68] *Forsøksringen* is the old name for Norsk Landbruksrådgivning (NLR). A *forsøksring*, (which translates to test circle) is a group of farmers who together with a consultant from Norsk Landbruksrådgivning (NLR) test new methods on the farmers own fields (Almås 2023).

It is important to point out that the farmers I have spoken to do not challenge the epistemic authority of "orthodox science," like White and Andrew (2019) criticize Australian regenerative farmers of doing. My informants point to anomalies in the existing paradigm that sees soil as inert, and plants as recipients of minerals – not taking into account what plants give back to the soil. What they are calling for is for "orthodox science" to incorporate these anomalies, so that a new "normal science" can flourish which includes "the whole world into science" (Gieryn 1999, 335). However, because research on RA in Nordic conditions has barely begun[69], farmers have taken this task upon themselves.

One farmer I spoke to is a scientist and works as a researcher. Most farmers, however, are not. Nonetheless, they do develop and generate valuable knowledge by experimenting, testing, and measuring the effects on their farms. For example, Frode who kept plowing one field to see how the couch-grass responded there, found that in his fields, mulch-tilling worked better.

One farmer made his farm into a comparative field study of conventional and regenerative agriculture. One half was farmed conventionally, and the other regeneratively. He has measured soil compaction, microbial mass, and soil carbon. He found that since 2019, his regenerative field had increased its soil organic matter by 1.4 % per year, and his conventional half had lost the same amount. These scientific measurements were supplementary to his own observations of soil structure, and the fact that heavy rains did not create gullies and wash soil into the bordering creek anymore. In addition, this farmer and others are experimenting with self-brewed microbial seed coatings, to give their seedlings a microbial boost – which is proving to increase growth dramatically.

Importantly, the Norwegian farmers who have worked closely with regenerative consultants are co-producing knowledge together with them. The methods that these farmers are using is new to consultants as well, and it is new to test them in Norway. It is unknown territory. They acknowledge that their "cartographic maps" are not

[69] Some examples of budding research are: (i)VitalAnalyse's project with testing out new methods for grain farmes (Holten 2021), (ii) the collaboration between Regenerativt Norge and NRL on testing out the tool Ecological Outcome Verification for measuring regeneration (NRL 2023), and (iii) "orthodox" science from institutions like NIBIO who research how to increase soil-health and yields although without employing the concept of RA (Uhlen et al. 2017; Holmen 2020).

complete but have begun the work of redrawing them. Therefore, the consultants themselves are also learning, and adjusting their advice as they observe the effects on the field. This mirrors Anna Krzywozynska's (2019) research in England. She researched farming communities of "sustainable soil managers", a group who is increasingly adopting the concept of regenerative agriculture as well (Krzywzynska, 2023). She found that first, farmers seek information – very often in science. Then they experiment themselves based on this knowledge, and finally they contribute to science as they co-create knowledge together with their regenerative consultants (Krzywoszynska 2019b, 3).

The report *Nasjonalt program for jordhelse* (Landbruksdirektoratet 2020), which translates to The National Program for Soil Health, even writes that "the field of soil-health will be benefited by supporting farm based testing of new measures, farming practices and systems" (Landbruksdirektoratet 2020, 46 my translation). This is exactly what the farmers I have spoken to are doing – but they feel that they are doing it without the structural support.

> I experience the agricultural consultancies as very… traditional. They are scared to give advice when there are some risks, and that doesn't make for very much innovation. The way I see it, it's us farmers who dare to test out new methods. We are driving development, not *Forsøksringen*, who should be the ones to do it[70]. (Frode)

It does not come as a surprise that Forsøkringen or NLR do not give risky advice, when they are operating from a different scientific "map." What farmers like Frode are saying mirrors the experience of organic pioneers, who felt they needed to approach agricultural research from a different angle than conventional agricultural research. Eivind Østergaard (1998) found that,

> The development of organic agriculture in Norway the past decades have not come as a consequence that agricultural researchers have brought new ideas and new technical agricultural measures. Organic agriculture has largely emerged based on farmer's critique of the established agricultural practice, and from their will to develop another kind of development based on a more holistic view of

[70] NLR are working on a pilot project with Regenerativt Norge to see if and how Savory Institute's Ecological Outcome Verification (EOV) can be used in Norway (NRL 2023).

> nature and humans. This means that the basis for organic agriculture is not supported by the dominant agricultural science, but is a critique of many sides of this. (Østergaard 1998, 5)

This is confirmed by NIBIO researchers Solemdal and Serikstad (2015).

> Work at the laboratory level or in small grid-trials in the field has not shown to be enough to answer questions about what can improve the methods for organic agriculture. In practice, history shows that it is often the [organic] farmers themselves who have driven research- and development work, in lieu of relevant scientific work. (Solemdal and Serikstad 2015, 24)

Questions asked from a new paradigm can not always be answered by using the same tools of the previous paradigm (Kuhn 1962, 72). The conventional scientific method for agricultural research was not enough to answer questions regarding organic agriculture. Organic farmers spearheaded a new kind of agricultural science, that used real-life farm trials as a scientific method, which had not been acknowledged by conventional agricultural science (Solemdal and Serikstad 2015, 24).

