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The political economy of agroecological transitions: key analytical dimensions

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ABSTRACT

There is a growing global interest in agroecology, yet agroecological transitions remain fraught with challenges. These include the need to reconfigure the productive and reproductive agrarian relations of unsustainable food systems and to rethink how we work with ecosystems. Using a political economy approach, we propose five key interrelated dimensions for analyzing agroecological transitions: (i) social metabolism; (ii) labor dynamics; (iii) markets and resources; (iv) social organization; and (iv) policies and politics. While these dimensions are often analyzed separately and to varving degrees, we argue that together they contribute to a comprehensive analysis of the political economy of agroecological transitions.

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Introduction

The global food system is failing to deliver welfare and health to many societies while also undermining ecosystems around the world. Ongoing socioeconomic, climate, ecological, and political crises are deepening the injustices faced by those who produce much of the world's food. The promised productivity of industrial agriculture has been unable to address the multiple and urgent food system-related crises - hunger, food insecurity and malnutrition (FAO et al. 2022); rural poverty (FAO 2023),¹ climate change, environmental degradation, biodiversity loss (FAO 2019a; IPBES 2018) and zoonotic diseases and pandemics (Wallace 2016) – all while corporate concentration solidifies its control over the global food system, producing new vulnerabilities (Clapp 2023). Alternative food futures have long been proposed by grassroots movements (mainly peasants and indigenous peoples), civil society organizations and critical scholars. Agroecology is one such alternative.

Described as the application of ecological and social principles for the design and management of healthy, fair, and resilient food systems (Altieri and Nicholls 2012; Francis et al.

¹80 percent of the world's poorest people live in rural areas and primarily depend on farming for their livelihood (FAO 2023). This article has been corrected with minor changes. These changes do not impact the academic content of the article.

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2003), agroecology has been historically practiced in peasant and indigenous agriculture (Altieri 2021; Toledo and Barrera-Bassols 2008). More recently, it has been taken up by civil society organizations, social movements and researchers as a desirable alternative to industrial agriculture. After decades of being pushed aside and ignored by the dominant discourses of agricultural research institutes, international organizations, and most of the academia, agroecology is now being adopted and at times co-opted to serve the interests of global sustainability agendas (e.g. FAO 2018; Quintero et al. 2023; WEF 2018; World Bank 2023).

The process of going from an external input-dependent system based on monocultures to a biodiverse system centred around agroecological principles is referred to as an agroecological transition. We understand 'transition' beyond a purely technical focus by including questions of power and politics explicitly in our analysis (c.f. Scoones, Leach, and Newell 2015). Multiple, interacting transitions may lead to 'transformations', understood as 'a comprehensive socio-economic, political, and socio-cultural process of change' (see Brand 2012, 121). In this contribution, we use a political economy approach, incorporating elements of feminist political economy and political ecology, to outline several key interrelated dimensions for analysing agroecological transitions with the aim of contributing to a better understanding of the possibilities for, and barriers to, food system transformations.

Agroecological transitions are fraught with challenges. Not only are there structural and institutional barriers, or 'lock-ins', that uphold an unsustainable food system (see IPES-Food 2018; Leach et al. 2021), agroecological transitions require rethinking how we work with ecosystems and involve a shift in productive relations, social reproduction and care in agricultural and food systems (Pontes et al. 2023; van der Ploeg 2021). Agroecological systems work to repair epistemic and metabolic rifts by prioritizing traditional ecological knowledge and strengthening the co-production of human and non-human nature (Bezner Kerr et al. 2019; Schneider and McMichael 2010; van der Ploeg 2021). Going against the grain of industrial agriculture and its powerful coalitions is no easy task. Nonetheless, agroecological research, practice and advocacy continue to advance, gain support, and provide solutions to the urgent food, agrarian, climate, sanitary and other systemic crises (Altieri et al. 2015; Altieri and Nicholls 2020; De Schutter 2010; HLPE 2019; IAASTD 2009; LVC 2015).

Growing interest and literature on the topic have resulted in various and often competing interpretations over the definition of agroecology and its different roles (see Giraldo and Rosset 2018; Wezel et al. 2020). This article does not intend to put forth a new definition, a set of guiding principles, or performance indicators, but rather it puts forth key dimensions to consider when analysing agroecological transitions from a political economy perspective. We build on the rich literature that situates the foundations of agroecology in 'agrarian social thought and movements that emerged in opposition to early processes of agricultural modernization [...] problematizing capitalist relations of production' (Sevilla Guzmán and Woodgate 2013, 32–33). As argued by González de Molina et al. (2020, 1) agroecology is inherently political as 'agroecosystems ... are a product of socioecological relations'. We frame agroecological transitions as requiring a broader shift in the social relations of production, property regimes, and forms of power that undergird them, as well as in their socio-metabolic profiles. While many others have called for the need for socio-economic and political reforms (see for e.g. Altieri and Toledo 2011; Giraldo and Rosset 2023; Rosset and Altieri 2017), we hope to contribute to this literature with a relational approach grounded in agrarian political economy. Our approach centres around key analytical dimensions in order to deepen and expand our understanding of the challenges and opportunities for agroecological transitions, including those related to the structural and institutional conditions, as well as the more contingent, context-specific political and material realities on the ground.

This paper begins with a selective review of different frameworks on agroecological transitions and transformations. We then explain our political economy approach and put forth five key interrelated dimensions for analysis: (i) social metabolism; (ii) labour dynamics; (iii) markets and resources; (iv) social organizations; and (v) policies and politics. We argue that these key dimensions offer analytical and political utility for comprehensively examining the political economy of agroecological transitions, which can both address gaps and complement existing frameworks.

