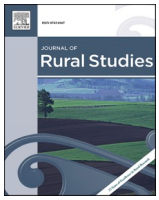
Journal of Rural Studies 108 (2024) 103298

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud



Soil extractivism: Political ontology of soil erasure in the European Union's agricultural politics

Saana Hokkanen

Global Development Studies, University of Helsinki, Helsinki, Finland

ARTICLE INFO

Keywords:
Soil
Extractivism
Agriculture
Political ontology
Biodiversity loss
European Union
Common agricultural policy
CAP

ABSTRACT

This article examines how specific (non-relational) political ontological understandings of soils are incorporated into industrial agricultural politics in the European Union and introduces a complementary contribution to existing literature with the concept of *soil extractivism.* The concept is used to describe current institutionalized ways of relating to soils and their dynamics of power. Through an integrative literature review, the article links existing research on soils with the development of modern agriculture in Europe. The theoretical contribution of soil extractivism provides a conceptual tool for understanding currently dominant ways of treating soils as a key part of modernity and industrial capitalism as well as part of wider destructions of multispecies relations.

1. Introduction

The current moment is characterized by multiple crises which present cascading threats to the survival and livability of humans and other-than-human life. Climate emergency and global biodiversity loss are the most obvious manifestations of these. In addition (or in entanglement), different landscapes, bodies, and waterways are depleted and permeated with toxic matter, while the radical simplification of ecosystems and the fragmentation of relations signify an overall degradation of diverse multispecies existence (Haraway 2015). One less-studied example of this fragmentation and depletion of life is the global eradication of soils as complex living entities (Pardo et al., 2020; Engel-Di Mauro 2014). While the future of agriculture and societal life are dependent on the health of soils and soil biota (and increasingly recognized as such by scientists, policy-makers, and farmers; see, e.g., FAO and ITPS 2015; Montgomery 2007; Krzywoszynska 2019; (Gebremehdin et al., 2022) and, as early as the 1800s, e.g., Marx 1976), the multispecies nature of soils and the wider implications of systemic soil abuse have only recently begun to attract increasing interest in social and multidisciplinary science (Krzywoszynska 2019; Engel-Di Mauro 2014). This article aims to fill part of that gap by examining how specific ontological notions of soils are institutionalized in modern industrial agricultural practices and drive what I term *soil extractivism*. The urgency to gain better understanding of the systemic drivers behind the loss of soils is concretized in a report by the Intergovernmental Panel for Climate Change (2019), according to which, arable soils throughout the world are being lost about 100 times faster than they are being formed in ploughed areas and 10–20 times faster even in non-ploughed areas. In addition, the systemic over-fertilization of croplands has led to wide-scale problems in soil health, loss of biodiversity, and the pollution of waterways (IPCC 2019). In 2014, the Food and Agriculture Organization of the United Nations (FAO) issued a stern warning that, with the current rate of soil loss, agricultural production might face catastrophic collapses in the coming decades.

Although my research is fundamentally somewhat "undisciplined", my thinking in this article arises from the fields of political ontology, political ecology, critical agrarian studies, environmental justice, and multispecies anthropology, as well as world-ecological examinations of past erasures of nature in the face of industrial development (Moore 2010). The article links these conversations with the development of modern industrial agriculture in Europe and how it relates to the use and abuse of soils. Within this framework, I offer an examination of the historically institutionalized understandings of soils that are incorporated in the model of agriculture driven by the European Union's agricultural politics (currently dominated by the EU's Common Agricultural Policy, CAP) and examine these understandings in conjunction with politics of power and capital accumulation. This allows me to demonstrate how historically and politically specific conceptions of soils and multispecies life fundamentally guide and determine modern agricultural practices and policies and thus the treatment of soils. Building on this analysis, I propose a conceptual contribution with the term *soil extractivism*, which refers to a mode of capital accumulation and profit

E-mail address: saana.hokkanen@helsinki.fi.

https://doi.org/10.1016/j.jrurstud.2024.103298
Received 15 May 2023; Received in revised form 7 May 2024; Accepted 7 May 2024
Available online 25 May 2024

production achieved through depletion and violent re-organization of soils' multispecies life, in order to produce crops that are treated as commodities. As such, soil extractivism names a key process and a set of practices in which soils multispecies lives' are mined to facilitate a specific modernist, industrialized and politically centralized relation to soils and land.

This article argues that thinking about soils and thinking with soils can provide vital openings for holistic understandings of current global multi-crises and ways out of them. Building on a wide set of multidisciplinary studies on soils and cross-pollinating this with a political ontological analysis, I demonstrate that the degradation of soils and soil biota are representations of systemic destruction and re-organization of life and landscapes driven by extractivist practices, capital accumulation, and economies centered on growth. As discussed by Salazar et al. (2020b: 5), soils are the perfect companion to 'think with,' as they enable a nuanced recognition of "the complex blend of socio-political predicaments and physico-material negotiations of planetary boundary conditions and safe operating spaces."

By bringing together the Latin American theory of Political Ontology (de la de la Cadena and Blaser, 2018; Blaser, 2009) and the theoretical framework of global extractivism (Chagnon et al., 2022), the study proposes a complementary contribution to existing literature bridging multiple on-going discussions related to agriculture, natural resource politics, extinction, agrarian change, and biodiversity loss. It is also important to note that, while this article focuses on industrial agriculture and agricultural politics in Europe (and more specifically in the European Union), very similar and in many cases more severe and destructive processes are occurring all over the world, especially in the Global South, and these are all representative of a wider world-ecological and world-historical process.

The timeframe for my analysis in this article begins in the 1850s, which marks the beginning of the industrial and agricultural revolution in Europe, which engendered major changes in agricultural practices characterized by intensification and expansion of land use, mechanization and chemicalization of farming, specialization of production, and an increased focus on monocultural and large-scale farming. Within this timeframe, I also focus on the decades following the Second World War (post-1945) as a *boundary period* during which the aforementioned practices became deployed and institutionalized across most European countries. This process was due to international political and economic pressures and, to a large extent, the foundation of the EU's Common Agricultural Policy (CAP). I thus treat the case study of the CAP as a political and legal institutionalization of the more general world-making (i.e. political ontological) processes of modernization and capitalism as ways of organizing the web-of-life.

1.1. Political ontology

This article is based on a critical and integrative examination of existing scholarly contributions on the ontological and multispecies politics of soils and agriculture. The method of analysis is an integrative literature review, which is a form of research that reviews, critiques and synthesizes representative literature on a given topic in an integrated manner in order to generate novel frameworks, conceptualizations and perspectives on the topic (Torraco 2005). I will use this method in conjunction with a political ontological analysis of the European Union's Common Agricultural Policy (CAP), which I will feed and cross-pollinate with social scientific and more-than-human philosophies on soils.

By political ontological analysis (from de la Cadena and Blaser, 2018), I refer to the critical examination of the different socially shared ways in which people understand how the world is, what exists, how things relate to each other, and the politics and frictions of these meaning-makings (de la Cadena and Blaser, 2018; Blaser 2009). More specifically, in this article I use political ontology as a theoretical framework with a specific focus on how certain realities (i.e. worlds) are done, enacted and made visible (while others are undone and made invisible) through extractivist industrial agricultural practices and politics. I thus examine the different politically institutionalized forms of relating to and using soils (in this case industrial agriculture and the CAP) as particular modes of *being in and of making worlds*.

Differing from a specific field of study within philosophy (ontology as a study of being,[1] with its own set of theoretical work) (Campbell 2020), *political* ontology as a theoretical lens emerged from research in anthropology (see e.g. Viveiros de Castro, 1998; De la Cadena 2015; Blaser, 2009), actor network theory, and science and technology studies (Latour, 1993; Law 1999, 2008; Mol, 1999). These works examine both the frictions between different ways of understanding and making realities (i.e. worldings/world-makings) (e.g. de La Cadena 2015), and the ontological power of modernity (e.g. Latour, 1993; Law 1999; Mol, 1999).[2] A particular focus in political ontology is also on the ways in which modernity creates a single, universal view of reality that is enacted, imposed upon, and expanded to occupy all other ways of being (a phenomena Law [1999] refers to as the 'one-world-world', and which takes the form of colonial expansion and destruction of different lifeworlds, both human and non-human). Within empirical research, political ontology thus often presents itself as a way of examining the struggles, contestations and conflicts between diverse lifeworlds and diverging world-making practices (Blaser 2009; Law, 2015).

Some recent work which examines both political ontology and extractivisms (see e.g. Chagnon et al., 2022; Kröger 2021; Ehrnström--Fuentes 2022) provides insights on how extractivist processes (with related processes such as commodification) can be understood as systemic and globalized enactments of modernity, which render and re-organize physical landscapes and multispecies relations (including humans) in accordance with western, modernist or human-centric ontological imaginaries. This paper is a continuation of such work, in as it aims to show how historically and politically specific ontological understandings of soils are institutionally enacted onto rural landscapes through political projects such as the European Union's Common Agricultural Policy (CAP), and which materially take the form of *soil extractivism*.

By approaching industrial agriculture's (and more widely modernity's) relations to soils through the use of political ontology, the issues of non-human agency, relational materiality, instrumentality of different imaginaries on soils, and the politics of soil abuse are central to my exploration. Through a political ontological analysis, I aim to uncover the specific practices and ontological foundations which drive the erasure of multispecies life within soils and examine to what extent the dominant agricultural politics in the EU are framed by and perpetuate these 'ontologics.' The main focus is on mapping out the theoretical aspects of the political ontological foundations of soil-erasing practices in Europe. The case study of the CAP functions as an empirical example within which both the grand historical processes of destruction of soil as other-than-human life and the ontological foundations of soil extractivism can be examined.

[1] My use of political ontology as a theoretical frame is also built on an understanding of ontology that is not separate from epistemology, thus abandoning the stubborn notion that separates knowing from being (which in itself expresses specific dualistic western ontology, see e.g. Watts 2013).

[2] Political ontology as a theoretical framework also gives emphasis to how mundane practices and relational interactions of both human and other-than-human beings enact or perform worlds and realities into existence (Campbell 2020; Blaser 2009; Mol, 1999). Moving beyond human-centrism, worlds are not only enacted through intentional human actions, but in continuous correspondence with the materials and relations between human and non-human agents (Campbell 2020), such as soil and its multispecies existence.

1.2. Research gap and the case for studying political ontology in European agriculture

Social scientific understanding of soil loss has long been dominated by political economic or agrarian studies analyses, while soils as relational materialities have remained rather under-explored (Krzywoszynska 2019). Some of the earliest social and political science examinations of the significance of soil loss come from Marx (1976), who posited both soil and labor as the original sources of wealth and argued that capitalist progress is fundamentally founded on robbing them both.[3] Marx's work has been influential in the field of political ecology and in other critical analyses on the exploitation of soils, as seen, for example, in the seminal work of Piers Blaikie (1985), who studied the political economy of soil erosion in what he called 'the developed world.' Although there are some foundational contributions for example within political ecology and environmental humanities that diverge from conventional ways of conceptualizing human–soil relations (see, e.g. Tironi et al., 2020; Engel-Di Mauro 2014; de la Bellacasa 2014; Krzywoszynska and Marchesi, 2020; Lyons 2014; 2020), the majority of studies in the social sciences continue to treat soils as static (rather than living) matter (Krzywoszynska 2019). Even though much of natural scientific soil science has long examined soils as complex living entities (Kutílek and Nielsen 2015), the majority of research on soils outside the natural sciences has treated them merely as "governable, ownable, controllable" land (Krzywoszynska 2019: 662) and as a resource for food production (Salazar et al., 2020b).[4] This is further exemplified by Tironi et al.'s (2020: 19) concept of the "un-theorization of soil," which refers to a "form of soil determinism which conceptualizes soil health as essential to human life, agricultural productivity, and adaptation to environmental change," while still placing soil outside the scope of human social existence. Some recent scholarly contributions nevertheless provide exceptions to this trend. Such studies include María Puig De la Bellacasa and María, 2014; 2015, 2017, 2021) pioneering work on soil temporalities, care, and soils as bio-infrastructure, Anna Krzywoszynska and Marchesi, 2020 in-depth conceptualizations of the relational materiality of soils, Kristina Lyons' (2020) brilliant book on vital decomposition, and the work of Salazar et al. (2020a) on the material politics and social theory of soils. Additionally, Salvatore Engel-Di Mauro (2014) provides an eco-social approach and a social theory for understanding soil degradation in conjunction with capitalist production and social relations, without essentializing soil degradation merely as a capitalist problem. My article aims to *think with* this insightful set of work and offer a contribution which ties new knots between existing literature, in order to conceptualize soils and care for soils in conjunction with historically emergent and contemporary practices in industrial agriculture and global extractivisms.

Although political ontological examinations of extractivisms have increased in recent years (see e.g. Lassila 2021; Stensrud 2019; Ehrnström-Fuentes 2022; Kröger 2021; Tornel 2023), there remains a need to expand the analytical breadth and depth of how extractivisms take an important part in making and unmaking worlds. Research on extractivism[5] has thus far exhibited a strong geographical focus on Latin America (Nygren et al., 2022), with an increasing amount of literature on the Arctic (see, e.g., Kröger 2016; Wilson and Stammler 2016), Africa (see, e.g., Hamouchene 2021; Greco 2020; Ayelazuno 2019; Hargreaves 2016; Nogueira et al., 2017) and Asia (see, e.g., Tapiheru et al., 2022; Kröger 2020; Rowedder and Tappe 2022). Due to world-systemic structures of coloniality, extractivist processes have been most prominent and overtly violent in the Global South, manifesting in the systematic plunder of marginalized people and lands in order to build modernity and fuel growth in the Global North (Chagnon et al., 2022; Moore 2015; Galeano 1997). Because of these specific world-historical and world-systemic dynamics, many key theoretical contributions on extractivism have understandably arisen from global political economic analyses with a focus on world-systems analysis and core-periphery dynamics (Acosta, 2013; Bunker 1988).