It seems history is repeating itself as regenerative pioneers develop new ways of farming, and challenge paradigms once again. The farmers themselves dare to think outside the box, ask questions that cannot be answered by the conventional paradigm. Therefore, they develop new solutions and test new things that the dominant paradigm cannot recommend – despite the financial risks.

As mentioned in the section on cover crops, there are some subsidies like RMP that farmers who add cover crops can use. However, the farmers I have spoken to are not only adding cover crops, they are experimenting with a completely new way of approaching large-scale agriculture that regular subsidies at the moment are not designed to support. Helena mentions this as one of many interconnected barriers for beginning with regenerative agriculture.

> I think it's a combination of how the subsidies are organized, and of course the traditions and ways you've farmed for many years shape how you think things should be. So think it's a big threshold for some. And you have to… based on the financial incentives today, you have to invest quite a lot yourself. We invested millions to get where we wanted. (Helena)

Those who shape subsidies are also important gatekeepers, and are also shaped by the dominant paradigm and cultural boundaries. The fact that the Ministry of Agriculture even issued the *National Report on Soil Health* means that these cultural boundaries are beginning to change at structural levels as well. However, farmers are innovating and engaging with new science and practices faster than bureaucracy, despite being one of the worst paid professions in the country (NOU 2022:14). Other farmers who strive to farm based on regenerative principles, but do not feel they have the capital, recognize the financial risk farmers are taking on behalf of them all.

> It would have been nice if the state could mitigate the risk. Okay, if [he] takes up – it's not quite right if he has to take up a loan, and does society a service and tests this out, because you have to be allowed to make mistakes… (Julia)

Julia is referring to a farmer I interviewed who invested millions in the transition to regenerative agriculture, as he is doing a "large scale trial." Others only invested a fraction of this. Frode mainly shifted out machinery, changed his grazing practices and has already made a return on his investment. He also works less than before.

> I work a lot less actually, so I have more time for other things. You can't really say that as a farmer, but there's something called less is more. You should really evaluate if what you're doing on your field is necessary, and I've become much more aware of that. (Frode)

The farmers I interviewed have approached RA in various ways, depending on the contexts of their farms. Although regenerative farmers are not (yet) working with research institutions conducting "orthodox science", they are nonetheless developing a diverse and robust agricultural knowledge and practice, which society will benefit from if they succeed – all while building soil.

9.3 Beyond the dichotomy and stereotypes

Importantly, both organic and conventional farmers navigate by, and help co-create these new maps. Ever since the first organic pioneers began farming in Norway during the 1980's, organic and conventional farms have been polarized groups (Østergaard 1998), something the farmers I have spoken to confirm is still true today. However, the polarization seems to be lessening with the emergence of the new concept of RA.

Historically, organic farmers have had a more holistic approach to farming and have challenged assumptions and practices in conventional agriculture, both at its inception and as it has spread (Howard 1943; Østergaard 1998). However, as we have seen above, both organic and conventional agriculture have been shaped by the paradigm that sees soil as a growth medium and sees plant growth as mainly dependent on the amount of minerals added (in either organic or synthetic form) (Guthman 2004). Robert Rodale (1983) saw organic farmers as attempting to work with nature, but who were caught in the paradigm of dominating over nature – such as sweeping agricultural fields "clean" of nature, and a focus on feeding plants over seeing plants in relation to the ecosystem.

As farmers begin with RA, both organic and conventional farmers challenge these same paradigms, in a renewed attempt to "actually regenerate" (Helena), and grow food based on natural processes.

> I think it's really great. All kinds of production can benefit so much from farming regeneratively. The more who do it, the quicker we will find methods that work well. (Frode)

> They have the same goals as I do, they just have different tools. So think it's pretty alright that we can have a common goal without arguing and scolding each other… I really don't appreciate the conflict between conventional and organic, it's not fruitful. (Arne)

The fact that Frode and Arne see organic and conventional farmers as working together towards a common goal is quite extraordinary. The two groups seem to be accepting of each other, and even collaborate, share tools, help each other conduct experiments on their fields. By focusing on soil and ecosystem health, farmers can go beyond the discussion on fertilizers and pesticides altogether, and focus on the more "pertinent metric" of soil health (Montgomery et al. 2022, 2). This is also why Regenerativt Norge have formulated their definition of RA as based[71] on results, not methods.

[71] Regenerativt Norge define RA as "making possible the highest thinkable vitality in the ecosystems at the same time as human needs are efficiently satisfied" (Regenerativt Norge 2022 my translation)

> That is what we think is so ingenius, because it does not discriminate anyone. (Geir)

Perhaps the farmers' newfound land literacy has also given them a new common language to speak about ways to farm in ways that support soil life and ecological processes without ending up debating synthetic or organic input.

All farmers spoke regretfully about the polarization between organic and conventional agriculture, and were keen to make sure regenerative agriculture is not portrayed in the same way that organic did during its emergence.