Agroecology in review: approaches and frameworks

Agroecology is not static, and as its popularity surges, new actors emerge, as well as new (or nuanced) meanings, approaches, and practices. Giraldo and Rosset have explored the politics around how agroecology is being 'co-opted, institutionalized, colonized and stripped of its political content' as it becomes adopted by mainstream actors (2018, 545). They refer to agroecology as an epistemological and implementation 'territory in dispute' and highlight the need to politicize agroecology, prioritizing its emancipatory and transformative features (Giraldo and Rosset 2018, 2023).

Stephen Gliessman's definition of agroecology includes many aspects which, in many cases, are not all considered with the same level of relevance:

Agroecology is the integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic, and social. It's transdisciplinary in that it values all forms of knowledge and experience in food system change. It's participatory in that it requires the involvement of all stakeholders from the farm to the table and everyone in between. And it is action-oriented because it confronts the economic and political power structures of the current industrial food system with alternative social structures and policy action. The approach is grounded in ecological thinking where a holistic, systems-level understanding of food system sustainability is required. (Gliessman 2018, 599)

In Gliessman's definition, agroecology encompasses a wide range of knowledge systems, social mobilization, and agricultural management aspects, all included in an integral view aiming for transformation. But different actors, including scholars, provide different emphasis on what agroecology entails in terms of processes and aims. Some emphasize the ecological dynamics and interactions to enhance functional biodiversity for achieving food sovereignty (Altieri and Nicholls 2012; Gliessman 2015), the socioeconomic dimensions (Dumont et al. 2016; Giraldo and Rosset 2023), policy incentives (Place et al. 2022) or the political elements and the necessity to challenge the underlying relations of power in food systems (Anderson et al. 2019; González de Molina et al. 2020; Rosset and Altieri 2017).

Others limit agroecology to a one-dimensional perspective, paving the way for cooptation. This is the case of the bio-technical emphasis of production practices and inputs, or a residual and market-based approach (e.g. World Economic Forum, WEF 2018). Alonso-Fradejas et al. (2020) highlight corporate capture with the term 'Junk Agroecology' referring to the purely technical, productivist and market-based approaches that take advantage of agroecology as a market and funding opportunity, without addressing broader political issues of power, autonomy, or labour and resource-property relations, such as those as advocated by social movements at the International Forum for Agroecology in Nyéléni, Mali in 2015 (LVC 2015). Giraldo and Rosset (2023) further flag what they call 'reformist' approaches to agroecology based on input-substitution and top-down methods that perpetuate dependencies and are very limited in terms of effective transformation. Instead, they call for 'emancipatory' processes in agroecology to radically transform the dominant logics and structures of the food system (Giraldo and Rosset 2023).

In terms of assessment, scholars and practitioners have developed a range of frameworks and tools to assess the performance of agroecological transitions and transformations. For instance, Nicholls et al. (2020) propose participatory tools for analysing the redesign and management of farming systems based on agroecological principles. Their aim is to identify areas for enhancing agroecosystems' functioning (therefore their productivity, stability, and resiliency) in relation to (1) functional biodiversity, (2) biomass and nutrient recycling, (3) soil health; (4) efficiency in energy, water, nutrients, soil and seeds use, (5) plant-animal sequences and combinations, and (6) functional interactions and synergies of the agroecosystem components. The participatory approach proposed seeks to foster self-reflection among agroecological practitioners, emphasizing the biophysical aspects of the design and management of agroecosystems however not addressing explicitly other political economic factors.

Gliessman (2016) puts forth a 'Five Level' framework for agroecological transitions (i.e. efficiency increases; input substitution; agroecosystem redesign; producer-consumer direct linkages; build a new global food system) as a guide to classify various steps (or levels) towards food system change. This framework is useful, yet for some contexts it may be interpreted as too linear and rigid, overlooking the multiple, interrelated and interacting dynamics that shape a transition, as well as the diverse circumstances under which a transition may begin.

Mier y Terán Giménez Cacho et al. (2018), based on their analysis of emblematic cases from the Global South, suggest eight drivers to 'territorial scaling' of agroecology, which can also be considered as leverage points to foster agroecological transitions and transformations. These are: (1) crises that drive the search for alternatives; (2) social organization; (3) constructivist teaching–learning processes; (4) effective agroecological management; (5) mobilizing discourse; (6) external allies; (7) favourable markets; and (8) political opportunities and favourable policies. The authors argue that these drivers are catalytic for strengthening the social fabric upon which agroecology is built, amplified and sustained from below. While this study is helpful to understand the success of agroecological scaling, the 'drivers' may not necessarily explain how transitions shape and are shaped by the social relations of agrarian change, which our approach brings to the centre of the analysis. Moreover, we believe that such an approach could be complemented by analysing broader political and economic conditions (including unfavourable policies and markets) and how these shape the prospect for the emergence of agroecological transitions more relationally.

Another valuable contribution is the 'domains of transformation' framework elaborated by Anderson et al. (2019) who use the multi-level perspective to analyse various enabling and disabling conditions within six proposed areas that shape agroecological transformations. These include (1) access to natural resources; (2) knowledge and culture; (3) systems of exchange; (4) networks; (5) equity; and (6) discourse. Using a socio-technological systems approach, they argue that community-self organization (within what they call the 'niche) has the most potential for a transformation (within what they call the 'regime') to take root. However, they also state that the 'enabling' and 'disabling' conditions within each 'domain' 'are fundamentally political choices because "governance" sets the rules, access rights, economic tools, and accountability mechanisms for all actors involved [...] and determine to what extent communities can "self-organize" [...]' (Anderson et al. 2019, 17–18). This interplay between the 'niche' and 'regime' will of course vary depending on the context and would benefit from a deeper look into the social relations within and between each domain to help us understand the complexity of power, politics and asymmetries in human-environment dynamics (see Scoones et al. 2020).