Additionally, a lot of the theoretical research on political ontology and agriculture has focused on issues related to ontological conflicts and indigenous world-making (important exceptions being e.g. Campbell 2020; Kumpf 2021). As such, there is a need to further expand political ontological examinations of extractivisms and industrial agriculture in order to understand processes of world-making which do not necessarily occur in the frontiers or edges of modernity and capitalism, but rather at their assumed cores. In addition, political ontological analysis can further enrich theoretical work in fields such as agrarian and peasant studies in conceptualizing the long-studied processes such as agricultural industrialization and changes within peasantry as expansions and impositions of specific kinds of human and other-than-human worlds. Therefore, while continuing to build on the important set of the literature within political ontology and extractivisms, I also diverge from it by examining political ontologies of extractivism within a European context.

The motivation for this focus is twofold. First, by examining extractivisms in Europe through a Latin American-derived theory of political ontology, I aim to produce knowledge which de-normalizes and deconstructs realities that are predominantly taken for granted, or even viewed as a model for normality. This approach is also intended to demonstrate how modernity and capitalism are based on ecocide across the globe rather than solely within the frontier areas of global capitalism. Second, I wish to show how the loss of multispecies life and the degradation of soils and landscapes has come to be considered normal in Europe, partly because of the gradualness and long-established nature of the destruction (discussed, e.g., by Ollinaho 2015). This has also meant that the conflicts and struggles over different rural lifeworlds have not been examined from political ontological perspectives to any great extent, as they have often been framed as either issues related to farmers livelihoods or environmental considerations (rather than issues of existences). Due to the assumed normality of soil degradation and multispecies loss, the destruction of lands and beings in European landscapes has become invisible and overlooked, thus creating "environments of lived erasure" (Dunlap 2021: 213).

2. Overlooking existences and the political ontology of soils

Soils are important on a number of scales. These include the micro-level relations between individual soil organisms and the macro-level issues of storing carbon, growing food, and providing habitat, as well as the global interactions with water cycles, atmospheres, and oceans

[3] Nonetheless, a large part of Marx's writing on the foundations of soil exhaustion was misinformed to some extent, as it was based on the theories of agricultural chemistry of his time (which were fundamentally modernist and emphasized a mechanistic and chemical understanding of soils, as well as being permeated with colonial and racist narratives), which resulted in Marx actually promoting for the intensification, mechanization, and chemical fertilization in agriculture and calling rotational and regenerative agricultural practices a "fairy-tale" (Marx 2016: 729) (pace Saito 2017).

[4] However it is extremely important to note that many of the overarching notions such as relational materiality, human-animal relations, multispecies care, or any forms of "radical alterity" (Graeber 2015) discussed as part of the so-called 'ontological turn' in social sciences have been written about by many indigenous thinkers for decades (see Todd, 2015; Kimmerer 2013; Hunt 2014; Watts 2013; Deloria et al., 2001; Tallbear & Wiley 2019; Kopenawa and Albert 2013). Therefore, building on Todd (2015), ideas such as relational and multispecies existence or ontological erasure (of for example soils) are not realizations or new conceptualizations which arose from anthropology or western philosophical thought, but that they are also embodied, lived and fought-for realities of many indigenous life-worlds.

[5] The concept of extractivism is further explained in the later section "Theoretical contribution: Soil Extractivism."

(Krzywoszynska and Marchesi 2020; Schulte et al., 2015). Soils participate in and drive the majority of all biological and chemical processes that make Earth habitable (Salazar et al., 2020b; Krzywoszynska and Marchesi 2020; Engel-Di Mauro 2014). As discussed by de la Bellacasa (2021), soils are a vital medium through which the dead and minerals are turned back to (and for) living earthly beings. Additionally, while being completely inseparable from their wider environment, soils are also a manifestation of moving matter in themselves (De la Bellacasa 2020b; Hird 2009). Just a teaspoon of rich soil contains about a billion bacteria and thousands of fungi, single-celled organisms, and nematodes (de la Bellacasa 2019). Moreover, algae numbers can vary between 3 and 100 million in 1 g of soil (Kutílek and Nielsen 2015). In addition to microbial life, there also exist immense amounts of different macrofauna, such as centipedes, millipedes, slugs, snails, larvae, and spiders (Kutílek and Nielsen 2015). It has been estimated that around 25% of all species diversity is found in soils (FAO 2020), while only 1–2% of soil microorganisms have been identified (Orgiazzi et al., 2016). This being said, there exists no static 'natural state' of soils, but soils in whatever state they are, are always constituted and composed from wider relations and geo-physical processes, both within and beyond the soil (through interactions that include or do not include humans, as discussed e.g. in Engel-Di Mauro [2014]).

From a relational multispecies perspective, soils are entire worlds in themselves, in which organisms and inorganic materials dwell in tight co-constitutive relations. Soils defy any attempts to analyze materiality and agency as separate categories, as soils are not merely a habitat for different beings; rather, the soil itself is made of those beings. In other words, the structure of the soil and its fertility are *synonymous* with the different beings living, dying, and decaying within and as the soil, together with the soil's mineral and geological components (Tironi et al., 2020; Krzywoszynska and Marchesi 2020). The process of how soils come to be also emphasizes decomposition, which disrupts any notion of creation without breakdown, or life without death (de la Bellacasa 2021).

The treatment and ontological notions of soils are fundamentally intertwined. In other words, how soils are understood affects and to some extent creates the ways in which they are cared for or (ab)used (de la Bellacasa 2015). The dominant way in which soils are currently treated in modern industrial agriculture and agricultural politics is characterized by Anna Krzywoszynska (2020) as part of an agro-productivist mindset and status quo that posits soil as a passive resource. Such an ontological framing renders the labor and lives of soils' multispecies assemblages as static matter (i.e., dirt, with all that word's negative connotations). However, historically, the definition of soil and its ontological status in relation to human life have undergone many changes (Hartemink 2016), and they continue to be debated both within scientific and political discourses on soil management (Krzywoszynska and Marchesi 2020; Engel-Di Mauro 2014. Engel-Di Mauro (2014) for example emphasizes that as with any form of producing knowledge, soil science is inextricably dependent on the social context it develops in. He also emphasizes the political nature of defining soil quality and discusses how techno-scientific notions of soils have become complicit in promoting agricultural commodification (Engel Di-Mauro 2014). Similarly, building on a review of soil science (Hartemink 2016), Krzywoszynska and Marchesi (2020) note that the changing definitions and different understandings of soil always arise in relation to technological and agronomic developments, in conjunction with wider societal needs and interests.

As discussed by Krzywoszynska and Marchesi (2020), the currently dominant understandings of agricultural soils are rooted in emergent knowledge systems that gained ground during early industrialization and post-Enlightenment in Europe. The aforementioned agro-productivist and reductionist understanding of soils as passive and static thus arises from a wider set of historically institutionalized assumptions, such as notions of a nature-society dichotomy, nature as a passive resource, human exceptionality, and the idea of the world as a mechanistic entity (rather than relational) (building on Moore [2015] and Plumwood [1993]). More specifically, the currently dominant way of treating soils in industrial agriculture (and modern societies in general), is founded on theories of soil fertility introduced by the German chemists Carl Sprengel, in the 1820s, and Justus von Liebig, in the 1840s (Van der Ploeg et al., 1999; Marchesi 2020; Clapp 2023), which paved the way for modern agricultural science[6] and "set agriculture on its industrial path" (Pollan 2006: 146).

Liebig's work was motivated by the notion that soil exhaustion was a result of 'primitive' agricultural practices and could be completely overcome with mineral fertilization (Saito 2017). Liebig's theory (which became better known than Sprengel's) introduced a mineral understanding of soil fertility (rather than organic or humus-based) that promoted the idea of soil as an inert growing medium and essentially disregarded aspects such structure, humidity, oxygen-levels, density, and the billions of beings that make and inhabit the soil (Marchesi 2020; Saito 2017). This passive chemical understanding of soils thus simplified the issue of how to increase yields to a question of what chemical substances need to be added to the soil (Krzywoszynska and Marchesi 2020). Operationalized into practice, this meant that farmers were simply required to adjust a cocktail of a few chemical elements—in practice, mainly nitrogen, phosphorus, and potassium (Uekoetter 2006; Pollan 2006). With this reliance on chemical inputs, soils could thus continue to "fulfill their function" as a medium for growing crops, with no regard for the overall health of soils as living ecosystems (Krzywoszynska 2019: 665).

Liebig's theory initiated a radical shift in agricultural practices and laid the foundation for a form of agricultural science that could be universalized into a 'one size fits all' kind of agriculture (Marchesi 2020). This in turn served the interests of European countries aiming to industrialize and feed growing populations, as it enabled the geographical expansion and intensification of agrarian capitalism during the same period (Krzywoszynska and Marchesi 2020). Following this ontological marginalization, soils came to be regarded as an infrastructure and an invisible background (de la Bellacasa 2014; building on Star 1999). This, as I will later show, was firmly institutionalized in European agricultural politics post-WWII.

Another important aspect of the political ontology of soils in Europe concerns the separation of soil from the rest of the landscape and the life 'above-ground.' Philosophers such as Kant, Immanuel, 1933: 606 in Ingold 2015) described the earth as "a flat surface, with a circular horizon"— a mere stage for human life. According to Ingold (2015), this kind of understanding completely fails to recognize the life of soils and its relations with all other lifeforms, thus positing land and anything below-ground as formless matter, the physical stuff of the world. What is central here is the disregard not only for the multispecies agential existence of the below-ground, but also for the dynamic and co-constitutive relationality that crosses and deletes the assumed boundary between above and below ground. This failure to recognize that human existence is not separate from what is invisible or below ground is what ecologist David Wolfe (2001 in Lyons 2020) calls 'surface chauvinism.'

What however enables and creates the existence of, for example, both microbes or a root system below ground and a grazing mammal above ground is the movement of matter, of living and dead bodies between and within the soil and the rest of the world, which are moved by the labor and actions of different multispecies agents (such as the farmer, the grazing animal, burrowing nematodes, pecking birds, and the growing crop). In this sense, just like the microbes, fungi, and

[6] Interestingly, Liebig also significantly influenced Marx's theorization of metabolism and soil exhaustion (although Marx did later distance his work from Liebig's theories), which explains Marx's early optimism about the possibility of continued improvements in agricultural productivity (Saito 2017) and which is indicative of the modernist ontological basis of Marx's work.

macrofauna within the soil, it could well be argued that the manure-producing and grazing livestock and the ploughing, sowing, and harvesting farmer are also species of the soil and inseparable parts of the process that determine its health and livability. In later sections, I demonstrate how the separation between the 'physical stuff' of soil, its laborers, and the remaining agricultural practices is at the core of industrial agricultural organization and politics. This is evident, for example, in the extractivist treatment of soil as a pool of resources and in the expanding separation of livestock production and other land practices, such as crop production.

2.1. Power and politics in soil ontologies

It is important to note that the heterogeneous field of soil science has long distanced itself from a mere chemical and a-biotic understanding of soils and shifted toward the current definitions of soils as living systems (Lyons 2020). Therefore, the issue of unsustainability in soil management is not a question of lack of knowledge per se. Additionally, even in the 1850s, the reductionist, simplified notion of soils promoted by Liebig and other modernist chemists of his time did not arise because it was according to the best available scientific or practical knowledge (Saito 2017; Manlay et al., 2007), but because such thinking served the interests of the rapidly industrializing and urbanizing societies of early capitalism[7] (Marchesi 2020). Even Liebig himself later criticized agricultural principles that relied solely on external chemical inputs (what he called 'chemical hocus pocus') and defended the idea that soil fertility depended on reciprocity and the recycling of nutrients, which he discussed in his 1861 book *The Search for Agricultural Recycling* (Shiva 2022). Therefore, the main significance of Liebig's contribution to industrial agriculture was primarily in its *instrumentality* in the emergence of the new capitalist ecological regime (Marchesi 2020). A century and a half later, European rural landscapes, farming practices, and agricultural politics are fundamentally shaped and continue to be re-organized according to the logics set forth by Liebig's (and his contemporaries') early theories on soil and agricultural productivity, as well as the general separateness of soils from society. The very normality people in Europe know in landscapes and farming practices is thus a product of historically particular conceptions of what soils are, and which serve particular interests.

It is however important to mention that the ontological foundation of the treatment of soils in modern industrial farming cannot be reduced merely to the description presented above. Similarly, the origins of the exploitation of soils cannot be pinpointed to the 1850s alone[8] (or at any other moment in time for that matter), as there are many examples of agricultural practices that depleted soils across the world well before industrialization (Hillel 1992) or the origins of capitalism (whether one traces those origins to the 1800s or to the long-16th century; see Moore 2015). The primary significance of studying the changes in agricultural practices and treatment of soils since the start of industrialization and especially after the World Wars, however, is that both mark a *boundary moment* of clear intensification of a process where exploitation and extraction of soils became *systemically* driven and radically expanded. This indicates a shift from *practices* of exploitation and degradation to a *system based on extraction* of soils multispecies life, with its specific relations of power and politics (thus denoting a wider extractiv*ism*). The important point therefore is not whether unsustainable ways of relating to soils have previously existed, but rather that the specific (European) ontologics which reduced soils to mere dirt or to their productive capacity became institutionalized into political and economic practices and policies across continents and were operationalized for the benefit of state-projects,[9] capital accumulation, economic growth, and modernity. This emphasis is important because it enables thinking with the underlying ontological drivers (i.e. imaginaries) of societal processes and practices, while avoiding treating those imaginaries as determinants.

3. Mining soils: effects of industrial agriculture in Europe

In the previous section, I presented the specific soil ontologies behind industrial agriculture and discussed the historical foundations of a mechanistic and chemical understanding of soils, as presented by Marchesi (2020) and Krzywoszynska and Marchesi (2020). In this section, I aim to demonstrate how these particular understandings of soils, which posit them as a passive medium for growing crops, physically manifest themselves in modern industrial agriculture and rural landscapes in Europe.