> I think organic agriculture, when it began transitioning in 2000, did a strategic mistake the first five years. Not me, but many talked about organic food being better and healther, and that we were morally superior. Because then you get a war, and others felt inferior…*sigh* we have to end that shit. (Thomas)

It is important to point out that although there was skepticism towards organic agriculture when it came in the 80's (Østergaard 1998), the polarization between farmers was spurred on and made worse by the "gatekeepers" of food culture – those making commercials and campaigns. Bjørkdahl and Syse (2021) have analyzed the advertisements that were aimed to increase organic consumption, after the Norwegian government set a goal to increase organic consumption[72]. Because the Agricultural Agency was responsible for promoting both organic and conventional agriculture, they had to promote organic in a way that did not place conventional agriculture in a bad light. The solution became "welfare-washing[73]" (Bjørkdahl and Syse 2021, 3). They ended up advertising organic (animal) production as "overindulged," "pampered" and "spoiled," suggesting that organic production was "really taking things too far" (Bjørkdahl and Syse 2021, 7–9). Although the campaigns that Bjørkdahl and Syse (2021) analyzed focused on meat, these campaigns cemented in place the cultural boundaries that were emerging between conventional and organic farmers.

[72] In 1999 the government set a goal to increase organic agricultural production from 1.5% to 10% by 2010, and in 2009 they increased the goal to 15% (Det Kongelige Landbruksdepartementet 1999; Landbruks- og Matdepartementet 2009),

[73] Bjørkdahl and Syse (2021, 3) define welfare washing as "disinformation disseminated by an organization so as to present a public image in which the organization appears to take responsibility for animal welfare".

That being said, several organic farmers felt that it was still important to differentiate between regenerative organic, and regenerative conventional. Especially if a label would be implemented in the future, so consumers would be able to see if a food had been sprayed with pesticides or not.

Several farmers I spoke with also brought up the stereotype of the organic pioneers of the 80's, which was someone who "knit their own sweaters" and "smelled like garlic" (Lars). There was also a stereotype that organic farmers only lived on subsidies and did not contribute enough to food production (Pål). The farmers beginning with regenerative agriculture did not want this stereotype to be transferred to them. Therefore, they were clear that in order for others to begin with RA, it had to be communicated as research-based and as something that works – both financially and agronomically.

> That's why it's important that things are communicated with regard to research, larger perspectives, economy, that it can be good for keeping soil healthy in the long run – so it can have an effect, right? (Lars)

Farmers are aware of the importance of communicating the what, how and why's of regenerative agriculture as "scientific," because of the epistemic credibility that it gives RA[74]. Through their boundary-work of expansion (Gieryn 1999), they are working to get both fellow farmers and those in places of power at political and agricultural institutions to acknowledge the microbial and ecological science they have discovered as credible and applicable to agriculture[75]. Donella Meadows (1999), drawing on Kuhn (1962) described how paradigms are changed:

> In a nutshell, you keep pointing at the anomalies and failures in the old paradigm, you keep speaking louder and with assurance from the new one, you insert people with the new paradigm in places of public visibility and power. You don't waste time with reactionaries; rather you work with active change agents and with the vast middle ground of people who are open-minded." (Meadows 1999, 18)

[74] Interestingly, Yara is also describing regenerative agriculture as "science-based" (Yara 2023,3). Syngenta points out that "as a science-based company, Syngenta Group drives innovation that enables farmers to adopt regenerative practices across the world" (Syngenta Group 2023).
[75] Farmers who are balancing their soil based on the Albrecht soil analysis, with impressive results, are also working to get gatekeepers to be curious about its possibilities, instead of dismissive.

RA is still so new, so I would be wary to describe most organic and conventional farmers as the "vast middle ground of people who are open minded," but many are curious, and all are welcome to learn about RA and test it out. Many farmers are vocal and public about their new regenerative approach, vocal about anomalies, and invite colleagues and even paradigm-gatekeepers along on their journey (like one of the farmers I interviewed who catalyzed a systemic shift in which mixes of cover-crops were available on the market). However, many feel that RA is still so new in Norway, and are therefore a bit careful to be too bombastic. Instead, they let their actions speak for themselves since they know that the hybridization of new practices is a learning experience and that they will be watched by curious neighbors regardless.

They also know that just like themselves, farmers who want to begin with RA need to change their mindset as well, which – as they have experienced through the organic/conventional polarization – is not necessarily done by talking.

> I think many are sitting on the edge of the fence and watching. Of course, if you can show that soil fertility is increasing, you get less problems with weeds, *and* you have a better economy… that says more than going around talking. If you convince others by talking, then they need to be pretty interested to begin with. Because it's your head that changes what you do. If you don't want to change you continue on the same path you're on, because that's the safest. (Frode)

Farmers trust that their own farms will eventually a spark curiosity (perhaps by inducing a little cognitive dissonance?) in their neighbors when they do things that should not be possible according to traditional agricultural science. For example, the farmers I interviewed have been able to set weeds back without chemicals or plowing, transform an unproductive heavy clay field into soft soil in just a few years, and grow more grass than ever before without synthetic fertilizer. These practices and results trigger conversations.

