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Agroecological transitions: reading, writing, and thinking across disciplinary divides

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There is great diversity in the methods, terms, and empirical focuses employed by social and natural scientists working on agroecological transitions. The upshot is that whilst various researchers may nominally be putting their shoulder to the same agroecological wheel, the impact of their combined efforts is not what it might be. The aim of this article is to assist in the co-ordination and collaboration of disparate research activities and actors. It does so by offering the readers of this journal a user-friendly guide to some of the terms being used by social scientists (particularly human geographers and anthropologists) in their work on pests, diseases, crop protections and agroecological transitions. Such a document is of particular use as the terms and concepts employed by social scientists are equipped to generate analysis with explicit political insight in a way that those used by natural scientists may not be. The concepts and theories of social scientists foreground the commonalities that cut across case studies which might otherwise seem separated by a reservoir of context specificity. Tooled with these terms of analysis, the promise of agroecology rightly becomes something with far reaching political and justice consequences. These terms are presented across five areas: the ontological, the epistemological, the methodological, the historical, and the aesthetic. Given the range of social, ecological, cultural, and economic barriers involved in effecting an agroecological transition, it is vital that different researchers are conversant in each other's language.

KEYWORDS

interdisciplinarity, social sciences, agroecological transitions, crop protections, ontology, epistemology, methods, aesthetics

1 Introduction

Due to the diminishing efficacy of crop protection programmes predicated on chemical inputs and the considerable socio-ecological costs associated with their production and application, there is now major impetus behind the development of agroecological approaches to pest and disease management. Around the world, biologists, agronomists, entomologists, sociologists, economists, geographers, and anthropologists are all asking questions relevant to this transition: how to make pest suppression and disease control an

emergent function of the farm's ecosystem rather than something applied to it in chemical form? And how to encourage greater uptake of relevant agroecological practices?

There is, understandably, a diversity in the methods, terms, and empirical focuses employed by these researchers. The upshot is that whilst various thinkers may nominally be putting their shoulder to the same agroecological wheel, the impact of their combined efforts is not what it might be. The aim of this Perspective Piece is to assist in the co-ordination and collaboration of disparate research activities and actors. Given this journal's readership, it does so by offering a user-friendly guide to some of the terms being used by social scientists (particularly human geographers and anthropologists) in their work on pests, diseases, and agroecological transitions. Beyond just a general call for greater interdisciplinary work, there is a specific reason why I believe such a document will be of use in this agricultural context. Namely, that the terms and concepts employed by social scientists are equipped to open up room for analysis with explicit political potency in a way that those used by natural scientists may not be.

Where agronomic and ecological research methods major on the biological interactions between pests, crops, soils, landscapes, livestock animals, and farming inputs, social scientists working in this space foreground the commonalities that cut across disparate empirical analyses, connecting case studies that might otherwise seem separated by a reservoir of context specificity. This allows, by way of example, the leaf rust hampering Mexican coffee plants (Perfecto et al., 2019) and the Fusarium Wilt Tropical Race Four ravaging Filipino banana farms (Paredes, 2023) to be read as ecological expressions of the same legacy of plantation farming predicated on ecological simplification and capitalist accumulation. Tooled with social science terms of analysis, the promise of agroecological crop protection rightly becomes something with important social, cultural, political, and justice consequences.

Throughout the paper, key terms are presented in **bold** font. Each is accompanied with one or two references readers might follow up on. The terms are interspersed throughout the paper's five main sections. The list is not an exhaustive account of all the social science research on crop protections and agroecological transitions. It has, instead, been curated to reflect areas of emerging social science research that readers of this journal might be interested in learning about, potentially as a precursor to more interdisciplinary thinking. The five sections are: the **ontological** (categories to organise the world); the **epistemological** (ways of knowing the world); the **methodological** (the empirical practices needed to develop agroecological management strategies); the **historical** (the importance of knowing where pests and diseases come from); and the **cultural** (the habits, norms, and aesthetics that shape the desirability of different approaches to crop management). These five concepts for interdisciplinary thinking can be seen in Figure 1.

2 Ontology: categories to organise the world

What is a pest? The question might seem like an odd place to start, but when thinking about transitions from conventional to agroecological protections, it is worth giving it some pause. Pests and pathogens are, from a conventional farming perspective, the biotic agents that have a detrimental impact on agricultural production owing to the way they can cause disease. From an agroecological vantage point, such categorisations are a little less stable. Pests are only problematic when they are in an agroecosystem (intensive, simple, rationalised) where they can rapidly proliferate and cause great agronomic and financial damage. Whether something can properly be considered a problem is, therefore, dependent on the system it is part of, rather than something essentialised to itself.