European landscapes are shaped by agriculture, which has been practiced on the continent for millennia, with approximately 40 percent of Europe's land currently used for agriculture (EUROSTAT 2021c). Agricultural production in Europe has undergone significant changes both structurally and in relation to rural livelihoods and multispecies existence. A wide variety of studies show that especially during the last hundred years European farmland and European landscapes have experienced massive changes (Pardo et al., 2020). During this time, agricultural land use has intensified both locally and on a landscape level. Local intensification has entailed the increased use of chemicals and fertilizers, higher cropping intensity, and the overall mechanization of farming operations (Pardo et al., 2020). On a landscape level, this intensification has meant regional specialization of agricultural production and the expansion of monocultures (meaning only one crop species is farmed on one field in one year, and often year after year), consolidation of small fields into larger ones, and the simplification of farmlands in general (Kallio 2022; Concepción et al., 2008; Pašakarnis and Maliene 2010; Jongman, 2002). This simplification is the result of eliminating rotational and cover crop farming, as well as the elimination of landscape elements and habitats in farmlands, such as field margins, ponds, streams, hedges, trees, or grassland in order to facilitate the use of modern machinery and expand production (Pardo et al., 2020; Aviron et al., 2018; Concepción et al., 2020; Šálek et al., 2018). A large part of these major changes in agricultural operations and rural landscapes have occurred within three generations and through rapid processes of 1. mechanization of agriculture, 2. intensification and commercialization of farming (from family farms to industries), 3. active globalization and cheapening of the food market, and 4. farmland abandonment along

[7] The chemicalization and industrialization of agriculture also provided personal benefits for Liebig and other agricultural chemists who promoted the mineral theory of soils. Liebig, for example, created and patented one of the very first synthetic fertilizers, which meant that the increasing influence of his mineral theory of soil also greatly contributed to the growth of his personal wealth (Saito 2017: 194).

[8] In fact Liebig himself also attempted to develop his theory of soil fertility to *prevent* soil exhaustion, which resulted from what he called 'robbery agriculture' (see Saito 2017). However, it could be argued that due to his political ontological frame, disregard for the biology of soils, and his non-relational understanding of how soils are connected to the wider landscape and multispecies existence, his 'solution' was misinformed and because of that led to the intensification and expansion of agricultural practices that exhaust and poison soils.

[9] Which includes socialist states. Soil exhaustion and scientific notions on soils in the context of socialist states has for example been studied at length by Salvatore Engel-Di Mauro (see e.g. 2021; 2014; 2006; 2002).

with farmland expansion[10] (Pardo et al., 2020; Kimbrell 2002; Clapp 2023).

Similar changes have also occurred in pastoralism and livestock rearing (Le Noë et al., 2018). Agricultural modernization has significantly decreased the diversity of livestock species and moved animals from pastures and grasslands to indoor facilities; meaning that animals have been reduced from 'lively' beings within the farming landscape (within networks of multispecies existence playing a central role in crop production and maintaining soil health) to commodities encased in indoor factories (Despret and Meuret 2016).

3.1. Effects on soils

The developments pictured above have had fundamental implications for the state and health of soils in European farmlands. As discussed by the soil scientists Kutílek and Nielsen (2015), many of the currently normalized and commonly accepted agricultural practices of managing soils are immensely destructive and eventually lead to the exhaustion of soils. Montgomery (2007) also argues that soil degradation in Europe can be primarily attributed to the fundamentals of modern industrial agriculture (i.e., the heavy use of machinery, mono-cropping, and agrochemicals), which neglect soil fertility, render soils' own nutrient provision superfluous, and separate crop production from animal husbandry (see also Le Noë et al., 2018). It has been estimated that each ton of grain produced by industrial agricultural practices results in several tons of lost topsoil globally (Salazar et al., 2020b; see also footnote).[11]

The mechanized industrial form of agriculture currently practiced in Europe is heavily based on monocrop cultivation, a system in which fields are often stripped bare of their plant cover each year (Krzywoszynska 2019). This leads to the depletion of microbial life in soils and the exhaustion of the nutrients upon which plant growth depends, eventually leading to major reductions in yields (or furthering the dependence on chemical fertilizers). Even if farmers replace soil's nutrients with mineral fertilizers (which often only means nitrogen, phosphorus and potassium), other required nutrients or substances begin to diminish and often disappear (Kutílek and Nielsen 2015). The lack of organic matter and microbial life in soils leads to weakened root systems, a reduction of growth in the aboveground plant parts, and the overall deterioration of the physical, chemical, and biological properties of the soil. Eventually, with continued monotonous monocultural production, coupled with intense plowing, soils lose their structure (Kutílek and Nielsen 2015). Industrial agriculture is thus based on stripping the land bare during harvest and essentially mining the soil of its nutrients and organic matter (Krzywoszynska 2019; Nearing et al., 2017).

The 'mining of soils' (aptly named by Krzywoszynska [2019: 6]) is not the only problem with intensive farming, as monocultures also require massive amounts of fertilizers and pesticides, without which large-scale industrial farming would not survive (Guthman 2017). This is because cultivating the same crop on the same field with minimal crop rotations will eventually lead to the prevalence of weeds and plant diseases as the natural processes of plant protection through biodiversity are reduced and eliminated (Kutílek and Nielsen 2015; Tostado et al., 2022) Consequently, producers are forced to combat 'unwanted' weeds and pests with various kinds of pesticides, which might lead to short-term successes but eventually create a dependency on pesticides (as well as fertilizers). This is aptly described as the 'pesticide treadmill' by Bakker et al. (2020). The heavy use of pesticides has also failed to lead to sustained production increases, as pesticide use is increasing almost twice as fast as food production (Schreinemachers and Tipraqsa 2012).

Additionally, even with the most selective use, pesticides will always impact and kill vast amounts of other micro and macro soil fauna and flora that are beneficial and necessary for soil, plant, and animal health (Kutílek and Nielsen 2015). Pesticides thus alter the very ecology of farming systems and end up accumulating in the web-of-life, as some of the chemicals used do not decompose but rather continue to move through the landscape and bodies. Intensive agricultural practices like monocultures thus lead to soils becoming sick and stripped of their multispecies life (Kutílek and Nielsen 2015). Currently, there are almost no soils left in Europe which are not contaminated by a cocktail of chemicals (EUROSTAT 2021a). In other words, pesticides are one of the prime tools through which producers and agro-chemical companies decide which beings are permitted to live or made to die, and for whose benefit (Paredes 2022).

In addition to the ecocidal impacts of fertilizer and pesticide use, mechanized and monocultural farming has many other effects. For example, when soils lose their structure, they become more susceptible to packing, erosion, and runoff. To be able to continue farming on packed soils, farmers start to rely on heavy tilling, which leads to further disturbance of the soil structure, increasing its vulnerability to erosion (Kutílek and Nielsen 2015). Many of the core practices of modern industrial farming thus actually result from the need to fix or override problems created by the very same system of production, which is driven by pressures to intensify and scale up (Weis 2010).

As discussed by de la Bellacasa (2015), all of these major changes in the treatment and health of soils are part of a wider trend in modern management centered around a productionist mindset and the maximization of soil beyond its possible renewal pace. As a result of decades of mechanized and chemical-based industrial agriculture, a large part of European farmlands has become what Anna Tsing, 2017; Tsing et al., 2017: 52) calls industrial landscapes, which "kill off beings that are not recognized as assets." The effects are also much wider and seep and travel beyond the fields and farmlands, which is evident in the massive losses of bird and insect populations in Europe as well as in the pollution of waterways.[12] In Belgium for example, all of the country's rivers have become so severely polluted by the fertilizer and pesticide use of industrial agriculture, that in some streams the water itself could be

[10] Le Noë et al. (2018) provide a brilliant summary of the changes in agricultural land use and nutrient flows in France from the 1850s until the 2010s. They show how small-scale integrated crop and livestock farming was the norm everywhere in France (as in most of Europe) during the second half of the 1800s, as production and fertilization completely relied on manure recycling and the maintenance of organic content in soils. Although crop specialization, the use of new technologies, and chemical fertilizers (fueled, for example, by heavy lobbying from fertilizer companies; see Duby and Wallon, 1977) began to gain traction in the first half of the 20th century, the biggest change occurred from 1946 onwards. The decades after the Second World War in France were marked by a clear move away from rotational and mixed farming practices, the expansion of crop specialization, and, thus, rapid acceleration of a new type of agro-food system characterized by monocropping and the heavy use of external inputs and machines. The use of synthetic fertilizers began to increase from the end of WWII and exploded in the 1960s (Le Noë et al., 2018; Bouwman et al., 2017), fundamentally transforming agricultural relations with soil life.

[11] Estimations on annual soil erosion in arable lands vary greatly, as exact amounts are difficult to obtain. However, regardless of the exact numbers, most estimations show soil erosion to be manifold compared to the amount of crops produced; According to the FAO (2022) in 2021 the global production of agricultural crops was 9.5 billion metric tons (increasing by 54 percent since 2000 and 2 percent since 2020), while the annual loss of agricultural soil has been estimated to be between 36 billion metric tons (Borrelli et al., 2017) and 75 billion metric tons (FAO 2017), amounts which are three to eight times larger compared to the amount of crops produced.

[12] Additionally, the importance of soil health in non-rural areas is evident in soils' ability to absorb water and carbon, facilitate pollination, and enable microbial resistance. Eroded soils, on the other hand, release carbon and other gasses and lose their ability to absorb water. Thus, while healthy, soils contribute greatly to resilience against the climate emergency and disasters such as floods, eroded soils can accentuate the disaster itself (Payton 2021).

classified as pesticide (Casado et al., 2019).

Le Noë et al. (2018: 142) argue that the problems resulting from over-fertilization, excess nitrogen in soils, and the overall intensified dependence on external chemical inputs (represented, e.g., by the term 'metabolic rift'—see Foster, 1999; 2000) ought to be attributed to "political choices and modes of insertion within the market economy, rather than to endogenous mechanisms in agricultural production itself." As shown and discussed by a variety of studies (see, e.g., Pardo et al., 2020; den Herder et al., 2017; Henle et al., 2008; Klijn 2004; Tscharntke et al., 2005; van Vliet et al., 2015), all the above-mentioned changes in farming practices are actively driven by policy programs such as the Common Agricultural Policy (CAP), which I discuss more explicitly later in this article.

The extractivist form of treating soils in modern industrial farming also firmly links agriculture to wider political economic systems of fossil capitalism. As argued by researchers such as Montgomery (2007) and Weis (2010), by seemingly disconnecting agricultural production from regenerative management of local soil conditions and introducing machinery, mineral fertilizers, and pesticides, agriculture has become dependent on fossil fuels and agrochemical companies.[13] The use of pesticides and fertilizers is thus necessary for the reproduction of a specific type of political economy in agriculture (Shattuck 2021). Farmers' dependency on chemical fertilizers and pesticides also increases production costs, which often leads to debt relations and paves the way for further financialization of rural landscapes and corporatization of agriculture[14] (McKay 2018; McMichael 2013; McKay et al., 2021).

3.2. State of European soils

Although soil degradation in Europe is generally recognized as a serious threat, its quantification, geographical distribution, and total proliferation are only roughly known (European Soil Observatory, 2024; European Environment Agency, 2020) and differences exist between countries and regions. Regardless of the uncertainty, most estimations indicate that the overall situation is severe and worsening (European Soil Observatory, 2024; Panagos et al., 2019). For instance, a study by the European Commission (2020) found that over two thirds (70%) of soils in Europe are losing their capacity to maintain plant growth and almost half of all soils in the EU contain extremely low levels of organic matter (European Environment Agency, 2020). Since 2010, more than 12 million hectares of agricultural land (7.2% of the total area) have become severely eroded each year (Panagos et al., 2015). On average, European landscapes are losing about 2.5 tons of soil per hectare (t/ha/year), while about 12.7% of European arable lands are subject to soil loss of over 5 t/ha (FAO 2020). Erosion is highest in Austria, Spain (where loss of soil in agricultural land peaked at an average of 28 t/ha/year between 1990 and 1995) and elsewhere in the Mediterranean region. To put these numbers into context, it has been estimated that with the very slow rate of soil formation, any soil loss of more than 1 t/ha/year can be considered irreversible within a time span of 50–100 years (European Environment Agency, 2020: 189).

In addition to the mechanical erosion of soils, the organic and chemical composition of European soils is being significantly depleted. European agricultural soils are currently losing carbon at a rate of 0.5% per year, which is equivalent to the carbon emissions of 500 million extra cars (European Commission 2020: 8). Overall, soil moisture in the EU decreased over 10% between 2000 and 2019 (Eurostat 2021a), and the vast majority (83%) of EU soils are contaminated with pesticide residues that do not decompose (Silva et al., 2019). In addition, 65–75% of agricultural soils are over-fertilized with external nutrient inputs, which is leading to the eutrophication of soils and water. In cities, the majority of urban soils are sealed, and only 13% of new infrastructural developments occur on recycled land. Other markers show that 23% of all arable land suffers from high density soil compaction, and 25% of land in Southern Central and Eastern Europe is at high risk of desertification—an increase of 11% in just 10 years (European Commission 2020: 7).

4. The European Union's Common Agricultural Policy as a world-maker and a driver of soil abuse

Farms and agriculture make particular kinds of worlds visible with their related structures of power (Campbell 2020). Contemporary agricultural politics, industrially organized agriculture, and with them, the underlying relations to soils are not simply the outcome of social and economic processes under modernity, but rather, as argued by Campbell (2020: 14), "they play their own role in enacting the ontology of modernity." In this section I provide an overview of the general development and political structures of industrial agriculture in Europe, and of the European Union's agricultural policies as processes of establishing a specific kind of institutionalized relation to soils. I argue these to be a process of world-making, in which certain kinds of worlds and existences are made at the cost of erasing and extracting others.

Since its inception, after the agricultural revolution in the 1800s and especially post-WWII, industrial-scale agriculture has been a major driver of soil loss as well as other related processes, such as species loss, landscape degradation, and pollution of waterways (Pardo et al., 2020; Le Noë et al., 2018; Pe'er et al., 2014, 2019). An increasing number of studies identify the roots of modern industrial agriculture in world-historically dominant systems of production and consumption, premised on principles of growth and accumulation, and powered by extractivist practices (see Chagnon et al., 2022; Clapp et al., 2018; McKay et al., 2021; the world-systemic aspects of agriculture and agrarian change are best illustrated by Friedmann and McMichael [1989] in their work on global food regimes). Therefore, the type of agricultural development and modernization that is now dominant in Europe has long roots in the general industrialization of societies and dominant ontological understandings that view nature as a passive resource separate from humanity.