IPES-Food (2018), with Gliessman as lead author, also provides an analytical framework based on 'Four Key Dimensions of Change' for agroecological transitions. This includes changes in: (1) production practices; (2) knowledge generation and dissemination; (3) social and economic relations; and (4) institutional framework. They use these categories as the foundation to analyse case studies of agroecological transitions from different parts of the world and find that various types of overlapping changes within and across these components are necessary to kickstart and sustain them. The strength of this framework is its empirical grounding into a common analytical proposal in order to identify 'the range of entry points and leverage points for transition' (IPES 2018, 13). We build on these dimensions, but find them to be too broad and generally descriptive, and thus could be bolstered with a more detailed analysis into the political economy within each dimension.

Petersen et al. (2020) present the LUME Method for analysing the economic-ecological functioning of agroecosystems, combining Chayanovian, socio-metabolic and political economy approaches. LUME includes two major dimensions of analysis: (A) qualitative through systemic attributes (e.g. autonomy, social participation, gender equity/ women's empowerment, etc.); and (B) quantitative through economic indicators through analyses of agroecosystems (e.g. gross income, the gross value of the agroecosystem, etc.), work (commercial and self-consumption, domestic and care work, social participation and pluriactivity), economic circulation (commercial exchanges or reciprocity), gender and generational dynamics. LUME is comprehensive and provides a framework to analyse agroecosystems in relation to the broader dynamics of agro-food systems, acknowledging that both are co-productions of social organizations in their interaction with ecosystems. At the methodological level, LUME aims to visualize peasant modes of production and life from an integral and participatory perspective, beyond the limitations of conventional economic or purely biological analyses. Our approach builds heavily on the LUME method, attempting to provide more conceptual clarity to the key analytical dimensions grounded in agrarian political economy and social metabolism approaches. While the LUME method is designed to assess agroecological performance in a holistic way, our approach highlights key dimensions that influence a transition, including impeding and facilitating factors. Our approach is also proposed to be used in a comparative way, in order to assess key differences between agroecological and conventional farming systems.

Outside scholarly literature, the FAO put forth '10 Elements of Agroecology' as a framework 'to help countries operationalize agroecology' and to act as 'a guide for policymakers, practitioners and stakeholders in planning, managing and evaluating agroecological transitions' (FAO 2018, 2). These elements aim to serve as broad guidelines that include both normative aspects (e.g. 'responsible' governance) and relationships between agroecology and broader systems (e.g. part of circular and solidarity economies). The FAO then leveraged these 10 elements into what is called the Tool for Agroecology Performance Evaluation (TAPE). Its objective is to produce evidence on the ecological, sociocultural, economic, health and nutrition, and governance dimensions of agroecology to support agroecological transitions and policy making. The core performance criteria considered in TAPE are: (1) Secure land tenure; (2) Productivity (and stability over time); (3) Income (and stability over time); (4) Added value; (5) Exposure to pesticides; (6) Dietary diversity; (7) Women's empowerment; (8) Youth employment; (9) Agricultural biodiversity and (10) Soil Health (FAO 2019b). The latest validation workshop of TAPE² concluded that although it has made strides as a methodological tool, it still requires adjustments, reformulations, and a better contextualization of the different steps within the TAPE approaches.

While TAPE's indicators are useful to a degree, assessing the 'performance' of agroecological production will vary according to a variety of context-specific factors and, importantly, according to the maturity of the agroecological system. For instance, newer and/or transitioning farm units will likely not reach the level of species diversity and richness to improve the organic matter and soil structure when compared with the more advanced and mature agroecological farms. This is why focusing on the transition remains so important since it is during this process where the most difficult challenges arise and prevent or dissuade farmers from pursuing agroecology.

All the frameworks briefly revised here make valuable contributions to understand the many facets of agroecological performance and transitions. We took them as reference for developing the political economy approach proposed here, which we argue offers both analytical and political utility and can further advance our understanding of the opportunities and challenges for pursuing agroecological transitions. We highlight key political economic and socio-political aspects that still need to be addressed. These are presented in the following sections.

The political economy of agroecological transitions: key dimensions for analysis

A political economy approach involves investigating the power relations at the heart of socio-economic and political systems. When analysing agrarian change, including agroe-cological transitions, this entails focusing on the relations of production, reproduction, care, property, and power in different agrarian formations and their implications for questions of access, distribution, justice, and sustainability. The approach goes beyond a residual logic of 'market-failure', 'technical fixes' (see Li 2007), or narrowly focusing on agroecology as a way to build resilience to climate change. As Holt-Giménez, Shattuck, and Van Lammeren (2021, 729) put it, 'without addressing the *agrarian resilience* of the

peasantry, it is impossible to conceive of resilient agriculture'. This means bringing to the forefront of our analysis the relations of access and control over land and its productive resources, markets, and labour dynamics to address longstanding agrarian injustices. These analytical dimensions are elaborated and presented below.

In agrarian contexts, social relations are inextricably linked to ecological change and sustainability which can be better understood through an examination of the flows of energy, materials, and information between agroecosystems and their socioecological environment, what González de Molina et al. (2020) refer to as 'agrarian social metabolism' or 'agrarian metabolism'. An analysis into the 'social metabolism' – another analytical dimension – can reveal the extent to which the conditions of production (fund elements³) are maintained or exhausted. As González de Molina et al. (2020, 1) put it 'an agroecosystems' sustainability does not result solely from a series of physical and biological properties: it also reflects power relations.' Agroecological management, for example, sustains and reproduces the conditions of production, while agro-extractivism extracts from and ultimately exhausts these conditions (see McKay, Alonso-Fradejas, and Ezquerro-Cañete 2021).

From this perspective, we cannot ignore the broader social and political dynamics that shape these relations of production, property and power. This implies undertaking an analysis into the social context and landscape of social organizations, as well as the policy context and politics of resource distribution negotiated, contested, and mediated through state-society relations. These social and political dynamics are represented in our analytical dimensions as 'social organization' and 'policies and politics'. We are concerned, then, with how and to what extent, agroecological transitions are shaping and being shaped by these political-economic dimensions, in order to better understand and reveal the opportunities and challenges for food system transformation. Here it is important to point out that depending on the context, different dimensions may be more influential in shaping the conditions for the emergence or expansion of agroecological transitions. Analysing these dimensions together in an interrelated manner, rather than separately and in isolation, offers a much more comprehensive approach to capture the conditions influencing the possibility for agroecological transitions.