Despite critique from established epistemic authorities and gatekeepers, the farmers trust that their new regenerative approaches will prove to be successful in the end, which will make both organic and conventional farmers interested. Furthermore, because the regenerative farmers I have spoken with support each other despite approaching RA in diverse ways, the curious farmers who are watching can see several examples of what is possible to do. Diversity and balance – some of the key words

farmers use to describe regenerative agriculture are also representative of the group of farmers who begin with RA themselves. Finally, they are, like Meadows (1999, 18) puts it, "active change agents" regardless of how vocal they are or not because of the visible nature of the farming profession.

9.4 A paradigm shift, but at what scale?

The farmers I have interviewed have navigated the undefined field of regenerative agriculture though internal boundary-work (shift in mindset and engaging with new sciences) and external boundary-work (shift in practices and negotiations with others about these). The question remains as to what effect the farmers' boundary-work can have at larger, structural scales – such as agricultural research institutions, consultancies and schools, and agrichemical companies. I do not aim to hypothesize about an unforeseeable future, but wish to place the farmers' personal paradigm shifts and the influence they have into a larger context.

The timing is right for a paradigm change in agriculture. Kuhn (1962) points out that scientific revolutions and paradigm shifts are

> inaugurated by a growing sense […] that an existing paradigm has ceased to function adequately in the exploration of an aspect of nature to which that paradigm itself had previously led the way. In both political and scientific development, *the sense of malfunction* that can lead to crisis is prerequisite to revolution. (Kuhn 1962, 92 my italics)

There is unarguably a sense of malfunction in agriculture today. Scientists, policy makers and even agrichemical companies are admitting that the environmental degradation that industrial agriculture has caused is too severe to ignore. Crises are catalyzers for change (Blythe et al. 2018; Moore et al. 2014), and if leveraged, they can be "windows of opportunity" (Pereira et al. 2019, 6).

The organic movement emerged at the start of the 20th century as a reaction towards "chemical farming" (Northbourne 1940). In its day, synthetic fertilizers were seen as innovative and gave impressive yields, averting a Malthusian crisis. Even Albert Howard acknowledged that "artificial manures involve less labour and less trouble than

farm-yard manure" (Howard 1943, 18). This was a difficult time to criticize the innovation of conventional agriculture.

Now, almost a century later, the "slow violence" (Nixon 2011) of this industrial, uniform and reductionist agriculture is catching up to us. Waterways and groundwater is polluted. Beneficial insects die at unprecedented rates, while pests are becoming resilient to our poison. The soil which we depend on is washed out into streams or blown by the wind into the ocean. Carbon, which used to be in the soil as a source of health, is oxidized into CO2 and warms our planet. Not to mention the "get large or get out" mentality that followed industrial agriculture, which has led to the dwindling and dying of rural communities. With this as a backdrop, the regenerative farmers who I have interviewed have a better "window of opportunity" (Pereira et al. 2019, 6) for changing set paradigms than the pioneers of organic agriculture did.

However, there is an even greater overarching paradigm, which I have not been able to include in my analysis, but is perhaps even more fundamental to the future sustainability of agriculture. This is the global food system and the growth-paradigm that fuels it – led by a hegemony of a few powerful agricultural actors.

> The way food systems are currently structured allows value to accrue to a limited number of actors, reinforcing their economic and political power, and thus their ability to influence the governance of food systems. (IPES-Food 2016, 3)

Although it has not been the scope of this thesis, nor a core focus in my interviews, I wish to briefly discuss the issue of global food systems. Several farmers have mentioned the relief of not having to spend so much money buying chemical fertilizer from Yara, and voiced fears of agribusinesses greenwashing regenerative agriculture.

At the moment, multinational food corporations and agrichemical companies are doing their best to jump on the regenerative wave that is washing over agriculture, and to define it in order to allow it to serve their interests, which ultimately, is capital (see PepsiCo's "Cautionary statement" in their goal to farm regeneratively on 7 million acres by 2030 (PepsiCo 2021)).

The world's largest agrichemical and food corporations have adopted, or perhaps, appropriated, the concept of regenerative agriculture, and are working hard to

define RA in a way that allows them to continue to do business as usual. For example, as we saw in chapter 2, they are connecting RA to carbon credits, digital agriculture, precision agriculture, and biological fertilizers and pesticides (Syngenta Group 2023; Yara 2023b). They are also turning the microbes' work into labor which they can profit on. As Anna Krzywoszynska put it, "today's enrollment of soil biota as labor thus opens up the whole biosphere to the logic of improvement, and to the operations of capital" (2020, 227). I am not critical to farmers' enrolment of microbes as soil "workers," but that microbial commons are being patented and bottled so that agribusiness can continue to control agricultural food systems at large (Kothamasi, Spurlock, and Kiers 2011; Oviatt 2020). This is the "apolitical" side of regenerative agriculture which has been critiqued (Tittonell et al. 2022). If these corporations are able to define what RA means at the scale of food-system, they may manage to incorporate the "anomalies" of the dominant agriculture into their own paradigm of corporate control over food systems. If so, it may be an example of how, sometimes, "normal science ultimately proves to handle the crisis-provoking problem despite the despair of those who have seen it as the end of an existing paradigm" (Kuhn 1962, 84).