The European Union's Common Agricultural Policy has long been, in all its contradictory features, the main political instrument behind agricultural change in Europe and as such a major driver in how rural lands and existences have become to be organized across Europe. Coupled with technological development and the globalization and corporatization of food production, the CAP has promoted structural changes in agriculture since its inception—changes that have led to the increased intensification, concentration, and specialization of production (e.g., monocropping) in some areas and abandonment of rural lands in others. The CAP came into force in 1962, following the founding of a European Common Market in 1957, with the aim of increasing agricultural productivity in order to improve food security, ensure a better standard of living for farmers, and stabilize agricultural markets and farmers' incomes (Lefebvre et al., 2015). However, since its earliest reforms, the CAP has mainly functioned as a tool for agricultural modernization, corporatization, and export-oriented agribusiness. According to Meeus et al. (1990), the CAP is among the main driving forces of the uniformization of European landscapes (thus also denoting the enactment and ecological expansion of the one-world-world [Law

[13] Manufacturing synthetic fertilizers is completely reliant on the use of fossil fuels and thus extremely energy intensive: Producing 1 kg of nitrogen requires the energy equivalent of 2 L of diesel, and for phosphate, 1 kg requires the equivalent of 1 L of diesel (Shiva 2008). In general, it has been estimated that industrial systems of food production use 10 times more energy than, for example, what Vandana Shiva calls 'ecological agriculture,' and 10 times more energy than the energy in the food that is produced (Weizsäcker et al., 1997 in Shiva 2008).

[14] A *New York Times* article in 2019 argued that the aforementioned developments driven by the CAP may even signal the emergence of 'modern feudalism' in Europe (Gebrekidan, Apuzzo & Novak 2019).

2015]). As discussed in Lymbery (2017: 86), even the European Commission itself admits that the subsidy system for farmers (one of the two main pillars of the CAP) explicitly encourages the intensification of farming practices and pressures farmers to adopt the use of modern machinery and chemical fertilizers (European Commission 2014, in Lymbery 2017). As summarized by Lymbery (2017), by supporting agricultural production and the intensification of farming, the subsidy program at the core of the CAP causes farm prices to fall, while the price of external inputs, such as chemical fertilizers and pesticides, continues to rise. This encourages farmers to favor production systems that rely on economies of scale (i.e., large-scale farms with highly mechanized monocrop-systems). Farmers in the EU have thus become trapped in a production system that was designed to promote expansion and export-oriented production and rendered them completely dependent on subsidies.

From a political ontological perspective, a key aspect in understanding the characteristics of any given world and the practices that enact it, is the question of who and what is being allowed to exist and how. Within industrial agriculture this is extremely limited (Kröger 2021), and manifests for example in the staggering levels and increase of monocultural farming and specialized livestock production. Already in 2016, over half (53 %) of all farms in the EU were specialized in just a small number of crop species, and a quarter (24.5 %) of farms only reared livestock (Eurostat 2021b). This specialization means that rural landscapes (and therefore Europe in general) are dominated by only a few crop species.[15] As a whole, mixed farms account for around 20% of all farms in the EU, but these farms are often small, as large-scale and corporate-style farms tend to specialize either in monocropping or livestock rearing. This trend away from mixed farming has only increased in recent decades. In conjunction with this change, the total number of farms is decreasing, with the exception of the largest farms (over 100 ha in size). Between 2005 and 2016, the number of farms in the EU decreased by 28% (4.1 million farms). As small-scale farms end their operations or go bankrupt, larger owners take over their lands. The largest farms (over 100 ha) currently account for 3% of the total number of farms but control over half (50.4 %) of the total area used for agricultural production in the EU (Eurostat 2021b).

Industrial form of agriculture was however not invented with the CAP. The policy program was merely an institutional response and manifestation of wider social and political (ontological) changes occurring at the end of 19th and beginning of the 20th century, driven both by international political economic pressures (e.g., trade liberalization) and the state interests of European countries in the post-war period. As shown by Le Noë et al. (2018), many drivers of a more extractivist form of agriculture can be understood by the state of national economies in the post-war context. After the Second World War, many European countries relied on international credit, with national economies running budget-deficits (Le Noë et al., 2018). To strengthen their economies, countries began to implement policies to increase agricultural and industrial production for the international market. As further argued by Le Noë et al. (2018), post-war policies and aid packages, such as the Marshall Plan, were extremely significant in this process, as they explicitly promoted structural changes that relied upon improving labor productivity, freeing labor for industry, and orienting production toward export. Additionally, the increasing competition created by trade liberalization, the pressure to increase production for economic growth, and the overall push for modernization were the main factors that ultimately caused farmers across Europe to adopt agricultural practices that would eventually lead to wide-scale soil degradation (Le Noë et al., 2018; González de Molina et al. 2020). In countries such as France, this was additionally driven by agricultural propaganda and strengthened by laws that restricted people's access to land, thus reinforcing competition between farmers, who were eventually forced to modernize to survive (Le Noë et al., 2018).

These world-making and life-altering processes of specialization, expansion, and intensification were González de Molina, Manuel et al., 2020further cemented in European agricultural production and rural landscapes from the 1970s onwards, as the neoliberalization of economic politics facilitated land consolidations, thus supporting large-scale production-modes and the emergence of the corporatization of agriculture. In many countries, the period from the 1970s until the 2010s was characterized by the continued and intensifying specialization of crop production systems and the emergence of intensive livestock farming, namely factory farms (Le Noë et al., 2018; Einarsson et al., 2021). On the EU-level, this was driven by the so-called 'Mansholt plan,' a reform in the CAP that aimed at wide-scale modernization of the agricultural sector by 'optimizing' the area of land under cultivation (i.e. to promote monocropping) and by merging farms to create larger units (Council of the European Union, 2022a). As a result of the reform, the CAP shifted from direct price support to the provision of subsidies indexed on the cultivated area and herd size (Le Noë et al., 2018). The Mansholt plan further heightened the regional specialization of farming (i.e., certain areas specialized in certain crops and crop cultivation became further separated from livestock rearing), which again increased the dependence on the external inputs of fertilizers and pesticides. The same process is also evident in the newer member states of Eastern Europe, mirroring the longer established trend within older member states in the speed and profundity with which the CAP remakes rural existences and alters the countryside, with detrimental effects on the diversity and locality of food production, and the loss of diversity in other-than-human lifeworlds (Reif and Vermouzek, 2019; Szép et al., 2014; Lymbery 2017).

The abovementioned changes occurred in conjunction with other economic policies aimed at promoting production efficiency and market liberalism, which, according to the political narratives of that time, were thought to equip farmers with the necessary tools for international competition (Bureau and Thoyer 2014). The Mansholt plan and the subsequent reforms of the CAP thus also reinforced the integration of agriculture into the market economy (Le Noë et al., 2018), transforming the lived worlds of farms by bringing in a new relational frame in which to function.

As previously discussed, the specific chemical-based understanding of soils (which ontologically posits them as inert) and the operational basis it provided for industrializing nations at the end of 1800s were established institutionally from the 1940s onwards to serve modernization and states' economic recuperation after the World Wars, as well as to provide new outlets for the mineral and machine industry that emerged during war-time and free labor for industrial development (Le Noë et al., 2018). Building on this, the CAP thus represents the legally and politically established institutionalization of processes and changes in agriculture that had already begun to emerge in Europe. To continue, the politically dominant notion of soils that enabled the emergence of industrial agriculture is therefore inextricably encoded by the logics of contemporary state-politics and narratives of modernity (Tironi et al., 2020; Engel-Di Mauro 2002; Van Sant, 2021), making industrial agricultural politics a central driver of how modernity and capitalism materially make, re-make and unmake the lived worlds of both humans and other-than-human life.

Furthermore, to understand the political ontological nature of how soils are treated and understood in industrial agricultural politics it is useful to note that increasing environmental and biodiversity considerations have not been able to challenge the productivism at the root of

[15] The majority of all crop production in Europe is cereal farming, and, of cereal farming, 67% (in 2019) consists of only wheat and grain maize (Eurostat 2021a). Wheat accounts for close to half of the total quantity of cereals grown across the EU each year. The remainder is principally composed of grain maize and corn-cob mix and barley, with smaller quantities of other cereals, such as rye and oats. Moreover, the majority of cereals consumed in the EU (in 2019) are used for animal feed, with only 30% of cereals going to human consumption (Eurostat 2021b).

agricultural soil relations. Although soils and other 'environmental considerations' have gained attention within the CAP, especially in the 2000s (Council of the European Union, 2022b), there are no binding or overarching policies for soil protection on the EU level (Heuser 2022). The existing environmental regulations and 'greening' measures remain strongly subsumed under the logic of productivism, and have mainly been adopted *because* they enable the continuation of current modes of production (de la Bellacasa 2017; Levidow 2015).

Building on the aforementioned sections, I argue, that the modern industrial food system (or the 'corporate food regime'; see McMichael 2005) is a manifestation of modernity as a way of organizing the world through its specific relations to soils, land and other-than-human life. The dominance of this political ontological power in organizing life and landscapes is also characterized by the lack of choice that farmers face. While most farmers in Europe are not drivers of agrarian capitalism or do not necessarily aim to practice extractivist relations to soils, the operational framework in which they are forced to function is shaped and determined by the principles of modern industrial agriculture and powerful agribusiness actors. Large farms currently control most of the arable land in the EU, and, as argued by Wendy Wolford (2021), large-scale commodity production thus shapes the conditions of most producers—irrespective of whether they participate in, reject, or even resist the form of farming which is degrading soils and landscapes. This is representative of the how industrial and extractivist forms of world-making function by denying and erasing the possibility of other ways of being in the world (as discussed in e.g. Kröger 2021).

The small-scale farm bankruptcies, land consolidations, simplification of rural landscapes, and specialization and re-organization of farm production for export witnessed in Europe can be seen as manifestations of the effects of extractivist forms of agriculture on the social fabric and agricultural community configurations. Similar to the imposition of plantations around the Global South discussed by Wolford (2021) (although on a different scale and intensity), the more gradual imposition of mechanized industrial farming in Europe is also predicated on the mining of life for profit, the removal of pre-existing community ties, and the reconfiguration of rural lifeways around commodity production. In this section I have shown how industrial agriculture's relations to soils contribute to making certain kinds of worlds at the cost of erasing others. In the next section I further elaborate on the concept of *soil extractivism* as an effort to make sense of and to describe a part of industrial agriculture's world-making, as it occurs through politically institutionalized relations towards soils.

5. Theoretical contribution: Soil extractivism

Extractivism, as a concept, is rooted in the history of extensive natural resource extraction fueled by colonial structures of power (Chagnon et al., 2022). As an academic discourse, extractivism has its origins in Latin American political economy and political ecology and is commonly used to refer to a mode of economic production in which 'natural resources' are removed in large quantities and used as raw materials for industrial processes elsewhere (Szeman and Wenzel 2021). Conceptually, extractivism has seen various definitions and emphases, and its' world-systemic significance continues to be expanded upon and explored (see Chagnon et al., 2022 for a review). However, the majority of existing literature on extractivism tends to address soils only in the context of their contamination by extractivist practices, such as mines. Soils are thus viewed merely as a realm in which negative environmental effects appear rather than a thing to be extracted in itself.

Agro-extractivism has been recognized as a key manifestation of extractivism by numerous scholars (Acosta, 2013; Svampa 2013; Chagnon et al., 2022; McKay et al., 2021). Many case studies on agro-extractivism focus on the Global South and on a form of agriculture that Gudynas (2010), for example, argues is characterized by monoculture plantations, the use of transgenic crop species, heavy mechanization, and the use of chemical pesticides and fertilizers, and is aimed at commodity production for export markets. In addition, as discussed in Chagnon et al. (2022), research on extractivist modes of agriculture also emphasizes its' connections to land-grabbing (Borras et al., 2012), class struggle (Bernstein 2010), and myriad socio-environmental harms (Alonso-Fradejas 2018; Cáceres 2015). Furthermore, agro-extractivism (like all forms of extractivism) should always be understood in the context of its wider operational logic (McKay et al., 2021) and as a specific way of organizing the world (Chagnon et al., 2022). According to McKay et al. (2021: 8), agro-extractivist practices fundamentally operate on a logic which "undermines the very material bases for which their reproduction and value appropriation depends." They continue by saying that agro-extractivism thus leads to soil exhaustion, ecological destruction, rural out-migration, and catastrophic impacts for multispecies life, including humans (McKay et al., 2021). Therefore, beyond its 'apparent features' (McKay et al., 2021), extractivism is not simply a political project, a feature of an economic system, or even a set of practices; rather, and more fundamentally, it is a *way of organizing life* (including land, bodies, relations, and labor—both human and other-than-human) and one of the main ways capitalism and modernity materially manifest themselves in the world today.

Based on the aforementioned logic, dynamics, and operational principles of industrial agriculture, I propose a definition of *soil extractivism* as practices and operations aimed at profit production and capital accumulation that deplete and violently re-organize soils' multispecies life. Soil extractivism is thus a description of a process and set of practices where the multispecies life and minerals of the soil are exploited and depleted in a non-regenerative way to produce crops that are treated as commodities. At the same time, due to its foundational core of violent and systemic depletion and re-organization of multispecies life and landscape, soil extractivism also constitutes a way of organizing life, similarly to all forms of extractivism (Chagnon et al., 2022). Under extractivist practices and logic, soils are thus assigned a rigid role and forced to labor until exhaustion (Lyons 2020). To further characterize and define soil extractivism, I offer the following criteria which, in conjunction with the aforementioned description, constitute the term. Materially soil extractivism thus refers to practices and ways of relating to soils that

- continuously strip soils bare of plant cover,
- deplete soils nutrients and microbial life, significantly reducing the amount and diversity of different lifeforms in the soil,
- by-pass or make redundant the soils' own multispecies base in producing plant growth, for example through the heavy use of chemical and synthetic fertilizers or pesticides to which the system becomes dependent on
- pay no or extremely limited attention to the regeneration or maintenance of soil, apart from adding substances that are assumed to directly contribute to the growth of cultivated crops,
- are based on high cropping intensity, heavy tilling, and disturbance of soil structure,
- produce barren or polluted soils which make it impossible or difficult for other agricultural operations to cultivate the soil, even when extractivist activities are discontinued (here lending from Kröger's [2021] general characteristics of extractivisms).