Social metabolism

An important aspect of farming is co-production through the interactions between human and non-human nature (van der Ploeg 2013). Co-production involves a particular socio-metabolic profile, or the 'manner in which human societies organize their growing exchanges of energy and materials with the environment' (Martínez-Alier et al. 2010, 153). These energy and material exchanges represent a key analytical aspect when examining transitions. The more an agroecosystem depends on external inputs and short-term 'fixes' to override biophysical barriers (see Weis 2010), the more it increases its social metabolism, long-term instability, and ultimately becomes unsustainable (i.e. soil erosion/degradation, increased water demand, species extinction).

³González de Molina defines fund elements as 'dissipative structures that use inputs to transform them into goods, services, and waste, i.e., into outputs within a given time scale' (2020, 6). In his agrarian metabolism approach, he focuses on four essential fund elements for the reproduction of agroecosystems: land, livestock, agrarian population and technical means of production.

In general, changes in the use of external, mainly synthetic, inputs are one of the aspects that define the initial stages of an agroecological transition. While some argue that external inputs are necessary (Falconnier et al. 2023), others maintain that reducing the dependence on external inputs (either synthetic or biological) is one of the fundamental practices to build producers' autonomy (Altieri, Nicholls, and Montalba 2017; Martínez-Torres and Rosset 2014; Mier y Terán Giménez Cacho et al. 2018; Rosset and Altieri 1997). From the latter, external input reduction of biological inputs and progressive elimination of synthetic inputs is part of the key technical steps for agroecological transitions (Altieri and Nicholls 2020; Gliessman 2015). From a political economy perspective, it is not just about the practice of using external inputs (or not), but also who controls their production and distribution, their interests, the nature of their relationship to those who use them, and the resulting socio-political effects.

For example, the global food system has been increasingly driven by an industrial ideal, replacing local knowledge, labour and inputs with a standardized 'every farm a factory' model (Fitzgerald 2010). The result has been the 'discontinuous but persistent undermining of discrete elements of the agricultural production process, their transformation into industrial activities, and their re-incorporation into agriculture as inputs' (Goodman, Sorj, and Wilkinson 1987, 2). This is what Goodman, Sorj, and Wilkinson (1987) refer to as 'appropriationism', or a process that enables the commodification and expansion of capital into new frontiers, overriding ecological constraints and allowing for the accelerated extraction of non-human nature. Based on the logic of industrial agriculture, so-called 'modern' technologies – including re-formulated versions of synthetic inputs – are proposed to override ecological processes. These overrides demand the introduction of large quantities of energy and materials that are external and harmful to the agroeco-system in the production/consumption process, while vast amounts of biomass are extracted during each cycle, threatening the biophysical foundations of production (Weis 2010).

Agroecological management aims to stabilize exchanges in the social metabolic order through increasing functional biodiversity that contributes to biomass and nutrient recycling, and soil health, in addition to enhanced biological synergies in the ecosystem, among others (Altieri 1995). Due to the challenges arising from the farm and broader context, it is often no easy task for producers to shift to agroecological production. Indeed, the implementation of agroecological principles themselves 'take different technological forms or practices depending on the local socio-economic needs of farmers and their biophysical circumstances, resources on hand, etc.' (Rosset and Altieri 2017, 19–21). The point here, however, is to focus on the material, energy, and informational flows between the agroecosystems and society, and how these exchanges effect the conditions of production (i.e. the fund elements) (González de Molina et al. 2020). What inputs and quantities are involved in production? Are they external to the ecosystem? Where do they originate? How do the input flows affect the ecosystem? What is being extracted from/ returned to the agroecosystems and the territory where they are located?

While it is possible to make broad generalizations regarding these flows – based on synthetic input and fossil fuel use, pollution/contamination, waste, deforestation, landuse change, soil degradation, biomass extraction, etc. – ecological economists have also developed various integrative and comprehensive approaches to study social metabolism such as the Material and Energy Flows Analyses (MEFA) and the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) (see Gerber and Scheidel 2018). Examining these flows, in addition to environmental health or ecological change, helps identify where in the system changes in input or output flows are needed, and the types of alternatives required, depending on the socio-ecological context. Agroe-cology can contribute to changing unsustainable food system structures by helping to repair the rift in the social metabolism. Recognizing the structural factors that lead to (un)sustainability alongside the ability (opportunities and capacities) of farmers (including women and youth) to manage energy and material input and output flows in agroecosystems are important aspects to understand the opportunities and challenges for agroecological transitions.

Labour dynamics

Labour dynamics, or how labour is organized, mobilized and controlled, represent another key analytical dimension in assessing the potential for agroecological transitions. In many contexts, there are structural or institutional arrangements shaping labour dynamics, often difficult to dismantle or change. Labour regimes consisting of, for example, contract farming, or those that produce relations of debt and dependency through value-chain integration (see McKay 2018; McMichael 2013), are examples of organizing labour where farmers cede control over their labour processes. These represent structural barriers for agroecology because they bind farmers in agro-industrial relations, closing or reducing the possibilities and the feasibility of change. In situations where farmers or workers have a higher degree of control over the labour process and are able to make relatively autonomous decisions over production, the possibilities and likelihood of a transition increases. This requires empirical investigations into different labour regimes in food systems to understand who controls and benefits from the labour process in place.