This agroecological approach implies a change in pest and disease **ontology** (Grix, 2002). The term ontology refers to the nature of existence and the classifications around which objects are organised. The focus on context in agroecological controls might be described an ontology of **relational materiality** (Krzywoszynska and Marchesi, 2020). In a relational material approach, the character and quality of some element in a system (like a pathogen in a cultivated field) is defined by the other elements it is surrounded by, and the way they all interact: by its *relations*. A biotic lifeform is only problematic if it is found in a highly simplified agroecosystem through which it can run rampant and give rise to a disease outbreak. If, however, it exists in a system whereby its proliferation is checked by agroecological diversity and natural host-predator dynamics, its claim to disease status becomes less clearcut. For this reason, soil quality, crop rotations, land use diversity, water drainage are all proper parts of agroecological crop protection programmes, owing to the way they shape the context in which some pest exists, and thus the chance it has of succeeding. No individual thing 'precedes' – is bigger than, more important that, more defining than – its relations (Puig de la

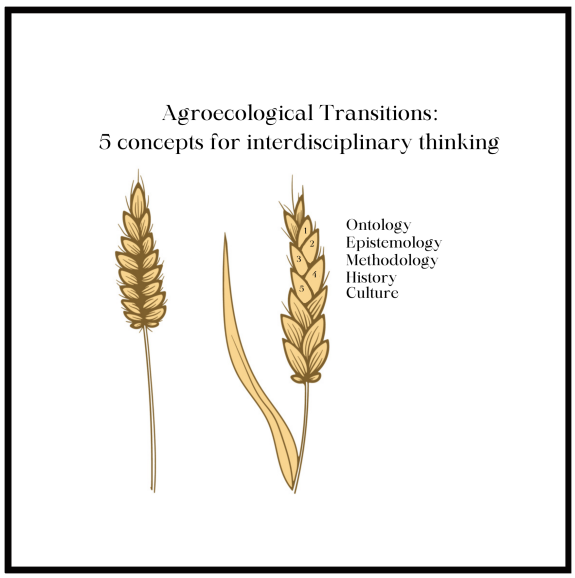

FIGURE 1
Agroecological transitions: 5 concepts for interdisciplinary thinking. Based on an open access image provided by Vecteezy.com.

Bellacasa, 2010). These ideas won't be novel to readers of the journal. The point, though, is that a term like **ontology** offers a shorthand for discussing alternative ways of thinking about the nature of agro-ecological systems and the elements of which they are comprised.

In the social sciences, these ideas are often used to initiate new thinking around agency, intelligence, and unity. Complex ecological systems – like humans, agricultural landscapes, and fields of wheat – can be understood as a set of **entangled** biotic and abiotic factors (Rose et al., 2012). The focus on entanglement reveals how all the components of a complex system exert their agency and influence on the relationship as a whole, and how all are engaged in their own world-making activities (Whatmore, 2002). **Assemblage thinking** (Delanda, 2006) and **Actor-Network-Theory** (Latour, 2005) are popular ways that these ideas are mobilised in the social science literature, both in relation to farm management and beyond (see Müller and Schurr, 2016 for a handy introduction to both). These theories stand to make helpful contributions to agroecological transitions, in which pests are managed via intervention in whole ecosystems (rather than in specific unwanted bodies), and in which greater levels of tolerance is shown towards complexity, variation, and even the pathogens themselves.

An agroecological ontology also necessitates a change in the way we think about the space and the movement of pathogens. In conventional systems, healthy spaces and the desirable bodies they contain (livestock animals in a shed, cereal crops in a field) are guarded to protect against breaches of potentially dangerous pathogens. In agroecological systems, the co-presence of multiple life forms (both wanted and not) is seen as inevitable. So, instead of seeking to (chemically) destroy unwanted life on the farm to preserve the system's sterility, agroecological practitioners look to thwart the progress of a pest by creating an ecological environment hostile to its unchecked proliferation. Agroecological systems, for this reason, protect crops and livestock animals via the presence of life (diverse rotations, biodiversity features, complex soil ecologies), not just by the absence of the pathogen in question. The **borderlines** of conventional and intensive disease prevention systems morph into **borderlands** of multispecies contact (Hinchliffe et al., 2013; Hinchliffe et al., 2016); whilst pest and disease outbreaks shift from a problem of **contamination** to **configuration** (Cusworth and Lorimer, 2024).