In order to situate the concept further, although soil extractivism is a subset of agro-extractivism, and all agro-extractivisms deplete soils, these two terms cannot be conceptually equated. This is because, even if the other core characteristics of agro-extractivisms (such as plantation-sized fields, labor exploitation, dispossession of lands, deforestation, production for exports [McKay et al., 2021]) were absent, soil extractivism can and does also occur in less obviously unsustainable agricultural practices (such as wheat production in Europe). As examinations of agro-extractivism often focus on plantation-sized monocultural farming, they miss the issue that extractivist forms of (ab)using and re-organizing soils can and do occur in small- or medium-scale settings where farmers

practice normalized forms of industrial agricultural practices, such as use of heavy-machinery, high cropping intensity, and the extensive use of external inputs. Nonetheless, soil extractivism should also not be equated with all forms of soil degradation and contamination. Beyond the apparent features of agro-extractivism, soil extractivism focuses on the *type of relation* with soil through which soils are mined of their nutrients and organic mass (i.e., life); making extractivism the *modus operandi*, not a symptom or a result. Thus far, only a small number of contributions have explicitly used the term soil extractivism in the extractivism literature. Kröger and Ehrnström-Fuentes, 2021: 203), for example, characterize forestry extractivism (as a subset of agro-extractivism) through "soil, water, and carbon extractivism" due to its destructive impact on these realms. Theoretically, the concept of soil extractivism builds on some recent (and divergent) contributions to extractivism, such as Kröger's (2021) work on the political economy of existences, which examines the existential redistributions and extinctions produced by monoculture plantations in Brazil. Another example is Alonso-Fradejas' (2020: 140) research on predatory agrarian extractivism in Guatemala, which he characterizes as "life-purging," as it manufactures environmentally and socially toxic landscapes. These contributions, along with an increasing amount of brilliant conceptual work within anthropology and indigenous, feminist, and decolonial studies (Tsing et al., 2017; Vindal Ødegaard et al., 2019; de la Bellacasa 2017; Grosfoguel, 2020; see also Chagnon et al., 2022), facilitate a shift in understanding extractivism and capitalist appropriation of both the material and intangible world(s) as commodification of life in general (Lyons 2020), from which concepts such as 'soil extractivism' are able to arise.

By naming the destruction of soils done by industrial agriculture as *extractivism,* (rather than for example degradation or exploitation), emphasis is put on both the materiality of production and value creation, as well as on the agency and power politics of the activities. The materiality of production and value creation refers to an understanding that value is extracted or harvested *from* something (in this case, the multispecies life of soils), rather than created or produced. Additionally, by focusing on the agency and the power politics that are necessary for extractivism to occur, the conceptual foci differ from analyses which examine soil degradation as merely *a result* of agricultural or social practices. Conceptually, extractivism thus always includes a more central focus and an acknowledgement of agency in extractivist operations, and power asymmetries within these relations. Importantly, extractivism does not therefore just 'happen' amidst other activities but is the *main purpose of the activity*.

By examining soil extractivism through a political ontological lens one is also able to understand the erasure that ensues from extractivism as erasure of existences (and not just a decrease of passive resources or elimination of things). Additionally, soil extractivism as a political ontological (i.e. world-making) process does not just erase soils multispecies life, but also re-organizes existences of the remaining beings (as discussed for example in Kröger [2021] in the case of increased proliferation of pests), creates new simplified ecologies, and as such determines new conditions for what kinds of lives and lifeways are possible and which are not (for both human and other-than-human). This does not however mean that all re-organizations of soil ecologies are extractivist, as all farming practices modify and rearrange soil life to some extent.

In addition, what this means for wider theocratizations on extractivisms is that the concept of soil extractivism enables examination of extractivisms which do not only stem from certain historical dynamics between the Global North and South or other colonial political economic power structures. Soil extractivism arises from, and speaks to, a wider understanding of coloniality as not only a monolithic structure of historical imperialism and state-relations, but also "a set of contemporary and evolving land relations that can be maintained by good intentions" or presumed best-practices (Liboiron, 2021: 6). Soil extractivism thus denotes a profound ontological logic and way of organizing the web-of-life and acknowledges that there are different levels of extractivism (as discussed in depth by Kröger 2021) as well as different levels of visibility of the effects of extractivist practices.

Soil extractivism is also at the very foundation of modern industrial social organization, although it has remained an unnamed footnote in political economic and agrarian studies analyses related to capitalist agriculture. For instance, Friedmann and McMichael (1989) discuss capitalist development through the concept of 'food regimes.' They, along with Bauerly (2017), argue that the standard model of agriculture which has been reliant on mechanization and chemical inputs from early on, arose from colonial land relations and the idea of harnessing land for state- and industry-building after WWII (as already discussed in the case of European Union's early agricultural politics). This subsequently set the stage for contemporary global extractivist agriculture (Chagnon et al., 2022). Soil extractivism (although not named as such) thus began to globalize and intensify due to specific geopolitical and economic projects. Later on, with the neoliberal turn in the 1980s, agriculture became increasingly dictated by corporate capital, thus marking the shift towards what McMichael (2005) calls the corporate food regime, which strongly characterizes the current moment in agricultural soil relations.

As with all forms of extractivism, soil extractivism cannot be uncoupled from the political ontological relations that cheapen and marginalize that which is being extracted. Extractivism, as one of the globally and historically established engines of capital accumulation, is founded on the exploitation of unaccounted, cheap nature and labor (Moore 2015) in which capital and economic growth are produced *through* the lives and bodies of other-than-human beings (Krzywoszynska 2020). Through extraction and depletion of nutrients and organic matter, soils, land, and plant, fungal, and microbial life become not just commodified but re-organized in the service of capital accumulation. As Lyons (2020: 52, italics added) argues, it is the "*injection of capital into the soil*, the so-called permanent improvements that change the physical characteristics, chemical properties, and biological life of soil, that converts soil into a laboring body deemed capable of being worked overtime, exhausted and continuously resuscitated through chemical input substitution." Through this 'injection,' landscapes and soil ecologies are transformed to uphold and intensify current dynamics of capital reproduction. Therefore, as summarized by De la Bellacasa 2020a: 100), "agricultural intensification is not only a quantitative orientation—yield increase—but also a way of life, and a *qualitative mode* of conceiving relations to the soil", thus denoting the enactment of an ontology.

Soil extractivism is also characterized by the massive scale and intensity in which microbial, fungal, and plant deaths (resulting from, for example, pesticides) begin to occupy lively bodies and lively landscapes, such as waterways (building on Rose 2011). All soil is the result of beings "living and dying within the soil" (Krzywoszynska 2019: 668), but one of the core tenets of soil extractivism is a type of destruction of multispecies life in which dead matter and dead bodies do not 'turn back into life,' but rather begin to expand and pile up in the web-of-life as waste, as discussed by Rose (2011) and Van Dooren, 2014) in their work on extinctions. In the same vein, Chao and Kirksey (2022) argue that industrial processes (including industrial agriculture) systematically uncouple life from death and by doing that diminish "death's capacity to channel vitality back to the living."

From a political ontological point of view, as discussed for example in Chagnon et al. (2022) extractivism is thus a mode of organizing life that does not allow for multiple worlds to co-exist. In the same vein,

Kröger (2021) refers to extractivisms as a form of ontological occupation of territories. Reflecting on industrial agriculture through the concept of soil extractivism as ontological occupation also allows one to better understand the role of invisibility and gradualness of the destruction. The current capitalist world-system manifests itself extremely violently in the Global South, creating toxic landscapes and fragmented assemblages of life[16] (Alonso-Fradejas 2020; Wolford 2021). However, a similar process of manufacturing environmentally and socially toxic landscapes is also present in Europe, albeit in a 'stealthier' manner, with related contestations and conflicts often not framed as ontological.

In Europe, the violence towards other-than-human life is almost banal in its relatively slow accumulation. This slower, more inconspicuous, and gradually produced destruction of soils and rural landscapes thus also works to normalize the process itself, as this violent degradation occurs 'under the radar' and is seen as correct and efficient kind of farming and land governance. This also further legitimizes the EU's colonial relations in agricultural trade elsewhere (as seen in the 'Green Revolution', see, e.g., Patel 2013; Hetherington 2020). The gradual degradation of life through soil extractivism thus resonates powerfully with Rob Nixon's idea of 'slow violence,' which is made mundane through its repeated exposure and representation (Laurie and Shaw 2018; Parks 2021). The mining of soils and gradual contamination of land, bodies, and water thus create new conditions for normality, in which daily lives are permeated by unseen deadliness and emptiness of multispecies loss.

6. Conclusions

> *The soil is the great connector of lives, the source and destination of all. It is the healer and restorer and resurrector, by which disease passes into health, age into youth, death into life. Without proper care for it we can have no community, because without proper care for it, we can have no life.* (Wendell Berry, 1977)

This article discusses how certain ways of relating to soils produce and enable specific kinds of agricultural policies, economic practices and ways of being in the world. I described how mechanistic, and non-relational soil ontologies have become institutionalized into physical landscapes and normalized practices that can be called upon with concepts such as soil extractivism.

As discussed by (De la Bellacasa (2020c), in the past 15 years, there has been a major resurgence of a more general understanding of soils as living. However, due to decades of intense industrial agricultural and other similar land practices, the imaginary of soils as a chemical, passive medium for plant growth has already become operationalized into physical landscapes and normalized into an extractivist form of relating to soils. A core characteristic of the thinking of how the world works at the foundation of modern industrial agriculture and agricultural politics is the reduction of the world to a simplified form of itself, of soils into dirt, of landscapes into passive areas, of farming into the production of things. The continued abuse of soils, even in times of growing attention to their aliveness, is indicative of how the issue of caring for soils is not just epistemic but ontological. While the increasing scientific and technological knowledge is crucial in bringing attention on soils in the political sphere, conventional techno-scientific conceptions alone are unable to reconfigure the current dominant extractivist soil-relations (de la Bellacasa 2020a). Thus, thinking with de la Bellacasa (2020c) and Mies and Shiva (2014), sustainable and more just relations can be fostered only through alternative conceptual, ethical, and ontological 're-tellings' of soils.

Paying attention to soils and operationalizing more caring relations with them is extremely urgent, as the destruction of soils and soil health has fundamental implications for all societal life. Modernity is built on the institutionalized extraction of soils and other(ed) life. The on-going systemic degradation of soil ecosystems through chemical pollution, erosion, salinization, sealing, and loss of organic matter are representative of historically institutionalized disjunctures in the organization of societal life in relation to the wider web-of-life. The industrial revolution, the current scale of urbanization, and the modern organization of societies hinge upon the industrial and intensive forms of agriculture that emerged in the 1800s. Because this form of agriculture is currently coming to an end, the mode of societal life built upon it will also face foundational changes (or endings). The question of soil degradation is therefore not just a question of agriculture but rather how our environments and surroundings are organized in general. This is also evident in the lived environments of European cities, which are built to insulate people from soil and its multispecies life (Tironi et al., 2020). The extraction, depletion, sealing, and pollution of soils discussed in this article are perfect examples of 'everyday ecocide' disguised as normality, where "bodies of dead others litter our everyday life" (Rigby and Jones 2022: 112).

This article offers a historically and materially situated analysis of the ruptured relations between the currently dominant ways of organizing soil life and their multispecies foundation. The article provides conceptual and theoretical vocabularies for understanding extractivist modes of death- and world-making that are sedimented in landscapes, normalized into social imaginaries, and institutionalized into political structures. Soil extractivism provides a way to conceptualize and better understand the destructions occurring in non-frontier areas of the capitalist world-system and in places where agro-extractivism, as it is currently understood, might be lacking or not fitting. Soil extractivism uncovers the pervasiveness of extractive-based forms of death and destruction and shows how capitalist growth and modernity are premised on ecocide everywhere. Additionally, as a conceptual tool and a theoretical contribution, it indicates that more just and sustainable ways of treating and relating to soils inescapably require attention to relations of power and capital accumulation.

Considering soils through a political ontological lens enables the disruption of dominant categories and modern temporal divides between past, present, and future. Soils are the co-laborers and hosts of all earthly lifeways. They are both a "life sustainer, evolving body, a grave, and trash dump" (Lyons 2020: 62–63). As shown in this article through an analysis of the effects of the CAP, soils and landscapes become 'living archives' (following de la Bellacasa 2020b) for different socio-ecological, political, and economic histories. Thus, thinking with different understandings of soils can potentially create ontological openings and facilitate a shared sense of belonging with other-than-human life (de la Bellacasa 2017). Soil extractivism also enables the realization that modernity, capitalism and the concurrent global crises are fundamentally based on the extraction and depletion of the invisible and unaccounted.

While the degraded state of soils reflects the systemic abuse and neglect of extractivist ways of being, these dominant modes of relating to soils are not the only ones. A plethora of long-established examples exist of sustainable and caring soil relations, from different indigenous farming and land practices to other forms of regenerative agriculture practiced by many small-scale farmers and peasant communities (see, e.g., Kimmerer 2013; Lyons 2020; Gonzalez and Kröger 2020; Nabhan 2018). These ways of being with soils along with the everyday practices of planting, growing, restoring and composting are examples of how soils are being remade and cared for outside of extractivist forms of world-making (Salazar et al., 2020a). While the global degradation of soils signals the horrifying depth of the current global crises and the consequent implications for all life, working and living *with* soils opens ways out of them.

[16] This violence manifests itself, for example, in environmental 'sacrifice zones,' murders of indigenous and environmental protectors, wide-scale pollution and poisoning of bodies, lands, and waterways, and in the overall degradation of people's access and right to land (see, e.g., Oliveira and Hecht 2016; Klein 2014; Global Witness 2021).

Funding

Faculty of Social Sciences, University of Helsinki.