The farmers I have interviewed can be seen to be in a limbo – caught in the global food system while they also challenge certain aspects of it. Farmers are dependent on machinery, diesel, and amending a soil with minerals. They are dependent on the local food system in Norway to sell their crops. However, farmer independence was a key motivation for beginning with regenerative agriculture, and through RA they are gaining more freedom.

> Another reason why you farm regeneratively is kind of, for farmers to get back power… By cutting dependence on bought input and by selling meat yourself, you have the power in your own hand. (Frode)

Autonomy, the ability to manage one's own work and time is highly valued among farmers in Norway (Bjørkhaug 2006, 126) but this freedom is dependent on farmers' financial situation. Heiberg and Syse (2020) found that Canadian beef farmers who adopted a grazing- and farm management tools similar to that of Holistic Management, were able to reduce farm input, improve the farms resources and thus increase their independence. Importantly, they gained both financial autonomy and "knowledge autonomy" (2020, 482) as they developed and co-produced local knowledge instead of

"one-size-fits-all" solutions (2020, 482). The farmers I interviewed have begun to make their own compost, microbial brews, save their own seeds and graze in ways that reduce their reliance on external input – challenging the power of agribusiness. Some are selling their food directly to customers through channels like REKO[76] – challenging the "local" hegemony of the three largest supermarkets in Norway[77]. Coming back to what the farmer said in chapter 6, perhaps the greatest independence is "freedom of mind", being able to think outside the box, outside of the paradigms, worldviews and tools that have gotten us into the complex, interconnected, and encompassing problems that global agriculture is entrenched in. After Frode was able to reduce his couch-grass without weeding, some of his neighbors commented,

> "Yeah yeah, if roundup gets banned maybe these are the methods everyone has to use." (Frode)

This quote shows how regulations directly influence farmer choices, and also shape the cultural boundaries of knowledge and possibility. The EU regulates the use of herbicides, such as roundup (glyphosate). Several farmers have mentioned the potential upcoming ban of roundup[78]. Even if Norway is not part of the EU, they are sure that Norway will follow suit. Regulations directly influence farmer choices and also shape the cultural boundaries of knowledge and possibility. The quote also shows how farmers can spark conversations and sow seeds for future transitions.

This is why it is so important that farmers like the ones I have interviewed gain structural support from public institutions that can fund independent thinking and research, in contrast to corporate funded research. The farmers I interviewed are taking large financial risks that could be mitigated by increased subsidies or grants, and are expressing a strong wish to contribute to further research and develop the hybrid science that regenerative agriculture is becoming[79]. At the moment, Norway only produces 47% of the food its citizens eat (NOU 2022:14), and most of this is dependent on input from synthetic fertilizers and minerals. If increasing the level of self-sufficiency, preserving

[76] REKO is a network that uses an online platform to facilitate local and direct trade between consumers and producers (Engeseth 2020).
[77] REMA1000, NorgesGruppen and Coop
[78] EU regulates the use of herbicides, such as roundup (glyphosate), and the authorization for roundup was to expire in December 2022.
[79] As we have seen, farmers are merging "normal" agricultural science with microbiology, chemistry, ecology, as well as their own observations and experiences.

the country's 3% of arable soil, and increasing soil health are political goals (Landbruks- og Matdepartementet 2022, Regjeringen 2023, Landbruksdirektoratet 2020), then policy should support the farmers who are on the frontlines of navigating the unknown territory of regenerative agriculture. They are the ones who are experimenting, developing and setting a precedent for how to wean farming off agrichemical inputs, rebuild soil, and grow more food based on the resources at hand.

9.5 Summary

Changing paradigms entails social and political boundary-work. The farmers I have interviewed, pioneers, are drawing up new maps as they navigate a new terrain where they combine new sciences and new practices – hybridizing a new mode of farming despite a lack of structural support. As they bridge gaps between eclipsed and suppressed sciences and agricultural tradition, they also bridge the social and cultural divide that has historically existed between organic and conventional farmers. They are contributing to a more inclusive agricultural arena, making reality out of their understanding of RA as encompassing a social dimension as well as an ecological one. These farmers are also in small (but potentially big) ways challenging the power of global agribusinesses, as they develop a way of growing food that builds farmer independence.

10. Conclusion

The aim of this thesis has been to understand why farmers began with regenerative agriculture, and how they navigate in this undefined field. Through employing the concepts of *paradigm shifts* (Kuhn 1962), *cultural boundaries of knowledge* (Gieryn 1999), *reciprocity* (Mauss 1990; Sahlins 1972) and *cognitive dissonance* (Festinger 1952), I have explained the boundary-breaking and risk-taking journey these farmers have embarked upon. The research questions leading our own journey have been:

- *How do Norwegian farmers navigate and negotiate new knowledge and practices in the undefined field of regenerative agriculture?*
    - *Why do Norwegian farmers begin with regenerative agriculture?*
    - *How do they challenge agricultural paradigms?*
    - *How do they negotiate agricultural traditions, sciences, practices and social divides?*

The farmers I interviewed found regenerative agriculture (RA) in their search for ecological and financial improvement. They define the concept in slightly different ways, but agree that RA implies farming in a way that improves soil health and has positive effects on the diversity and balance in both ecosystems and communities.