3 Methodology: science for agroecological controls

What sort of science is needed to develop and refine agroecological crop protections? Whereas controls that are reliant on chemical inputs have emerged from a research agenda predicted on target action sites for herbicides, insecticides, and fungicides, agroecological systems that seek to manage pathogens via intervention in the farm's entire agroecosystem need a different approach. Their focus needs to be trained on disease implications of interactions between crop types, tillage regimes, soil, insects, buffer strips, precipitation, and they must ask how a set of ecological qualities can be installed on the farm to frustrate the spread of a pathogen. Such methods consider natural host-predator relationships, soil health, and the disease suppression achieved through agroecological diversity.

The difference between these two approaches is reflected in the difference between the terms **reductionist** and **holistic** science (Jordan, 2013). Where reductionist methods evaluate atomistic elements of a system, holistic methods consider the functioning of those systems in the round. The latter strive to accommodate the complexity that characterises rich, dynamic, and diverse ecosystems such as those that installed in agricultural landscapes. Agroecological research programmes, for this reason, experiment with different crop rotations, tillage regimes, cover crops etc. over multi-annual periods, assessing the protections afforded to crops and animals by reconfiguring the farm's ecosystem (Deguine et al., 2023).

A relevant body of research is seeking to understand how to **translate** (Seyhan, 2019) agronomic research into workable guidance for farmers managing farms out there in the world. To facilitate this translational work, agroecological research projects (along with those developing Integrated Pest Management techniques) use working farms like **living labs** (Mambrini-Doudet et al., 2023), experimenting with techniques that are designed to be appropriate and feasible for those in the farm sector. There, the empirical eye focusses both on the pathogen implications of the agroecological controls being studied, as well as their economic and yield outcomes. These research variables represent important factors for managers making decisions about the running of their farms. They can be used to attend to the political injustices associated with the economics of farm management; both in terms of pressure they exert on individual farmers, and as a set of forces shaping the sector in more aggregate terms.

For a related set of reasons, there is also growing agroecological interest in peer-to-peer learning. This amounts to a decentralisation of intellectual and scientific authority in the agricultural sector: away from the R&D departments of large ag-chemical firms, and out to individual farmers and cluster groups developing agroecological controls that work for their landscapes and systems. Here, farmers and other actors question the utility of off-the-shelf agronomy advice, and pivot towards considerations of context-specificity and practicability. This contradicts the universalising ambitions of the Green Revolution, in which knowledge and best-practice for pest and disease control was taken to be universalizable and applicable irrespective of location, context, or history.

This research is working to de-stabilise the **socio-technical lock-in** of intensive farming practices. These have benefitted from decades of dedicated research and development, have become embedded into farmers' psychologies, and have become central to the organisation of the food system today (Vanloqueren and Baret, 2009).

4 Epistemology: ways of knowing the world

The term **epistemology** refers to an account of knowledge (Moser, 2005). The term prompts us to ask questions like 'how do we know what we know?' and 'how do we produce knowledge?'.

This section focuses on the epistemological aspects of agroecological management and its approach to pest management and disease control.

Whereas conventional approaches to pathogens focus on the specific lifeforms that are having an impact on agricultural productivity, agroecological solutions intervene in the agroecosystem as a whole. The reimagination of the site of action carries with it epistemological hurdles. Whilst research can clearly provide insight into the design of effective agroecological controls (see above), noisy ecological systems like working agricultural landscapes cannot ever be comprehensively known. For this reason, any pathogen control intervention might yield unexpected and deleterious results (Deguine et al., 2021). So, what to do when information or data about agroecological pest management bottoms out? How to act under agronomic uncertainty?

Under the agroecological rationale, farmers supplement scientific understanding of pathogens with other forms of knowledge. Where farmers have worked the land for some time, they might have an instinctive grasp of which part of the farm is susceptible to what pest, and what agroecological management interventions have yielded good and bad results in the past (Wezel et al., 2020). Particularly regarding the long-earnt familiarity farmers establish with the landscapes they manage, this knowledge might be described as **situated** (Lundström and Lindblom, 2018). If the knowledge is less about a specific farmer's relationship with their farm, and more about a set of principles and practices observed within a landscape or bioregion or amongst a particular farming community, this knowledge might be considered **local, vernacular** or, depending on the individuals in question, **Indigenous** (Altieri, 2009).

Where farming know-how is not reducible to a set of conscious ideas farmers have about farm management – but where it is instead felt and enacted through the body – it might be described as **embodied** knowledge (Krzywoszynska, 2019). Such bodily attentiveness is often described as feeding into a programme of **agricultural care** (Cusworth, 2023) in which managers interact with the landscape being managed in a more visceral and emotionally attuned way.

5 History: stories of pests, regimes of control

Where do pests come from, and what bearing does that have on the way they are managed? The first section on agroecological ontologies hinted at a change in the way we might understand the genesis of a disease outbreak (recall the shifts from borderlines to borderlands, and from contamination to configuration). Social scientists working on agroecological controls are also interested in histories that reach further back in time.