CRediT authorship contribution statement

Saana Hokkanen: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The author reports there are no competing interests to declare.

Data availability

No data was used for the research described in the article.

Acknowledgements

I would like to thank the two anonymous reviewers for their feedback and comments.

References

Acosta, Alberto, 2013. Extractivism and Neoextractivism: two sides of the same Curse. In: Lang, Miriam, Mokrani, Dunia (Eds.), Beyond Development: Alternative Visions from Latin America. Rosa-Luxemburg Foundation, Quito and Transnational Institute, Amsterdam, pp. 61–86.

Alonso-Fradejas, Alberto, 2018. The Rise of Agro-Extractive Capitalism: Insights from Guatemala in the Early 21st Century. International Institute of Social Studies, The Hague. PhD diss.

Alonso-Fradejas, Alberto, 2020. 'Leaving no one unscathed' in sustainability transitions: the life purging agro-extractivism of corporate renewables. J. Rural Stud. 81 (2021), 127–138. https://doi.org/10.1016/j.jrurstud.2020.10.001.

Aviron, S., Lalechère, E., Duflot, R., Parisey, N., Poggiet al, S., 2018. Connectivity of cropped vs. semi-natural habitats mediates biodiversity: a case study of carabid beetles communities. Agric. Ecosyst. Environ. 268 (2018), 34–43. https://doi.org/10.1016/j.agee.2018.08.025.

Ayelazuno, Jasper Abembia, 2019. Land governance for extractivism and capitalist farming in Africa: an overview. Land Use Pol. 81 (2), 843–851. https://doi.org/10.1016/j.landusepol.2018.06.037.

Bakker, L., van der Werf, W., Tittonell, P., Wyckhuys, K.A.G., Bianchi, F.J.J.A., 2020. Neonicotinoids in global agriculture: evidence for a new pesticide treadmill? Ecol. Soc. 25 (3), 26.

Bauerly, Brad, 2017. The Agrarian Seeds of Empire: the Political Economy of Agriculture in US State Building. Brill, Leiden.

Bernstein, Henri, 2010. Class Dynamics of Agrarian Change. Nova Scotia: Fernwood Publishing, Halifax.

Berry, Wendell, 1977. The Unsettling of America. Counterpoint.

Blaikie, Piers, 1985. The Political Economy of Soil Erosion in Developing Countries. Routledge, London, UK.

Blaser, Mario, 2009. Political ontology: Cultural Studies without 'cultures'? Cultural Studies 23 (5–6), 873–896. https://doi.org/10.1080/09502380903208023.

Borras, Jr., Saturnino, M., Kay, Cristóbal, Gómez, Sergio, Wilkinson, John, 2012. Land grabbing and global capitalist accumulation: key features in Latin America. Canadian Journal of Development Studies/Revue canadienne d'études du développement 33 (4), 402–416. https://doi.org/10.1080/02255189.2012.745394.

Borrelli, P., Robinson, D.A., Fleischer, L.R., et al., 2017. An assessment of the global impact of 21st century land use change on soil erosion. Nat. Commun. 8, 2013. https://doi.org/10.1038/s41467-017-02142-7, 2017.

Bouwman, A.F., Beusen, A.H.W., Lassaletta, L., van Apeldoorn, D.F., van Grinsven, H.J. M., Zhang, J., Ittersum van, M.K., 2017. Lessons from temporal and spatial patterns in global use of N and P fertilizer on cropland. Sci. Rep. 7, 40366. http://dx.

Bunker, Stephen G., 1988. Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State. University of Chicago Press, Chicago.

Bureau, J.-C., Thoyer, S., 2014. La Politique Agricole Commune. La Découverte, Paris.

Cáceres, Daniel M., 2015. Accumulation by dispossession and socio-environmental conflicts caused by the expansion of agribusiness in Argentina. J. Agrar. Change 15 (1), 116–147. https://doi.org/10.1111/joac.12057.

Campbell, H., 2020. Farming inside Invisible Worlds - Modernist Agriculture and its Consequences. Bloomsbury Academic, London.

Casado, Jorge, Brigden, K., Santillo, D., Johnston, P., 2019. Screening of pesticides and veterinary drugs in small streams in the European Union by liquid chromatography high resolution mass spectrometry, 2019 Sci. Total Environ. 670, 1204–1225. https://doi.org/10.1016/j.scitotenv.2019.03.207. ISSN 0048-9697.

Chagnon, C.W., Durante, F., Gills, B.K., Hagolani-Albov, S.E., Hokkanen, S., Kangasluoma, S.M.J., Konttinen, H., Kröger, M., LaFleur, W., Ollinaho, O., Vuola, M. P.S., 2022. From extractivism to global extractivism : the evolution of an organizing concept. J. Peasant Stud. 49 (4) https://doi.org/10.1080/03066150.2022.2069015.

Chao, Sophie, Kirksey, Eben, 2022. In: *The Promise of Multispecies Justice*. Duke University Press.

Clapp, Jennifer, 2023. Concentration and crises: exploring the deep roots of vulnerability in the global industrial food system. J. Peasant Stud. 50 (1), 1–25. https://doi.org/10.1080/03066150.2022.2129013.

Clapp, Jennifer, Newell, Peter, Brent, Zoe W., 2018. The global political economy of climate change, agriculture and food systems. J. Peasant Stud. 45 (1), 80–88. http://www.tandfonline.com/doi/full/10.1080/03066150.2017.1381602.

Concepción, E.D., Díaz, M., Baquero, R.A., 2008. Effects of landscape complexity on the ecological effectiveness of agri-environment schemes. Landsc. Ecol. 23 (2008), 135–148. https://doi.org/10.1007/s10980-007-9150-2.

Concepción, E.D., Aneva, I., Jay, M., Lukanov, S., Marsden, K., Moreno, G., Pardo, A., Oppermann, R., Piskol, S., Rolo, V., Schraml, A., Díaz, M., 2020. Optimizing biodiversity gain of European agriculture through regional targeting and adaptive management of conservation tools. Biol. Conserv. 241 https://doi.org/10.1016/j.biocon.2019.108384.

Council of the European Union, 2022a. Timeline - history of the CAP. https://europa.eu/!mw4pJn [online. last visited 7.2.2023].

Council of the European Union, 2022b. Common agricultural policy 2023-2027. http://europa.eu/!pk46Bq [online. last visited 7.2.2023].

de Castro Viveiros., Eduardo, 1998. Cosmological Deixis and Amerindian perspectivism. J. Roy. Anthropol. Inst. 4 (3), 469–488. https://doi.org/10.2307/3034157.

De la Bellacasa Puig, Maria, 2015. Making time for soil: Technoscientific futurity and the pace of care. Soc. Stud. Sci. 45 (5), 691–716. https://doi-org.libproxy.helsinki.fi/10.1177/0306312715599851.

De la Bellacasa, María, Puig, 2014. Encountering Bioinfrastructure: Ecological Struggles and the Sciences of Soil. Social Epistemology 28 (1), 26–40. https://doi.org/10.1080/02691728.2013.862879.

De la Bellacasa, Puig, Maria, 2017. *Matters of Care: Speculative Ethics in More than Human Worlds*. University of Minnesota Press.

de la Bellacasa, Puig, Maria, 2019. Re-animating soils: Transforming human–soil affections through science, culture and community. The Sociological Review 67 (2), 391–407. https://doi.org/10.1177/0038026119830601.

De la Bellacasa Maria Puig, 2020a. Soil times: the pace of ecological care. Solitude Journal 1 Collective Care & Response-ability Jul 23, 2020.

De la Bellacasa, Maria Puig, 2020b. When the word for world is soil – The Understory of the Understory. The Serpentine. [online. last visited 21.5.2924] https://www.youtube.com/watch?v=bfNSPx24f2I.

De la Bellacasa Maria Puig, 2020c. Foreword. In: Salazar, Juan Francisco, Granjou, Céline, Kearnes, Matthew, Krzywoszynska, Anna, Tironi, Manuel (Eds.), Thinking with Soils: Material Politics and Social Theory. Bloomsbury Publishing. ISBN 9781350109599.

De la Bellacasa, Maria, Puig, 2021. Embracing Breakdown: Soil Ecopoethics and the Ambivalences of Remediation. In: Papadopoulos, D., Puig de la Bellacasa, M., Myers, N. (Eds.), *Reactivating elements. Substance, Actuality and Practice between Chemistry and Cosmology*. Duke University Press, Durham.

de la Cadena, Marisol, Blaser, Mario, 2018. A World of Many Worlds. Duke University Press.

de la Cadena, Marisol, 2015. Earth Beings: Ecologies of Practice across Andean Worlds. Duke University Press. https://doi.org/10.2307/j.ctv11smtkx.

Deloria Jr., Vine, 2001. American Indian Metaphysics. In: Deloria Jr., V., Wildcat, D.R. (Eds.), Power and Place: Indian Education in America. Golden, CO: Fulcrum Publishing, vol. 2001, pp. 1–6.

den Herder, M., Moreno, G., Mosquera-Losada, R.M., Palma, J.H.N., Sidiropoulou, A., Santiago Freijanes, J.J., Crous-Duran, J., Paulo, J.A., Tomé, M., Pantera, A., Papanastasis, V.P., Mantzanas, K., Pachana, P., Papadopoulos, A., Plieninger, T., Burgess, P.J., 2017. Current extent and stratification of agroforestry in the European Union. Agric. Ecosyst. Environ. 241, 121–132. https://doi.org/10.1016/j.agee.2017.03.005.

Despret, Vinciane, Meuret, Michel, 2016. Cosmoecological Sheep and the Arts of living on a Damaged Planet. Environ. Humanit. 8 (1), 24–36. https://doi.org/10.1215/22011919-3527704, 2016.

Duby, Georges, Wallon, Armand, 1977. Histoire de la France rurale, tome IV depuis 1914. Seuil, Paris.

Dunlap, Alexander, 2021. The politics of ecocide, Genocide and Megaprojects: Interrogating natural resource extraction, identity and the Normalization of erasure. J. Genocide Res. 23 (2), 212–235. https://doi.org/10.1080/14623528.2020.1754051.

Ehrnström-Fuentes, M., 2022. "Confronting extractivism - the role of local struggles in the (un)making of place. Crit. Perspect. Int. Bus. 18 (1), 50–73. https://doi.org/10.1108/cpoib-01-2018-0016.

Einarsson, Rasmus, Sanz-Cobena, Alberto, Aguilera, Eduardo, et al., 2021. Crop production and nitrogen use in European cropland and grassland 1961–2019. Sci. Data 8, 288. https://doi.org/10.1038/s41597-021-01061-z, 2021.

Engel-Di Mauro, Salvatore, 2002. Gender relations, political economy, and the ecological Consequences of state-socialist soil science. Appl. Econ. Lett. 13 (3), 92–117.

Engel-Di Mauro, Salvatore, 2006. From organism to commodity: Gender, class, and the development of soil science in Hungary, 1900–1989. Environ. Plann. Soc. Space 24, 215–229.

Engel-Di Mauro, Salvatore, 2014. Ecology, Soils, and the Left. Palgrave Macmillan, New York, NY. https://doi.org/10.1057/9781137350138.

Engel-Di Mauro, Salvatore, 2021. Socialist States and the Environment: Lessons for Eco-Socialist Futures. Pluto Press. https://doi.org/10.2307/j.ctv1sjwpx6.