Agroecology entails particular ways of managing agroecosystems and, at least during the initial stages of a transition, could require more labour. As agroecological systems become more advanced, they tend to be labour saving as biological interactions and synergetic processes decrease the human management e.g. in weeding, pest management, and fertilization (see Funes-Monzote 2008; Rosset and Altieri 2017, 80; c.f. Bernstein 2014; Jansen 2015). However, the high levels of agrobiodiversity in agroecological systems could imply more labour power for other specific management tasks, e.g. harvesting due to different timing and techniques for the different species in the system. Such changes may imply a shift in the household divisions of labour both inside and off farm. Here it is useful to examine who performs production and also care roles; how these activities are divided (in terms of tasks and time devoted); who makes what decisions; and how household income is distributed. What are the implications (and for whom) for a transition under different conditions, i.e. for landless families, when agriculture is the only source of income, or if the farm depends primarily on non-farm income?

Laske and Michel (2022) analysed how agroecological practices shape household labour allocation on family farms. They found that while there was no evidence of higher labour requirements for agroecology, women's working hours on the farm increased, while the need for wage workers decreased, which could be due to a substitution between the two. They also suggested it could also represent a shift from

unpaid care work, often unacknowledged and 'invisible', to the more 'formal' and 'visible' work on the farm by women (Laske and Michel 2022). While conventional monocropbased agriculture often exacerbates unequal gender relations (see Ojeda 2021), women's participation in agroecological food systems has been shown to improve gender equity within and beyond the household (IPES-Food 2018; Trevilla Espinal et al. 2021; Zaremba et al. 2021). More systematic analysis of the relationship between agroecological transitions and labour would provide a window into broader considerations of social equity. An equity approach of looking at labour within agroecological transitions considers how intersectionality shapes different value relations within the food system, including labour productivity considering monetary and non-monetary outputs.

Common measures of labour productivity through technological inputs and crop specialization tend to favour production at scale, such as monocropping and a division of labour to increase output. Agroecological systems require more integral approaches to labour productivity. For instance, a study in the Ecuadorian Amazon demonstrates that, when considering the energy efficiency of production, agroecological systems can have high labour efficiency (Caicedo-Vargas et al. 2023). This is due to the improved labour output resulting from the increase in productivity and production diversification linked to the richness in functional biodiversity of agroecological systems. They also found positive synergies with income generation and household food sovereignty through self-consumption. Further analysis on labour productivity in agroecological transitions could consider how diversified food systems – from production to consumption – draw on and contribute to energy gains and positive synergies for household food self-reliance and income (see Akram-Lodhi 2021; Altieri, Funes-Monzote, and Petersen 2012).

Job creation and income are also important aspects to consider. In a study of the 'economic potential of agroecology in Europe', van der Ploeg et al. (2019) argue that agroecological farms have the potential to capture more value added⁴ and have higher income levels⁵ than industrial farms, while providing more employment per hectare and supporting regional economies, among other positive effects. This is due to the fact that agroecological farms reduce external-input dependency and costs, while diversifying production and creating 'synergistic loops that strengthen resilience and help to build economies of scope rather than economies of scale' (van der Ploeg et al. 2019, 49). Industrial agriculture prioritize increasing total production per unit of labour which requires 'ongoing scale-enlargement and/or reducing labour input' (van der Ploeg et al. 2019, 48). These more nuanced features of labour productivity are important to consider when analysing labour dynamics of agroecological transitions.

Moreover, the political economy of agroecological transitions involves unpacking how labour relations are shaped by technological change and innovation. The Green Revolution produced labour-saving technologies (e.g. high-tech machinery), replaced local farmer knowledge (leading to agricultural deskilling,⁶ see Stone 2007), and simplification management (e.g. GM seeds, pesticides, etc.) to increase labour productivity, extract surplus value and, increasingly, render labour surplus to the needs of capital accumulation. While these fulfil their purpose of management simplification particularly at

⁴Value Added (VA) = Gross Value of Production (GVP) - Variable costs + depreciation (C)

⁵Measured by the Value Added as part of the Total Value of Production, (VA/GVP).

⁶Meaning the loss of skills and the knowledge associated to the management implemented, built in time through individual and collective learning.

medium and large scale, they also increase the social metabolic profile of food systems through biophysical overrides and extractivist relations, while shifting control over the labour process away from the farmers (van der Ploeg 2021; Weis 2010).

Analysing these labour dynamics can contribute to recognizing the factors impeding or facilitating farmers' agroecological transitions and their relative autonomy. How production is organized, practiced, and governed is key in this analysis, as well as the presence, autonomy and capacity of farmer associations, labour unions, cooperatives, and other forms of social organizations (discussed below) that may foster or oppose agroecological transitions.

Markets and resources

This dimension considers how access, ownership and control over productive resources is determined, as well as the nature of markets and the ways in which economic and social value is incorporated within food systems, where land, water, biodiversity and other productive resources are the fundamental basis for production. Such analysis could consider farmer and rural workers' control over components of the food system and the ways to increase that control – for example, by replacing external (e.g. GM seeds) with locally-developed internal inputs that contribute to self-reliance (e.g. native seeds), which lowers production risks and costs, and keeps more of the value-added and labour income on the farm (see van der Ploeg 2021). This can be facilitated through various forms of social organization (e.g. cooperatives, associations or horizontal networks) to expand farmer autonomy over seed or crop storage, processing facilities, channels of distribution, and direct links between producers and consumers.

While it is important to analyse the economic potential of agroecology, particularly for small-holders (see van der Ploeg et al. 2019), it is also relevant to identify how different property regimes, including land tenure relations and the upstream and downstream segments of the food system shape the possibilities of agroecological transitions. This includes analyses into knowledge and innovation systems, and schemes of access to land, water, seeds, agricultural inputs and machinery ('upstream'), as well as control over infrastructure (e.g. storage facilities, processing plants, packaging), distribution, and markets ('downstream'). Doing so enables us to understand the flows of capital within a given food system and where and by whom value is being appropriated.