As part of a broad engagement in decolonial thinking, contemporary socio-ecological crises like invasive species outbreaks and the rise of pesticide resistance are being linked to the historical changes in land management actuated through projects of European colonial expansion. The concept of **the Plantationocene** is particularly relevant for the study of agroecological protections (Barua, 2023; Chao et al., 2023). It seeks to draw attention to the way plantations have provided both intellectual inspiration and economic engine for the intensive farm systems that characterise the food system today. Under the plantation rationale, farmed landscapes were rationalised and accelerated to produce as much food and fibre per unit-area of land as possible. The plantation and Plantationocene terms help connect intensive land management directives – including approaches to crop protections – forged in colonial-era projects with those still employed around the world.

Agroecological pest control systems typically seek to re-establish the diversity manifest in Indigenous or other ecologically intensive systems to thwart the unruly proliferation of pathogens on the farm. For this reason, researchers and farmers often look back in time to **pre-modern** or **traditional** farming systems for instruction on how to manage pests without excessive reliance on modern chemical inputs (Cusworth et al., 2021). The plantation thus offers a socio-ecological counterpoint to agroecological systems, and the differing ways pathogens are managed within them.

Historical engagement from social scientists working on agroecological controls and agricultural pest management has also yielded insight into how pests spread. The process of globalisation (Janelle, 2001; Sheppard, 2002) has made the world smaller, more homogenous, and more connected. The traffic of labour, nutrients, seeds, tourists, and agricultural commodities has had particular consequences for the spread of invasive species (Barua, 2023), giving rise to a specific subset of agroecological approaches to their mitigation (Harrison et al., 2019; Tataridas et al., 2023).

6 Culture: the norms and aesthetics of agroecological protections

Whilst the desirability of pest controls are primarily defined by their efficacy, there are several other factors that shape their attractiveness for land managers. How a farmer feels about their identities as environmental stewards and/or producers of food, what they want their farmed landscapes to look like, and what they believe their farming peers expect from them all feed into their managerial considerations. Such cultural factors mingle with more straightforward pecuniary considerations to create a complex socio-economic nexus of on-farm decision-making.

Social scientists working in this space employ notions of **Landscape** or **Ecological Aesthetics** to foreground the way a landscape's visual appearance influences how managers organise and run their farms (Gobster et al., 2007). The productivity and profitability of intensive farm systems has created a cultural preference for ecological simplicity, order, simplified rotations, and the total excision of unwanted pathogenic life (Burton and Wilson, 2006). The desirability of agroecological landscapes therefore requires a change in the aesthetic preferences of those in the sector. This will need to include tolerance towards higher levels of pest abundance, the presence of connected semi-natural

habitats both within and across multiple farms, the existence of varied crop rotations, multi-cropping systems, fallow land, herbal leys, and more ecologically complex field boundaries (Jeanneret et al., 2021). For this reason, educational and funding interventions to increase uptake of agroecological pest control systems are being designed to blend information dissemination campaigns with a more diffuse aesthetic and cultural re-orientation (Klein et al., 2015; Laforge and Levkoe, 2018). Greater consumer interest in food produced through agroecological methods will also create upstream economic reasons for farmers to (re)consider the desirability of less chemically intensive pathogen controls.

Social scientists have developed conceptual aids to better understand the forces that shape culturally ladened notions of 'good' and 'bad' farming. The **Good Farmer** concept helps unpack the terms used by farmers to reveal how the decisions they make are shaped by a range of social, cultural, and economic concerns (Burton, 2004). If farmers inhabit a cultural environment that values highly productive intensive systems, then the presence of 'messy' agri-environmental features carries with it a threat of criticism from their farming peers that might deter potential engagement (Burton and Paragahawewa, 2011). Relevant to agroecological transitions, recent deployments of the good farmer concept are beginning to show increasingly positive reception from farmers towards those providing agri-environmental public goods (Cusworth and Dodsworth, 2021), and the censure they express towards environmental negligence (Cusworth, 2020).

7 Conclusion

The forces that have produced intensive and chemically dependent crop protections reach back in time and have influenced every aspect of farm decision-making. As a paradigm, it has shaped how pests are understood, how research on crop protections get conducted, and how farmers think about themselves and the landscapes they manage. To catalyse a transition towards greater usage of agroecological protections, interlinking **ontological, methodological, epistemological, historical,** and **aesthetic** barriers must be overcome. Such a project clearly demands sustained inter-disciplinary collaboration. This paper has been written to help facilitate this endeavour.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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