European Commission, 2014. The EU Explained: Agriculture. Publications Office of the European Union, Luxembourg. Nov 2014. http://europa.eu/pol/pdf/flipbook/en/agriculture_en.pdf.
European Commission, 2020. Caring for soil is caring for life – ensure 75% of soils are healthy by 2030 for food, people, nature and climate. European Commission Directorate-General for Research and Innovation and Directorate-General for Agriculture and Rural Development. https://doi.org/10.2777/821504. September 2020. https://www.novamont.com/public/modello-novamont/Mission%20Soil%20Health%20and%20Food%20-%20report%20EN.pdf.
European Environment Agency, 2020. Environment in the European Union at the turn of the century. 3.6 Soil degradation, 23 Nov. 2020. https://www.eea.europa.eu/ds_resolveuid/2fe0cc7cceda9901feeadb2583415216.
European Soil Observatory, 2024. EUSO soil health Dashboard. https://esdac.jrc.ec.europa.eu/esdacviewer/euso-dashboard/ [online. last visited 3.4.2024.
Eurostat, 2021a. Eurostat Regional Yearbook 2021. https://doi.org/10.2785/894358. ISBN 978-92-76-37762-7.
Eurostat, 2021b. Key Figures on the European Food Chain — 2021 Edition. https://doi.org/10.2785/180958. https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-fk-21-001.
Eurostat, 2021c. Land cover and land use, landscape (LUCAS). Land use overview by NUTS 2 regions. https://ec.europa.eu/eurostat/databrowser/view/lan_use_ovw/default/table?lang=en.
FAO, 2017. Global soil Partnership Endorses Guidelines on sustainable soil management, 2017. http://www.fao.org/global-soil-partnership/resources/highlights/detail/en/c/416516/. (Accessed 3 January 2022) [online. visited 5.4.2024.
FAO, 2020. *State of Knowledge of Soil Biodiversity - Status, Challenges and Potentialities,* Report 2020. FAO, Rome. Report found at. http://www.fao.org/documents/card/en/c/cb1928en.
FAO, 2022. Agricultural production statistics 2000–2021. FAOSTAT Analytical Brief 60. ISSN 2709-0078.
FAO and ITPS, 2015. Status of the world's soil resources (SWSR) – main report. Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy. ISBN 978-92-5-109004-6.
Foster, John Bellamy, 1999. Marx's theory of metabolic rift: Classical foundations for environmental Sociology. Am. J. Sociol. 105 (2), 366–405. https://doi.org/10.1086/210315.
Foster, John Bellamy, 2000. Marx's Ecology: Materialism and Nature. NYU Press, New York, NY.
Friedmann, Harriet, McMichael, Philip, 1989. The Rise and decline of national agricultures, 1870 to the present. Sociol. Rural. 29 (2), 93–117.
Galeano, Eduardo, 1997. Open Veins of Latin America: Five Centuries of the Pillage of a Continent. New York University Press, New York, NY.
Gebrekidan, Selam, Apuzzo, Matt, Novak, Benjamin, 2019. The Money farmers: how Oligarchs and Populists Milk the E.U. For millions. The New York Times Nov. 3, 2019 https://www.nytimes.com/2019/11/03/world/europe/eu-farm-subsidy-hungary.html?smid=url-share. (online. Accessed 8 November 2022).
Gebremehdin, Maheteme, Coyne, Mark S., Sistani, Karamat R., 2022. How much margin is left for degrading agricultural soils? The coming soil crises. Soil Systems 6 (1), 22. https://doi.org/10.3390/soilsystems6010022.
Global Witness, 2021. Last line of defense. The industries causing the climate crisis and attacks against land and environmental defenders. September 2021. https://www.globalwitness.org/en/campaigns/environmental-activists/last-line-defence/.
González de Molina Manuel, Soto Fernández, David, Casado, Gloria Guzmán, Infante-Amate, Juan, Fernández, Eduardo Aguilera, Traver, Jaime Vila, García Ruiz, Roberto, 2020. The Social Metabolism of Spanish Agriculture, 1900– 2008: the Mediterranean Way towards Industrialization, vol. 2020. Springer Nature.
Gonzalez, Nidia, Kröger, Markus, 2020. The potential of Amazon indigenous agroforestry practices and ontologies for rethinking global forest governance. For. Pol. Econ. 118 https://doi.org/10.1016/j.forpol.2020.102257.
Graeber, David, 2015. Radical alterity is just another way of saying "reality": A reply to Eduardo Viveiros de Castro. Journal of Ethnographic Theory 5 (2). https://doi.org/10.14318/hau5.2.003, 2015.
Greco, Elisa, 2020. Africa, extractivism and the crisis this time. Rev. Afr. Polit. Econ. 47 (166), 511–521. https://doi.org/10.1080/03056244.2020.1859839.
Grosfoguel, Ramón, 2020. Epistemic Extractivism: A Dialogue with Alberto Acosta, Leanne Betasamosake Simpson, and Silvia Rivera Cusicanqui." In *Knowledges Born in the Struggle: Constructing the Epistemologies of the Global South*, edited by Boaventura de Sousa Santos, and Maria P. Meneses. Routledge, New York, NY, pp. 203–218.
Gudynas, Eduardo, 2010. Agropecuaria y nuevo extractivismo bajo los gobiernos progresistas de América del Sur. Territorios 5, 37–54.
Guthman, Julie, 2017. Life itself under Contract: Rent-Seeking and Biopolitical Devolution through Partnerships in California's Strawberry industry. J. Peasant Stud. 44 (1), 100–117. https://doi.org/10.1080/03066150.2016.1217843.
Hamouchene, Hamza, 2021. The political ecology of extractivism in North Africa. In: Henry, Veltmeyer, Bowles, Paul (Eds.), The Essential Guide to Critical Development Studies. Routledge, London. https://doi.org/10.4324/9781003037187, 30 September 2021.
Haraway, Donna, 2015. Anthropocene, capitalocene, plantationocene, chthulucene: making kin. Environ. Humanit. 6 (1), 159–165.
Hargreaves, Samantha, 2016. Extractivism, its deadly impacts and struggles towards a post-extractivist future. Greening the South African economy: Scoping the issues, challenges and opportunities (2016), 145–160.
Hartemink, A.E., 2016. The definition of soil since the early 1800s. In: Advances in Agronomy, vol. 137. Academic Press, pp. 73–126. https://doi.org/10.1016/bs.agron.2015.12.001, 2016.
Henle, K., Alard, D., Clitherow, J., Cobb, P., Firbank, L., Kull, T., McCracken, D., Moritz, R.F.A., Niemelä, J., Rebane, M., Wascher, D., Watt, A., Young, J., 2008. Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe - a review. Agric. Ecosyst. Environ. 124, 60–71. https://doi.org/10.1016/j.agee.2007.09.005.
Hetherington, Kregg, 2020. Agribiopolitics: the health of plants and humans in the age of monocrops. Environ. Plann. Soc. Space 38 (4), 682–698. https://doi.org/10.1177/0263775820912757.
Heuser, Irene, 2022. Soil governance in current European union law and in the European green deal. Soil Security 6 (2022), 100053. https://doi.org/10.1016/j.soisec.2022.100053. ISSN 2667-0062.
Hillel, Daniel, 1992. Out of the Earth: Civilization and the Life of the Soil. University of California Press, Berkeley, CA.
Hird, Myra, J, 2009. The Origins of Sociable Life: Evolution after Science Studies. Palgrave Macmillan, New York.
Hunt, Sarah, 2014. Ontologies of Indigeneity: the politics of Embodying a concept. Cult. Geogr. 21 (1), 27–32.
Ingold, Tim, 2015. The Life of Lines, first ed. Routledge. https://doi.org/10.4324/9781315727240.
IPCC, 2019. Special report: climate change and land. The Intergovernmental Panel for Climate Change. https://www.ipcc.ch/srccl/.
Jongman, R.H.G., 2002. Homogenisation and fragmentation of the European landscape: ecological Consequences and solutions. Landsc. Urban Plann. 58, 211–221.
Kallio, Galina, 2022. Viljelyn estetiikka uudistavan maa/talouden maisemissa. In: Mikkonen, J., Lehtinen, S., Kortekallio, K., Korpelainen, N.-H. (Eds.), Ympäristömuutos Ja Estetiikka. Finnish Society for Aesthetics Publication; Nro 2). Suomen Estetiikan seura, pp. 92–133. https://doi.org/10.31885/9789526996103.
Kant, Immanuel, 1933. Critique of Pure Reason.
Kimbrell, Andrew (Ed.), 2002. The Fatal Harvest Reader: the Tragedy of Industrial Agriculture. Island Press.
Kimmerer, Robin, 2013. Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants. Milkweed Editions, Minneapolis.
Klein, Naomi, 2014. This Changes Everything : Capitalism vs. The Climate. Simon & Schuster, New York.
Klijn, J.A., 2004. Driving Forces behind Landscape Transformation in Europe, from a Conceptual Approach to Policy Options. The New Dimensions of the European Landscape, vol. 2004. Springer, pp. 201–218.
Kopenawa, David, Albert, Bruce, 2013. The Falling Sky: Words of a Yanomami Shaman. The Belknap Press of Harvard University Press, Cambridge, Massachusetts.
Kröger, Markus, 2016. Spatial Causalities in resource Rushes: Notes from the Finnish mining Boom. J. Agrar. Change 16 (4), 543–570. https://doi.org/10.1111/joac.12113.
Kröger, Markus, 2020. Iron Will : Global Extractivism and Mining Resistance in Brazil and India. University of Michigan Press.
Kröger, Markus, 2021. Extractivisms, Existences and Extinctions : Monoculture Plantations and Amazon Deforestation. Routledge.
Kröger, Markus, Ehrnström-Fuentes, Maria, 2021. Forestry extractivism in Uruguay. In: McKay, Ben M. (Ed.), Agrarian Extractivism in Latin America, Alberto Alonso-Fradejas, Arturo Ezquerro-Cañete. Routledge. ISBN 9781032006079.
Krzywoszynska, Anna, 2019. Caring for soil life in the Anthropocene: the role of attentiveness in more-than-human ethics. Trans. Inst. Br. Geogr. https://doi.org/10.1111/tran.12293.
Krzywoszynska, Anna, 2020. Nonhuman labor and the making of resources: making soils a resource through microbial labor. Environ. Humanit. 12 (1), 227–249. https://doi.org/10.1215/22011919-8142319, 1 May 2020.
Krzywoszynska, Anna, Marchesi, Greta, 2020. Toward a relational materiality of soils: Introduction. Environmental Humanities. ISSN: 2201-1919 12 (1), 190–204.
Kumpf, Desirée, 2021. Multispecies monocultures. Organic agriculture and resistance on Indian Tea plantations. Berliner Blätter 84, 49–61.
Kutílek, Miroslav, Nielsen, Donald R., 2015. Soil the Skin of the Planet Earth, first ed. 2015. Springer, Netherlands. https://doi.org/10.1007/978-94-017-9789-4.
Lassila, Maija, 2021. The Arctic mineral resource rush and the ontological struggle for the Viiankiaapa peatland in Sodankylä, Finland. Globalizations 18 (4), 635–649. https://doi.org/10.1080/14747731.2020.1831818.
Latour, Bruno, 1993. *We Have Never Been Modern.* Translated by Catherine Porter. Harvard University Press, Cambridge, Mass.
Laurie, Emma W., Shaw, Ian G.R., 2018. Violent conditions: the injustices of being. Polit. Geogr. 65 (2018), 8–16. https://doi.org/10.1016/j.polgeo.2018.03.005. ISSN 0962-6298.
Law, Jonathan, 1999. After Ant: complexity, naming and Topology. Socio. Rev. 47 (1_Suppl. l), 1–14. https://doi.org/10.1111/j.1467-954X.1999.tb03479.x.
Law, Jonathan, 2008. On Sociology and STS. Socio. Rev. 56 (4), 623–649. https://doi.org/10.1111/j.1467-954X.2008.00808.x.
Law, Jonathan, 2015. What's wrong with a one-world world? *Distinktion.* Journal of Social Theory 16 (1), 126–139. https://doi.org/10.1080/1600910X.2015.1020066.
Le Noë, Julia, Billen, Gilles, Esculier, Fabien, Garnier, Josette, 2018. Long-term socioecological trajectories of agro-food systems revealed by N and P flows in French regions from 1852 to 2014. Agric. Ecosyst. Environ. 265 (2018), 132–143. https://doi.org/10.1016/j.agee.2018.06.006. ISSN 0167-8809.
Lefebvre, M., Espinosa, M., Gomez y Paloma, S., Paracchini, M.L., Piorr, A., Zasada, I., 2015. Agricultural landscapes as multi-scale public good and the role of the Common Agricultural Policy. J. Environ. Plann. Manag. 58 (12), 2088–2112. https://doi.org/10.1080/09640568.2014.891975.
Levidow, Les, 2015. European transitions towards a corporate-environmental food regime: Agroecological incorporation or contestation? J. Rural Stud. 40, 76–89.
Liboiron, Max, 2021. *Pollution Is Colonialism.* Duke University Press.