Farmers' discovery of the concept of RA led them to a world of previously unknown ecological and biochemical processes. They learned that their soil was not just a medium but an ecosystem for microbes, which induced a fundamental shift in mindset. The nature of what they based their livelihood was suddenly transformed. It went from being something that they understood, to a universe of unknown beings and processes. They realized that only certain sciences had been included in the agricultural canon they had been taught. Other sciences had been dismissed as irrelevant, or perhaps even suppressed.

The discovery of the "microbial anomaly" catalyzed a personal paradigm shift in farmers, and transported them to the edges of the cultural boundaries of knowledge in which they had been immersed. Some farmers experienced cognitive dissonance, the psychological discomfort of new knowledge that does not match with established truths and practices. The "old" agricultural map did not match with what they were seeing. However, the fascination with this new universe, and the fact that it "made sense" led

them to accept this new knowledge and want to learn more. As they began engaging with sciences and practices that were outside "normal Norwegian society" as one farmer put it, they found that they were free to explore not just new ways of doing agriculture but could organize their lives differently as well.

When farmers began to see their soil as alive, their relationship to their farm changed as well. As soil shifted from medium to microbes, it also shifted from substrate to subject. Farmers developed a relational approach, not just to their own soil but with their animals, land and nature at large. All farmers can be seen to have a *reciprocal* relationship with the soil. When soil is substrate, the reciprocal relationship is *negative* or at best *transactional*. When soil is subject, the relationships moves towards a *balanced reciprocity*, which is actually the kind of reciprocity reserved for kin. Although this might be stretching it too far, the farmers I interviewed did come to see their soil microbes as friends and farmworkers. The farmers' job was to support these tiny farmhands, so they in turn could support their plants. Simultaneously as farmers developed a closer reciprocity with the land, they also began to engage in closer proximity to their land. Instead of mainly trusting experts to tell them about their soil based on soil tests, this proximity meant that they dug in the soil themselves, examined root microbiomes, and counted worms. They also looked closer above ground, and began learning to "read" what weeds, pests and animals told them about the health of their land. They began developing a *land literacy*, a hybridizing of scientific knowledge with their own experiences and observations.

As they developed a land literacy, the farmers I interviewed also began combining their new knowledge and observations into practice – in effect hybridizing a new agronomy that took into account the "microbial anomaly". This anomaly was connected to *all* their agricultural practices. Furthermore, they also learned how interconnected their practices were from an ecological perspective – the subversive science – and came to see several agricultural paradigms and practices in a new light. They decided to experiment with their new knowledge and engaged in a (public) process of learning new ways of farming, and unlearning old ways (regarding plowing, weeding, fertilizing, grazing and uniformity). This was a process of *boundary-work*, as they combined sciences previously eclipsed by the agricultural field, their own observations about their land and advice from regenerative consultants into new practices – inevitably inviting reactions. The farmers I spoke to can be seen as pioneers who test out new ways of

farming that break with established paradigms. They are cartographers, exploring undefined territory, mapping out their discoveries and mistakes so it will be easier for others to follow.

By challenging these paradigms, the farmers farmed in a way without anchoring their practice in research, especially those who grow arable row crops. Rather than trying to convince those still inside the dominant paradigm to do research, the farmers decided to begin testing out and experimenting themselves. As they experimented, they actively co-created knowledge together with consultants, hybridizing a new multifaceted agronomy despite the financial and social risks it involved. Because they worked on the edges of, and stretched cultural boundaries of knowledge, they were met with both scepticism and curiosity from both gatekeepers and neighbors who still read soil and plant nutrition based on the old boundaries of knowledge, the "old map". Some famers were vocal and engaged with paradigm-gatekeepers, inviting them along on their journey and catalyzing systematic changes. Other farmers were more careful, and instead let their very visible farming practices to spark curiosity and conversation.

Cultural boundaries of knowledge often coincide with social boundaries. Historically, organic and conventional farmer have valued different kinds of knowledge, and have navigated based on very different "maps". The agricultural cartography the farmers I have interviewed have engaged in has resulted in a map that can be used by both organic and conventional farmers alike. Instead of navigating based on organic or synthetic fertilizers/pesticides, they are navigating based on the metrics of soil and plant health – which results in maximizing symbiotic microbes, maximizing diversity (plant and animal) and maximizing photosynthesis. The scientific and cultural boundary-work of regenerative farmers is building bridges both between previously siloed scientific disciplines, as well as between historically polarized groups.