When considering the 'upstream' segment, take, for example, the seed – or what Kloppenburg refers to as 'the biological nexus of farm-level production' (1988, 37). The corporate appropriation of plant genetic resources, the genetic manipulation, and the imposition of an intellectual property rights regime has transformed the seed 'from a public good produced and reproduced by farmers into a commodity that is a mechanism for the accumulation and reproduction of capital' (Kloppenburg 1988, 37, xvi). The privatization of seeds and associated intellectual property is one such structural barrier to supporting the possibilities for agroecological transitions. In response, counter-movements of 'seed activism' have been on the rise,⁷ particularly given the centrality of seeds for farmer autonomy (see Peschard and Randeria 2020). As Garcia-López et al. put it:

⁷See the Forum on Seed Activism in the *Journal of Peasant Studies*, Volume 46, Issue 4, 2020, featuring case studies on Venezuela, Colombia, Argentina, Nicaragua, Turkey, Europe, Brazil and India.

Native and creole seeds are central to agroecology because they are adapted to local conditions, reduce input costs and strengthen the autonomy as seeds are saved rather than purchased, provide greater flexibility in the face of external shocks to agricultural systems such as climate change and promote essential agrobiodiversity. (García López et al. 2019, 828)

Global movements for food and seed sovereignty, such as the International Planning Committee (IPC) for Food Sovereignty and La Via Campesina, are working to change the structural-institutional conditions that restrict native seeds and ultimately separate farmers from their means of production, impeding, among other processes, agroecological transitions. To support them it is important to consider the political economy of public versus private goods and how different forms of ownership of resources and technical inputs shape food systems.

Agroecological transitions also rely on supportive land tenure structures (both at household and communal level), as well as the possibility to preserve the commons (e.g. forests and waters) and their functions. Wittman and James (2022) point to the importance of land governance to be included within agroecology. In doing so, they advance a critical perspective on treating land as property and instead argue for relational ontologies of land, such as collectives or land cooperatives where social and cultural values are incorporated into land governance for 'the possibility of more agroecological futures to foster social and ecological justice' (p.12). The conditions and feasibility for such collectives vary across sociocultural contexts; however, landscapes and territories managed agroecologically call for collective action and are opportunities for relational land management approaches, even if private or hybrid (private combined with communal) property systems are implemented. What is clear is that land governance requires an analysis of the types of property regimes – particularly the laws and regulations presiding over land ownership, access and use – that underpin food systems and condition the possibilities of agroecology (see Calo, Shields, and Iles 2023).

In addition to land tenure, the prospect of expanding and deepening agroecological transitions also relies on the political considerations of land use and its societal utility. Fairbairn (2020) refers to the 'politics of productivity' as a moral framework where the utility of land is narrowly looked at by the extent to which it is productive. Narratives around the so-called rational use of land are driven by the measurements of land productivity that tend to favour economies of scale and industrial production.

Land productivity is not as straightforward as mainstream economists might have us believe. If we take land productivity to refer to the wealth produced per unit of land, then this ultimately depends on one's perception of 'social wealth' (van der Ploeg 2014, 1002). For example, in a monoculture the yield of a single crop might be high, but the overall productivity (measured in calories/energy per harvest unit) might be lower when compared to an agroecological farm (Altieri, Funes-Monzote, and Petersen 2012). Furthermore, the temporal aspect is also important to consider. The use of high-energy-demanding synthetic inputs and machinery used to maximize yields results in soil degradation and loss over time (e.g. erosion, compaction, nutrient disequilibrium), while the high species richness of agroecological farms improves soil health (Rosset and Altieri 2017; Sánchez de Prager 2018). This is one of the reasons why prominent agroecologists (e.g. Altieri 1989; Guzmán and González de Molina 2015; Nicholls and Altieri 2018) have proposed additional productivity indicators to assess the performance of agroecosystems in a more comprehensive fashion. These include energy, water and

nutrients demand/use per harvest unit; total agroecosystem's output per harvest unit (rather than measuring the yield of a single crop); and the land equivalent ratio (LER, which calculates the land area that would be needed to produce in monocultures what is produced on one hectare of polyculture) (Vandermeer 1989). For agroecological transitions, such broader lenses are important not only to measure land as a productive resource, but also its socio-cultural and socio-political importance as territory, including the ways it contributes to social welfare.

On the 'downstream' side, access to markets is central for an agroecological transition to develop. Strong linkages among producers and consumers have resulted in 'territorial markets', or farmers and peasant markets. These markets 'often emerge out of (as much as they are an expression of) a critique on the relations that dominate the general food markets' (van der Ploeg, Ye, and Schneider 2012, 141). They aim to cut out predatory intermediaries and corporate price twisting, build trust and community cohesion (social fabric), and facilitate value-added capture and spill-over effects at the local level. Van der Ploeg, Ye and Schneider (2023) show the importance of peasant markets in Brazil, China and the Netherlands where labour, not capital, governs the market with direct benefits for producers and consumers. Peasant markets are conducive to agroecological transitions as they de-link producers and consumers from the corporate controlled food system, increase their relative autonomy, and foster cooperation. These markets 'thrive where there are 'structural holes', i.e. a lack of adequate connections, in the dominant system' (van der Ploeg 2020, 282). While they may share some key features, they are highly diverse, continuously evolving, 'unruly' processes, dependent on cooperation and everyday struggles in the countryside (van der Ploeg, Ye, and Schneider 2012).

A critical analysis of how markets effect marginalized groups within food systems, and the embeddedness of markets within the social organizations that are at the heart of agroecological transitions is important. Such analysis expands our understanding of how power shapes control over food systems, value-chains and value-networks, while still leaving spaces open for food system actors to reappropriate and redefine markets on their terms and in line with agroecological principles. This entails incorporating questions around ownership, use, and access to agroecosystems and its components (e.g. land, water), knowledge, technologies, inputs, services, physical infrastructure and facilities, non-monetary forms of accessing and sharing food, and others that are essential to support agroecological transitions. Incorporating these aspects in our analysis can help us identify the structural and institutional conditions shaping food system relations as well as different forms of resistance that are navigating the cracks in the system and opening opportunities for alternative futures.