Lymbery, Philip, 2017. Dead Zone : where the Wild Things Were. Bloomsbury Publishing, an imprint of Bloomsbury Publishing Plc.
Lyons, Kristina, 2020. Vital Decomposition : Soil Practitioners and Life Politics. Duke University Press. https://doi.org/10.1515/9781478009207.
Lyons, Kristina, 2014. Soil science, development and the "Elusive Nature" of Colombia's Amazonian plains. J. Lat. Am. Caribb. Anthropol.
Manlay, R.J., Feller, C., Swift, M.J., 2007. Historical evolution of soil organic matter concepts and their relationships with the fertility and sustainability of cropping systems. Agric. Ecosyst. Environ. 119 (3–4) https://doi.org/10.1016/j.agee.2006.07.011.
Marchesi, Greta, 2020. Justus von Liebig makes the world: Soil properties and social change in the nineteenth century. Environmental Humanities 12 (1), 205–226.
Marx, Karl, 1976. Capital, vol. 1. Penguin, London, pp. 637–638.
Marx, Karl, 2016. In: Fred Moseley (Ed.), Economic Manuscript of 1864–1865, vol. 729. Koninklijke Brill nv, Leiden.
McKay, Ben M., 2018. Control grabbing and value-chain agriculture: BRICS, MICs and Bolivia's soy complex. Globalizations 15 (1), 74–91.
McKay, Ben M., Alonso-Fradejas, Alberto, Ezquerro-Cañete, Arturo, 2021. Agrarian Extractivism in Latin America. Routledge. ISBN 9781032006079.
McMichael, Phillip, 2005. Global development and the corporate food regime. In: Buttel, F.H., McMichael, P. (Eds.), New Directions in the Sociology of Global Development. Elsevier Press, Oxford.
McKay, Ben M., Veltmeyer, Henry, 2021. Industrial agriculture and agrarian extractivism. In: Akram-Lodhi, A.H., Dietz, Kristina, Engels, Bettina, McKay, Ben M. (Eds.), Handbook of Critical Agrarian Studies. Edward Elgar Publishing, Cheltenham, UK, pp. 503–514.
McMichael, Phillip, 2013. Value-chain agriculture and debt relations: contradictory outcomes. Third World Q. 34 (4), 671–690.
Meeus, J.H.A., Wijermans, M.P., Vroom, M.J., 1990. Agricultural landscapes in Europe and their Transformation. Landsc. Urban Plann. 18, 289–352.
Mies, Maria, Shiva, Vandana, 2014. Ecofeminism. Zed Books, London.
Mol, Annemarie, 1999. Ontological politics. A word and some questions. The Sociological Review 47, 74–89. https://doi.org/10.1111/j.1467-954X.1999.tb03483.x.
Montgomery, David R., 2007. Dirt: the Erosion of Civilizations, vol. 2007. University of California Press, Berkeley.
Moore, Jason W., 2010. The end of the Road? Agricultural revolutions in the capitalist world-ecology, 1450–2010. J. Agrar. Change 10 (3), 389–413. July 2010.
Moore, Jason W., 2015. Capitalism in the Web of Life: Ecology and the Accumulation of Capital. Verso, London, UK.
Nabhan, Gary Paul, 2018. Food from the Radical Center : Healing Our Land and Communities, first ed. 2018. Island Press/Center for Resource Economics. https://doi.org/10.5822/978-1-61091-920-3.
Nearing, Mark A., Xie, Yun, Liu, Baoyuan, Ye, Yu, 2017. Natural and anthropogenic rates of soil erosion, 2017 International Soil and Water Conservation Research 5 (2), 77–84. https://doi.org/10.1016/j.iswcr.2017.04.001. ISSN 2095-6339.
Nogueira, Isabel, Ollinaho, Ossi I., Costa Pinto, Eduardo, Baruco, Grasiela, Saludjian, Alexis, Guedes Pinto, José Paulo, Balanco, Paulo, Schonerwald, Carlos, 2017. Mozambican economic Porosity and the role of Brazilian capital: a political economy analysis. Rev. Afr. Polit. Econ. 44 (151), 104–121. https://doi.org/10.1080/03056244.2017.1295367.
Nygren, Anja, Kröger, Markus, Gills, Barry, 2022. Global extractivisms and transformative alternatives. J. Peasant Stud. 49 (4), 734–759. https://doi.org/10.1080/03066150.2022.2069495.
Oliveira, Gustavo, Hecht, Susanna, 2016. Sacred groves, sacrifice zones and soy production: globalization, intensification and neo-nature in South America. J. Peasant Stud. 43 (2), 251–285. https://doi.org/10.1080/03066150.2016.1146705.
Ollinaho, Ossi I., 2015. Environmental destruction as (objectively) uneventful and (subjectively) irrelevant. Environmental Sociology 2 (1), 53–63. https://doi.org/10.1080/23251042.2015.1114207.
Orgiazzi, A., Bardgett, R.D., Barrios, E., Behan-Pelletier, V., Briones, M.J.I., Chotte, J.-L., et al., 2016. *Global soil biodiversity atlas.* Report, Sevillia, Spain. https://bit.ly/2tGCeBU.
Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., Lugato, E., Meusburger, K., Montanarella, L., Alewell, C., 2015. The new assessment of soil loss by water erosion in Europe. Environ. Sci. Policy 2015.
Panagos, P., Borrelli, P., Poesen, J., 2019. Soil loss due to crop harvesting in the European Union: a first estimation of an underrated geomorphic process. Sci. Total Environ. https://doi.org/10.1016/j.scitotenv.2019.02.009.
Pardo, A., Rolo, V., Concepción, E.D., Díaz, M., Kazakova, Y., Stefanova, V., Marsden, K., Brandt, K., Jay, M., Piskol, S., Oppermann, R., Schraml, A., Moreno, G., 2020. To what extent does the European common agricultural policy affect key landscape determinants of biodiversity? Environ. Sci. Pol. 114, 595–605.
Paredes, Alyssa, 2022. We are not pests. In: Chao, Sophie, Bolender, Karin, Kirksey, Eben (Eds.), The Promise of Multispecies Justice. Duke University Press, pp. 78–102.
Parks, Justin, 2021. The poetics of extractivism and the politics of visibility. Textual Pract. 35 (3), 353–362. https://doi.org/10.1080/0950236X.2021.1886708.
Pašakarnis, G., Maliene, V., 2010. Towards sustainable rural development in Central and Eastern Europe: applying land consolidation. Land Use Pol. 27 (2010), 545–549. https://doi.org/10.1016/j.landusepol.2009.07.008.
Patel, Raj, 2013. The long green revolution. J. Peasant Stud. 40 (1), 1–63. https://doi.org/10.1080/03066150.2012.719224.
Payton, Louise, 2021. Saving our soils: healthy soils for our climate, nature and health. Soil Association Policy Reports.
Pe'er, G., Dicks, L.V., Visconti, P., Arlettaz, R., Báldi, A., Benton, T.G., et al., 2014. EU agricultural reform fails on biodiversity. Science 344 (6188), 1090–1092. https://doi.org/10.1126/science.1252254.
Pe'er, G., Zinngrebe, Y., Moreira, F., Sirami, C., Schindler, S., Müller, R., et al., 2019. A greener path for the EU common agricultural policy. Science 365 (6452), 449–451. https://doi.org/10.1126/science.aax3146.
Plumwood, Val, 1993. Feminism and the Mastery of Nature. Routledge.
Pollan, Michael, 2006. The Omnivore's Dilemma: A Natural History of Four Meals. Penguin, New York.
Reif, J., Vermouzek, Z., 2019. Collapse of farmland bird populations in an Eastern European country following its EU accession. Conserv. Lett. 12 (2019) https://doi.org/10.1111/conl.12585e12585.
Rigby, Kate, Jones, Owain, 2022. Roadkill: multispecies Mobility and everyday ecocide. In: Van Dooren, T., Chrulew, M. (Eds.), Kin: Thinking with Deborah Bird Rose. Duke University Press, Durham, pp. 112–134.
Rose, Deborah Bird, 2011. Wild Dog Dreaming : Love and Extinction. University of Virginia Press.
Rowedder, Simon, Tappe, Oliver, 2022. Extracting Development: Contested Resource Frontiers in Mainland Southeast Asia. ISEAS Publishing. ISBN: 9789815011197.
Saito, Kohei, 2017. Karl Marx's Ecosocialism: Capital, Nature, and the Unfinished Critique of Political Economy. NYU Press. https://doi.org/10.2307/j.ctt1gk099m.
Salazar, J., Granjou, C., Kearnes, M., Krzywoszynska, A., Tironi, M., 2020a. Thinking with Soils: Material Politics and Social Theory. Bloomsbury Publishing.
Salazar, J., Granjou, C., Krzywoszynska, A., Tironi, M., Kearnes, M., 2020b. Thinking-with soils: an introduction. In: Francisco Salazar, Juan, Granjou, Céline, Kearnes, Matthew, Krzywoszynska, Anna, Tironi, Manuel (Eds.), Thinking with Soils: Material Politics and Social Theory. Bloomsbury Publishing, 25 Jun 2020. ISBN 9781350109599.
Šálek, M., Hula, V., Kipson, M., Daňková, R., Niedobová, J., Gamero, A., 2018. Bringing diversity back to agriculture: smaller fields and non-crop elements enhance biodiversity in intensively managed arable farmlands. Ecol. Indic. 90 (2018), 65–73. https://doi.org/10.1016/j.ecolind.2018.03.001.
Schreinemachers, Pepijn, Tipraqsa, Prasnee, 2012. Agricultural pesticides and land Use intensification in high, Middle and low income countries. Food Pol. 37 (6), 616–626. https://doi.org/10.1016/j.foodpol.2012.06.003.
Schulte, R.P.O., Bampa, F., Bardy, M., Coyle, C., Creamer, R.E., Fealy, R., Gardi, C., Ghaley, B.B., Jordan, P., Laudon, H., O'Donoghue, C., Ó'hUallacháin, D., O'Sullivan, L., Rutgers, M., Six, J., Toth, G.L., Vrebos, D., 2015. Making the most of our land: managing soil functions from local to continental scale. Front. Environ. Sci. 3, 81. https://doi.org/10.3389/fenvs.2015.00081.
Shattuck, Annie, 2021. Generic, growing, green?: the changing political economy of the global pesticide complex. J. Peasant Stud. 48 (2), 231–253. https://doi.org/10.1080/03066150.2020.1839053.
Shiva, Vandana, 2008. Soil Not Oil : Environmental Justice in a Time of Climate Crisis. Zed Books.
Shiva, Vandana, 2022. "The nitrogen problem in agriculture. Navdanya International." 7 (7), 2022 [online, last visited 19.12.2022]. https://navdanyainternational.org/the-nitrogen-problem-in-agriculture/#_ftn1.
Silva, Vera, Mol, Hans G.J., Paul, Zomer, Marc, Tienstra, Ritsema, Coen J., Geissen, Violette, 2019. Pesticide residues in European agricultural soils – a hidden reality unfolded. Sci. Total Environ. 653, 1532–1545. https://doi.org/10.1016/j.scitotenv.2018.10.441.
Star, Susan Leigh, 1999. The Ethnography of infrastructure. Am. Behav. Sci. 43, 377–391.
Stensrud, Astrid B., 2019. Water as resource and being: water extractivism and life projects in Peru.". In: Ødegaard, Cecilie Vindal, Andía, Juan Javier Rivera (Eds.), Indigenous Life Projects and Extractivism: Ethnographies from South America. CH: Palgrave Macmillan, Cham, pp. 143–164. https://doi.org/10.1007/978-3-319-93435-8_6.
Svampa, Maristella, 2013. Resource extractivism and alternatives: Latin American perspectives on development. In: Lang, M., Mokrani, D. (Eds.), Beyond Development: Alternative Visions from Latin America. Transnational Institute and Rosa Luxemburg Foundation, Amsterdam and Quito.
Szeman, Imre, Wenzel, Jennifer, 2021. What do we talk about when we talk about extractivism? Textual Pract. 35 (3), 505–523. https://doi.org/10.1080/0950236X.2021.1889829.
Szép, T., Nagy, K., Nagy, Z., Halmo, G., 2014. Population trends of common breeding and wintering birds in Hungary, decline of long distance migrant and farmland birds during 1999–2012. Ornis Hung. 20, 13–63, 2014.
Tallbear, Kim, Wiley, Angela, 2019. Critical relationality: Queer, indigenous, and multispecies belonging beyond Settler Sex & nature. Imaginations: Journal of Cross-Cultural Image Studies 10 (1), 5–15. https://doi.org/10.17742/IMAGE.CR.10.1.1.
Tapiheru, J., Capri, W., Lestariningsih, D., Nudya, H.K., 2022. The politics of Citizenship and Welfare: Countering "extractivism" in resource-rich regions in Indonesia. In: Hiariej, E., Stokke, K. (Eds.), The Politics of Citizenship in Indonesia. Springer, Singapore. https://doi.org/10.1007/978-981-16-7955-1_9.
Tironi, M., Kearnes, M.B., Krzywoszynska, A., Granjou, C., Salazar, J.F., 2020. Soil theories : relational, decolonial, inhuman. In: Salazar, J.F., Granjou, C., Kearnes, M., Krzywoszynska, A., Tironi, M. (Eds.), Thinking with Soils: Material Politics and Social Theory, pp. 15–38.
Todd, Zoe, 2015. Indigenizing the anthropocene. Art in the Anthropocene: Encounters among aesthetics, politics, environments and epistemologies 241–254.
Tornel, Carlos, 2023. Energy justice in the context of green extractivism: Perpetuating ontological and epistemological violence in the Yucatan Peninsula. Journal of Political Ecology 30, 1–28. https://doi.org/10.2458/jpe.5485.

Torraco, Richard J., 2005. Writing integrative literature reviews: Guidelines and examples. Hum. Resour. Dev. Rev. 4 (3), 356–367. https://doi.org/10.1177/1534484305278283.

Tostado, L., Bollmohr, S., Eimermacher, M., Bär, J., Bickel, U., Mies Bombardi, L., Bourgin, C., Bödeker, W., Brühl, C., Butscher-Schaden, H., von der Decken, H., Goulson, D., Gräub, B., Haffmans, S., Heimrath, J., Hoinkes, C., Holdinghausen, H., Lemken, D., Liebetrau, L., Mertens, M., Nabel, M., Prescher, A., Quijano, I.-I., Satzger, A., Spiller, A., Wenz, K., Zaller, J., Zühlsdorf, A., 2022. *The Pesticide Atlas 2022*. published by Heinrich-Böll-Stiftung, Friends of the Earth Europe, Bund für Umwelt und Naturschutz, PAN Europe. ISBN: 978-9-46400747-3.

Tscharntke, T., Klein, A.M., Kruess, A., Steffan-Dewenter, I., Thies, C., 2005. Landscape perspectives on agricultural intensification and biodiversity - Ecosystem service management. Ecol. Lett. 8 (2005), 857–874. https://doi.org/10.1111/j.1461-0248.2005.00782.x.

Tsing, Anna Lowenhaupt, 2017. A threat to holocene resurgence is a threat to livability. In: The Anthropology of Sustainability. Springer, New York, pp. 51–65.

Tsing, Anna Lowenhaupt, Swanson, Heather A., Gan, Elaine, Bubandt, Nils, 2017. Arts of Living on a Damaged Planet : Ghosts of the Anthropocene. University of Minnesota Press.

Uekoetter, Frank, 2006. Know your soil: transitions in farmers' and scientists' knowledge in Germany. In: McNeill, J.R., Winiwarter, V. (Eds.), Soils and Societies: Perspectives from Environmental History. White Horse Press, Isle of Harris, UK, pp. 322–340.

Van der Ploeg, R., Böhm, W., Kirkham, M., 1999. On the origin of the theory of mineral Nutrition of plants and the law of the Minimum. Soil Sci. Soc. Am. J. 63, 1055–1062. https://doi.org/10.2136/sssaj1999.6351055x.

Van Dooren, Thom, 2014. Flightways: Life and Loss at the Edge of Extinction. Columbia University Press.

Van Sant, Levi, 2021. The long-time requirements of the nation': the US Cooperative soil Survey and the political ecologies of improvement. Antipode 53, 686–704. https://doi.org/10.1111/anti.12460.

van Vliet, J., de Groot, H.L.F., Rietveld, P., Verburg, P.H., 2015. Manifestations and underlying drivers of agricultural land use change in Europe. Landsc. Urban Plan. 133 (2015), 24–36. https://doi.org/10.1016/j.landurbplan.2014.09.001.

Vindal Ødegaard, Cecile, Rivera Andía, Juan Javier, 2019. *Indigenous Life Projects and Extractivism. Approaches to Social Inequality and Difference*. Palgrave McMillian, London, UK. https://doi.org/10.1007/978-3-319-93435-8_1.

Watts, Vanessa, 2013. Indigenous place-thought and agency amongst humans and non-humans (first Woman and Sky Woman go on a European Tour. DIES: Decolonization, Indigeneity, Education and Society 2 (1), 20–34.

Weis, Tony, 2010. The accelerating Biophysical Contradictions of industrial capitalist agriculture. J. Agrar. Change 10, 315–341. https://doi.org/10.1111/j.1471-0366.2010.00273.x.

Weizsäcker, E. von, Lovins, A.B., Lovins, L.H., 1997. Factor Four : Doubling Wealth - Halving Resource Use : the New Report to the Club of Rome. Earthscan Publications.

Wilson, Emma, Stammler, Florian, 2016. Beyond extractivism and alternative Cosmologies: Arctic communities and extractive industries in Uncertain times. Extr. Ind. Soc. 3 (1), 1–8. https://doi.org/10.1016/j.exis.2015.12.001.

Wolford, Wendy, 2021. The plantationocene: a Lusotropical contribution to the theory. Annals of the American Association of Geographers 111 (6), 1622–1639. https://doi.org/10.1080/24694452.2020.1850231.