In this thesis, I have shown how farmers who are engaging with regenerative agriculture are developing agriculture in a more sustainable direction by daring to step outside established paradigms and cultural boundaries of knowledge. This is the first published research on RA in Norway, and more is needed – both from natural and social sciences. I hope my findings can contribute to a greater understanding of regenerative agriculture within academic and policy circles that want to support farmers in their quest for increased soil health.

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Appendix I: Information and consent form

Vil du delta i forskningsprosjektet

"Regenerativt landbruk i Norge"?

Hei! Jeg ønsker å undersøke hvorfor bønder begynner med regenerativt landbruk, og hvordan de opplever denne prosessen.

Forhåpentligvis kan denne forskningen være nyttig for andre som ønsker å gjøre det samme, samt for politikere og fagforeninger som ønsker å påvirke landbruket i en mer bærekraftig retning.

Hva innebærer dette for deg?

Hvis du velger å delta i dette forskingsprosjektet innebærer det at du deler dine tanker og erfaringer om det å legge om til regenerativt landbruk.

Hvis det er greit for deg spiller jeg inn samtalen. Hvis du ikke å bli spilt inn trenger du ikke å gi en forklaring til hvorfor. Samtalen kan bli transkribert, og senere analysert. Jeg tar også notater underveis.

Det jeg samler inn vil kun bli brukt til å skrive masteroppgaven og vil bli slettet når masteroppgaven er levert og bestått.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Du kan trekke samtykket dit når som helt uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Ingen andre vil ha tilgang til data samlet inn fra vår samtale. Dataen vil bli lagret på UiO sin server, og den vil være anonymisert.

Jeg vil også ta skriftlige notater underveis. Disse lagres i min notatbok hjemme.

Hvis informasjon fra samtalen brukes i masteroppgaven vil all gjenkjennelig persondata bli anonymisert.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Opplysningene dine, opptak og notater fra samtalen slettes når masteroppgaven er godkjent, noe som etter planen er desember 2022.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å klage på behandlingen av dine personopplysninger.

Klager kan rettes til personvernombudet i Universitetet i Oslo.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

Masterstudent: Elin Wyller

elineng@uio.no

40576512

Veileder: Karen Lykke Syse

k.v.l.syse@sum.uio.no

Personvernombudet: personvernombudet@uio.no

University of Oslo

Med vennlig hilsen,

Elin Wyller

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet ”Omstilling til regenerativt landbruk i Norge”, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- at samtalen blir spilt inn
- at Elin tar skriftlige notater fra samtalen
- at mine opplysninger behandles frem til prosjektet er avsluttet

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Signatur Sted, dato

Appendix II: Interview guide

Intervju guide – Omstilling til regenerativt landbruk

BAKGRUNN

1. Kan du fortelle litt om gården vi er på nå?
2. Hvor lenge har den vært i familien?
3. Hvis den har vært i familien i flere generasjoner, hvordan har den blitt drevet før? Når begynte man å bruke pesticider og hvorfor?
4. Når hørte du om regenerativt landbruk for første gang?
5. Hva tenkte du da?
6. Var det store forskjeller fra hvordan du drev gården ved det tidspunktet?
7. Hvor lang tid tok det fra det at du hørte om RL til at du bestemte deg for å legge om driften selv?
8. Hva skjedde i den perioden?

OMSTILLINGEN

9. Hvorfor ønsket du å legge om gården din til regenerativt?
10. Var det et vanskelig eller enkelt valg å ta?
11. Hvilke var med på å ta valget?
12. Var det noen som hjalp deg med å legge om, eller søkte du om hjelp?
13. Hvordan så omstillingen ut i praksis?
14. Hva var det enkleste å forandre på, rent praktisk?
15. Hva var vanskeligst å endre på, rent praktisk?
16. Søkte du om økonomisk støtte for å legge om?
17. Det er mye som er annerledes i regenerativt landbruk, hvordan prioriterte du forandringene?
18. Er du fornøyd med å ha begynt med regenerativt landbruk?
19. Har du sett noen forskjeller i avlinger, jordhelse, eller noe annet på gården siden du stilte om til regenerativt landbruk?

20. Er det noe du ville ha gjort annerledes?
21. Hva var det vanskeligste i prosessen? (mentalt, økonomisk, sosialt)
22. Hva var det letteste i prosessen?
23. Hva ble du mest overrasket over?
24. Hva var mest gøy?
25. Siden gården er forandret, har du også forandret deg på noen måte?
26. Hva tenker familien din om forandringen som har skjedd på gården?
27. Hvilke reaksjoner har du fått fra kollegaer/ bønder/ rådgivere/ kunder/ andre? Hva tenker de om regenerativt landbruk?
28. Hvis du skal fortelle en kollega om regenerativt landbruk, hvor starter du da?
29. Har du begynt å kalle driften din for regenerativ utad, eller er det noe igjen å legge om før du kan gjøre det?
30. Hva føler du er den største forskjellen mellom ”vanlig” gårdsdrift og regenerativ?
31. Hva tror du skal til for at flere bønder skal legge om til regenerativt landbruk?
32. Er det noe jeg har glemt å spørre deg, eller noe annet du har lyst til å fortelle?
33. Kan du vise meg et sted på gården som betyr mye for deg?