Social organizations

Social context is a core feature of agroecology and social organization is essential for its emergence, success, and amplification (see Mier y Terán Giménez Cacho et al. 2018; Rosset et al. 2011; Rosset and Martínez-Torres 2012; Val et al. 2019). For Rosset and Altieri (2017), 'social organization is the culture medium upon which agroecology grows, and social process methodologies accelerate that growth' (103–104). A political economy approach considers how alliances and/or fractures between different groups shape the possibilities of agroecological transitions at different territorial and institutional

scales. This entails an analysis into the form, character, autonomy and capacity of social organizations for such transitions and corresponding implications.

Peasant and farmer organizations and rural social movements are the vanguard social base for agroecological transitions. In addition to being on the forefront of adopting and amplifying agroecology, transnational agrarian movements such as La Vía Campesina (LVC),⁸ are committed to transforming food systems by fighting for food sovereignty (Guzmán Luna et al. 2022; Holt-Giménez and Altieri 2012). Food sovereignty entails social and political control of the food system by ensuring principles of democratization and rights to knowledge and productive resources for peasants and their movements (Patel 2009). Social organizations, then, are important at the level of production but also key for enacting broader systemic changes within the food system as a whole. While there are overlaps and common linkages between agroecology and food sovereignty (IPES-Food 2018; Gliessman, Friedmann, and Howard 2019), as well as with what van der Ploeg (2008) calls the 'peasant condition' (i.e. struggles for autonomy, co-production, cooperation), this does not mean we should conflate agroecology with peasant agriculture but recognize the complementarity among them acknowledging their mutual contributions (Altieri 2021).

For example, in Spain, agroecologically oriented farmer groups (associations and cooperatives) collaborate through collective economic structures yet are fraught with challenges and differences within them (López-García and Carrascosa-García 2023). Similarly, research in Belgium has shown that the application of agroecological concepts and adoption of practices can lead to tensions based on differences in knowledge and the interests of farmers and farm management (Plateau et al. 2021). However, it is important to recognize that conflicts, tensions and/or cleavages are part of the organizing process and should not necessarily be viewed negatively but can help sharpen their positions or clarify their goals and strategies (Edelman and Borras 2016).

What is important for the proposal here is to understand the social organization landscape. Who are the actors involved and (how) are they organized? The growing interest in agroecology has also brought new actors and institutions into the mix. New alliances, partnerships, and coalitions have emerged, yet some remain contested among certain agroecological movements due to divergent views in approaches and motivations to foster agroecology. How can agroecological movements form alliances and coalitions that are so necessary for amplifying without compromising its political and emancipatory features? Analysing the cultural, ideological, and interest-based differences within and between coalitions, networks and movements can also support a broader understandings of their implications for agroecological transitions (see Fox 2010).

Lastly, it is important to consider the degree of autonomy and capacity of the organizations heading towards transitions. Partnerships between grassroots movements and international NGOs, for example, could increase the capacity of a movement, but could also jeopardize its autonomy. Conversely, a movement might have a high degree of autonomy, but lack the resources to carry out its agenda. This is why strategic alliances that may increase capacities without threatening autonomy and identity are so important, even when they are filled with tensions and cleavages. The uptake of various agroecological initiatives, particularly by international research institutes and donor agencies, can

⁸For a list of other global movements promoting agroecology see Giraldo and Rosset (2023).

influence, disrupt, or cause tensions on the internal processes of a particular movement or association pursuing agroecology. Navigating the social landscape of alliances and interests is important for understanding how agroecology is susceptible to cooperation or, otherwise, cooptation.

Policies and politics

The policy context for agroecological transitions has received a lot of attention due, in part, to the adoption of national plans for agroecology. Most of the focus by researchers and policymakers has been on the design and identification of policies related to biological inputs and guarantee systems (e.g. participatory guarantee systems and third-party certification). This narrow focus has looked more at policies that control agroecology, with less attention paid to policies that effectively foster transitions or are inhibitive. We understand that agroecological transitions do not occur in a vacuum, but within a broader political economy that may not be favourable for transitions. Our focus on policies and politics is interested in understanding how and why resources are distributed, with what implications and for whom. This requires an investigation into the politics behind the policies and an exploration into how policies shape and are shaped by relations among different groups.

There are increasing examples of policies and programmes that intend to foster agroecology, but few are looked at in relation to the broader distribution of public resources, the reason for why resources are distributed the way they are and ways to enact policy change for a more equitable distribution. This section provides short examples to illustrate how political economy analysis can provide a basis for analysing the policy landscape as well as offer mechanisms to shift it.

Examining the policy context is one place to start. Here we can look at budgetary allocation, the policy landscape, and/or identify power networks in policy making (e.g. revolving door politics). This could include a range of interventions in agriculture and food systems from subsidies, taxes, trade, social protection, price supports, public pensions, credit, land reform and others ranging from production to consumption of food. Although each of those interventions support a specific type of production, level of the food system and/or targeted population, they also have distributional effects. We build on Anderson, Rausser, and Swinnen (2013), who contend that agricultural and food sectors are highly politicized due to the importance of agriculture in sustaining more livelihoods than any other sector and the importance of food (prices) for sociopolitical stability (see Barrett 2013). In addition, there are obvious economic interests in the value of inputs, goods and services along the food system value web (e.g. pesticide and commercial seeds). Thus, questions on the distributional aspects of policy, and related socio-economic and ecological implications are important to consider. This means that policies that are supportive of agroecology need to be viewed within a broader political economic context.

An example of the above is Brazil's national policy for agroecology and organic production which was launched with much fanfare in 2013. This plan was based on inter-ministerial responsibilities to support agroecological transitions around the country. It did so by combining and strengthening existing public policies and services to direct them towards organic and agroecological production (see Presidência da República 2012). In its first two years of implementation (2013–2015), the plan distributed an equivalent to

USD 391 million through existing public policies and services. Those resources played a role in agroecological transitions across the country, including the semi-arid northeast where inequality and poverty are the highest (Petersen and Silveira 2017). However, during the same period, some USD130.5 billion was allocated overwhelmingly to agribusinesses through the annual 'Harvest Plan' (*Plano Safra*) (Franca and Ramos 2014). Such a level of support to industrial agriculture and the socioecological transitions as part of a broader food systems transformation.