Appendix III: VitalAnalyse's five main methods

VitalAnalyse has adopted and works with Näser's (2021) five-step method to a fertile soil – one that grain farmers who wish to farm based on regenerative principles can use. The method was developed by Deitmar Näser and Friedrich Wenz in Germany, but VitalAnalyse has since modified and developed the method to suit Norwegian conditions. This method simultaneously reduces plowing, does not use pesticides for weed control *and* supports soil microbes. Preliminary findings show that using these methods in arable production results in a soil that is more fertile, has better structure, has better water infiltration and reduces weeds. The following is a translated excerpt from Vibhoda Holten's report, "Regenerative agriculture – experiences from four reference farms in Østlandet 2018-2020" (Holten 2021, 9).

The goal with increasing soil fertility is to build more humus, improve the conditions for soil biology, increase photosynthesis and thereby increase yields and quality. The necessary measures can be done stepwise. The priority of each step varies from farm to farm, and field to field.

- **Balanced mineral nutrition**
  (Albrecht Analysis / Base Cation Saturation Ratio)
  Effect: the correct base cation balance (Mg/Ca ratio) improves soil structure that give better living conditions for soil microbiology and improves plants' nutrient uptake.
- **Continuous green plant cover**
  (covercrops, green manuring, companion cropping, catch-crops, soil-cover-crops, etc.)
  Effect: Soil biology (bacteria and fungi) is fed through the plants' root exudates the whole year with a balanced "diet." Humus is built, especially through mycorrhiza, and the bacteria ensure nutrients are available to plants. A diversity of plants are emphasized (cruciferous, legumes, grass, etc.)
- **Shallow mulch-tilling / subsoiling**
  (A shallow incorporation of chopped up green plant matter sprayed with ferment). A newly developed method to shift from one crop to the next with minimal soil tillage.

Effect: It builds humus efficiently out of green matter (cover crop, green manure and catch crops) while soil life is minimally disturbed, and a seedbed for the next crop is created.

- **Steering microbial processes**
  (Adding ferments, mainly lactic acid bacteria, to steer the processes of decomposition and rebuilding in the soil.)
  Effect: The soil's metabolism is steered towards the reductive pole, which prevents putrefaction. Instead, we enable and speed up the processes of composting.
- **Plant vitalization / foliar sprays**
  (Plant sap analysis to measure Brix, pH and electric conductivity, use of compost tea, hay-tea, silica spray and foliar sprays.)
  Effect: Ensure maximal photosynthesis, especially when the plant is subjected to abiotic stress such as drought, cold, wind, and damp weather. It ensures that soil life receives root exudates even under stressful conditions.

Appendix IV: Ecological Outcome Verification

Regenerativt Norge are working to develop and implement Ecological Outcome Verification (EOV) as a way to measure regeneration.

What is EOV?

"Ecological Outcome Verification (EOV) is an empirically based data collection protocol for grassland environments. This includes: natural and seeded grasslands, grazed orchards, silvopastoral systems, mixed livestock/soil based cropping systems, and mixed livestock/forest areas. At this time, pure cropping systems are not included except for pilot projects. EOV tracks regenerative outcomes in biodiversity, soil health, and ecosystem function such as the water cycle, mineral cycle, and energy flow." (Savory Institute n.d.)

How does EOV work?

"EOV is composed of short term monitoring (occurring annually) as well as long term monitoring (occurring every five years). *Short term monitoring* (STM) collects qualitative data that provide leading indicators for land management decisions. *Long term monitoring* (LTM) collects quantitative data and provides lagging indicators for soil health, carbon, water, and biodiversity." (Savory Institute n.d.)

What does EOV measure?

An EOV measures the 15 ecological indicators in the table below (Regenerativt Norge 2021; Xu et al. (2019).

Indicator	**Description**	**Ecosystem cycle affected**
Live Canopy Abundance	Total green biomass production/Site potential	Energy flow
Living Organisms	Evidence of microfauna	Mineral Cycle
FG 1 – Warm Season Grasses	Vigor, reproduction, crown integrity	Community Dynamics
FG 2—Cool Season Grasses	Vigor, reproduction, crown integrity	Community Dynamics
Forbs/Legumes	Vigor, reproduction, crown integrity	Community Dynamics
Desirable Trees/shrubs	Vigor, reproduction, crown integrity	Community Dynamics
Contextually Desirable Rare Species	Frequency	Community Dynamics

Contextually Undesirable Species	Abundance	Community Dynamics
Litter Abundance	% Cover	Water Cycle Mineral Cycle
Litter Incorporation	Litter type, Soil contact	Mineral Cycle
Dung Decomposition	Dung Disappearance rate	Mineral Cycle
Bare Soil	% Bare soil	Water Cycle Mineral Cycle Energy Flow Community Dynamics
Capping	Soil surface resistance	Water Cycle
Wind Erosion	Blowout/Deposition Active pedestals	Water Cycle
Water Erosion	Rills/water flows Gullies	Water Cycle