This is not to discount the continued importance of advocating for and allocating financial resources to agroecologically conducive policies. Academic and institutional literature have identified relevant policy areas to support transitions, which include: research, capacity building and education based on the co-creation of knowledge, strengthening of local actors' organizations (particularly of marginalized groups) and comprehensive evaluation and monitoring frameworks (CFS 2021). In addition to these specific action-oriented policy recommendations, Place et al. (2022) categorize existing agroecologically-supportive policies within five different types: (1) consumer-oriented; (2) producer-oriented; (3) market- and food-environment-oriented; (4) macro and tradeoriented and; (5) cross-cutting. These policies are important to analyse and draw lessons for the promotion of agroecology and its principles. Yet, such policy categories need to be situated within the broader policy landscape, which includes enabling and disabling interventions for agroecological transitions. It is also important to analyse the political and economic forces at play in changing the policy landscape.

This is where the concept of coalitions is an important area to consider for policies and politics. What we mean here includes official political coalitions within the state (e.g. bureaucracies, legislative bodies, etc.,) but also coalitions of social organizations as elaborated above and coalitions between research organizations. That doesn't preclude the development of coalitions between any or all those categories as well. To draw on the previous case of Brazil, political coalitions of landed interests have historically been overrepresented in the Brazilian state. From federal institutions that oversee land allocation and titling (Wolford 2016) to public research organizations (Nehring 2022) and party politics (Santos and Moreira 2023; Sauer 2019), coalitions in Brazil have a rich and contested history between large-scale agricultural interests, on the one hand, and small-scale family farms and social movements on the other. How and in what conditions those coalitions form, yield influence and change over time is important to consider when analysing how policy change can be directed towards or away from agroecologically conducive policies.

In addition to coalitions, we argue that rights and recognition are especially important for historically marginalized and underrepresented groups to have their voices heard and to be involved in the policy process. Through the establishment of rights, citizens engage in the process of claiming, expanding or even losing rights (Isin and Turner 2002). One example on how rights and recognition are shaping prospects for agroecology is the Right to Food⁹ (De Schutter 2010). More than twenty countries have adopted the Right

⁹In addition to the Right to Food, the Rights of Peasants and Other People Working in the Rural Areas (contained in UNDROP), is another key example of a human-rights-based instrument that can contribute to advance agroecology (whose implementation is included as a right of peasants and an obligation for states) and address crucial agrarian issues relevant to rural livelihood and food system transformation.

to Food as part of rights guaranteed in their constitution or broader citizens' rights, including Brazil, South Africa, Cuba and others. It confirms food as a human right with measures of accountability and also as part of a broader extension of rights and policy guidelines to improve national food systems (see FAO 2019c). Although there are certainly limitations to the Right to Food in theory and practice (c.f. Beuchelt and Virchow 2012; Wittman 2011), it is a helpful example to illustrate how different forms of rights and recognition are being negotiated with the state to shift the policy and political context that can be more favourable for agroecological transitions. Consequently, a lack of rights and recognition for marginalized and historically underrepresented groups, including rural populations, can indicate areas of state-society relationships that constrains agroecology and other progressive shifts in the food system.

Considerations on policies and politics for agroecology are manifold. Existing analyses tend to focus more on the promotion or evaluation of policies that are conducive for agroecological transitions. We suggest broadening the scope towards a political economy analysis of the policy landscape in order to identify enabling/disabling policies for agroecological transitions and their implications for different social groups. Further, it is important to consider how such a policy landscape is embedded within political processes and subject to change. How such change happens, and who is involved and impacted, leads us to analyse the various coalitions among state and societal actors as well as the multiple struggles for rights and recognition in the political process.

Final considerations

Agroecology is rapidly gaining momentum, but there is still a long way to go for food system transformation. The plethora of existing literature and frameworks offer relevant insights, while case studies and analyses help us understand the diversity of local processes – all of which are helpful in illuminating the potential for agroecological transitions around the world. This paper aims to contribute to this discussion and debate by presenting key interrelated analytical dimensions grounded in a political economy approach.

Our proposal is to analyse these dimensions together in an interrelated and comprehensive manner in order to understand the underlying dynamics impeding or facilitating agroecological transitions in different contexts. Changes in one aspect, for example, have rippling implications for the others. This is the case of technological change that shapes, and is shaped by, the social relations of different property regimes (e.g. control over commercial seeds, animal genetic resources, machinery, agrochemical inputs, digital genetic information, etc.) with direct implications for labour dynamics (how labour is organized, mobilized and controlled), as well as the social metabolic profile. As van der Ploeg (2020, 277) puts it, 'Technological artefacts "tell" farmers how to run, adapt and develop their farm. New technologies often operate as change agents in disguise.' But, just as these interrelated spheres can entrench and reinforce existing power relations that impede agroecological transitions, they can equally unravel as crises can generate and demand change through new forms of social organization and pressures on the state and private sector, opening spaces for change.

Analytically, this approach can help us identify the interrelated factors that influence and even shape agroecological transitions, and expose narrow technical, economic and technocratic approaches that may serve as part of a coopting (including 'greenwashing'

and 'social washing') agenda. It points out that agroecological transitions require changes across multiple dimensions of a food system and cannot be tackled with apolitical and single-dimensional approaches. Politically, these dimensions can reveal where bottlenecks and openings exist. They can help both state and societal actors identify where best to allocate resources in order to create new pathways for food system transformations rooted in agroecology. The theoretical underpinnings of our approach are merely a first step. Our intention is that these aspects will inform and inspire rich empirical analyses on the political economy of agroecological transitions worldwide.

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