Barriers and enablers to uptake of agroecological and regenerative farming practices, and stakeholder views about 'living labs'

Report for Defra

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Executive summary

This report forms the second component of a Defra-sponsored research project entitled "Evaluating the productivity, environmental sustainability and wider impacts of agroecological compared to conventional farming systems". The first component comprised a rapid evidence review of regenerative/agroecological farming systems. This second component describes and discusses the results of a survey to explore i) farmer and stakeholder definitions of agroecological and regenerative farming, ii) the barriers to the adoption of agroecological and regenerative farming, and iii) farmer and stakeholder views towards the concept of 'living labs' as a way to share research and learnings about agroecological/regenerative farming (Figure 1).

We carried out in-depth semi-structured interviews with 23 respondents, who included farmers (from a range of farm type, size and geography), estate managers, agronomists, academic researchers, and people working for environmental charities, industry bodies, member organisations, government schemes, farmer networks and certification schemes.

Definitions of 'regenerative agriculture' and 'agroecology' vary, both in how they are understood by different stakeholders and how they are used. The two terms are employed interchangeably by some, and sequentially by some (with regenerative practices seen as steps towards a bigger whole-farm agroecological system) or divergently by others (who recognise the social justice, economic and political aspects of agroecology). Agroecological/regenerative agriculture is seen by some as a farmer-led movement, rather than a set of practices. While this presents opportunities to drive uptake, policy and corporate bodies should take care to avoid being perceived as appropriating or alienating existing actors. Recent studies in the UK join our qualitative interviews in identifying barriers and enablers to the agroecological/regenerative transition.

Prominent barriers to farmers include: lack of perceived financial viability and land tenure constraints, lack of policy support, limited support for knowledge sharing and advisory networks, cheap food narratives and a lack of support from the food system for agroecological/regenerative production, and barriers to industry entry of young and female farmers who are more likely to consider making transitions. Evidence from other countries, particularly France, show that agroecological transitions can succeed where the right combination of policy instruments (e.g. grants, support for advice and collaboration, cultural support) are sustained by long-term political will (Figure 2).

A 'living labs' network can build on the existing groundswell of farmer-led innovation and informal knowledge sharing around agroecological/regenerative farming. Important roles for a 'living labs' network include providing robust locally-relevant evidence of the productivity and financial viability of agroecological/regenerative farming, improving data standardisation, and encouraging collaboration between farmers, organisations, and researchers for data collection, sharing, and use. Such a "living labs" network should be sufficiently resourced in order to fund research and knowledge exchange and in order to build capacity among farmers and organisational stakeholders.

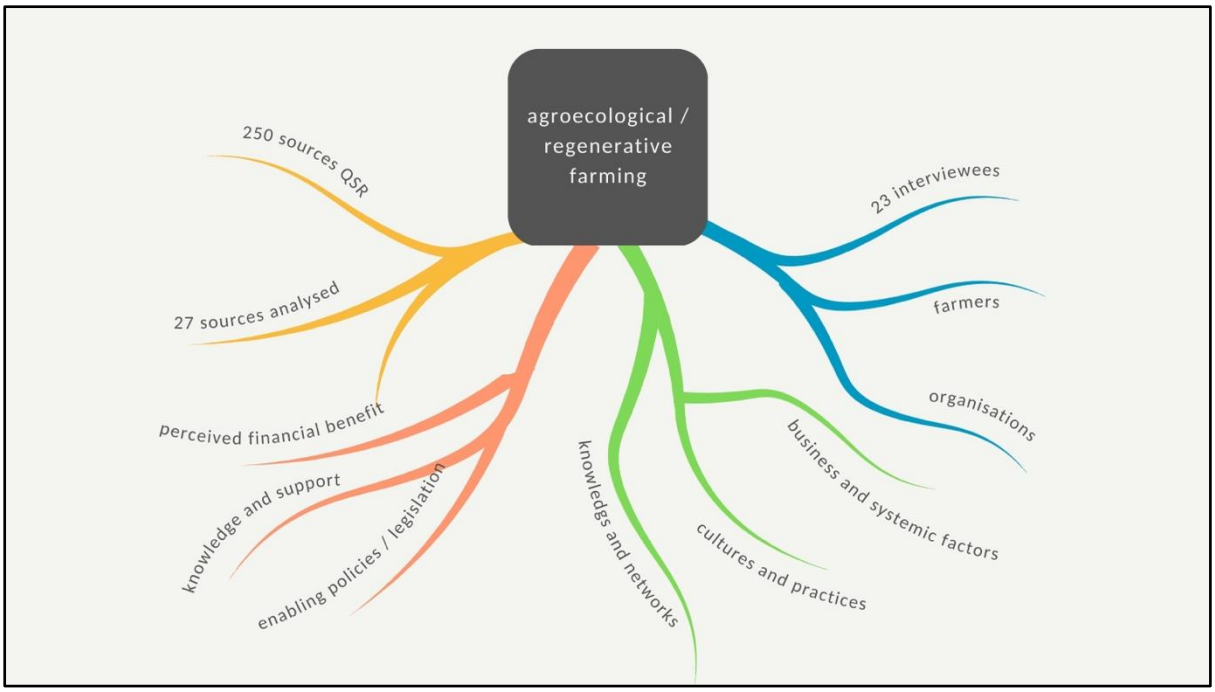

Figure 1. Graphic showing the methodology of the study

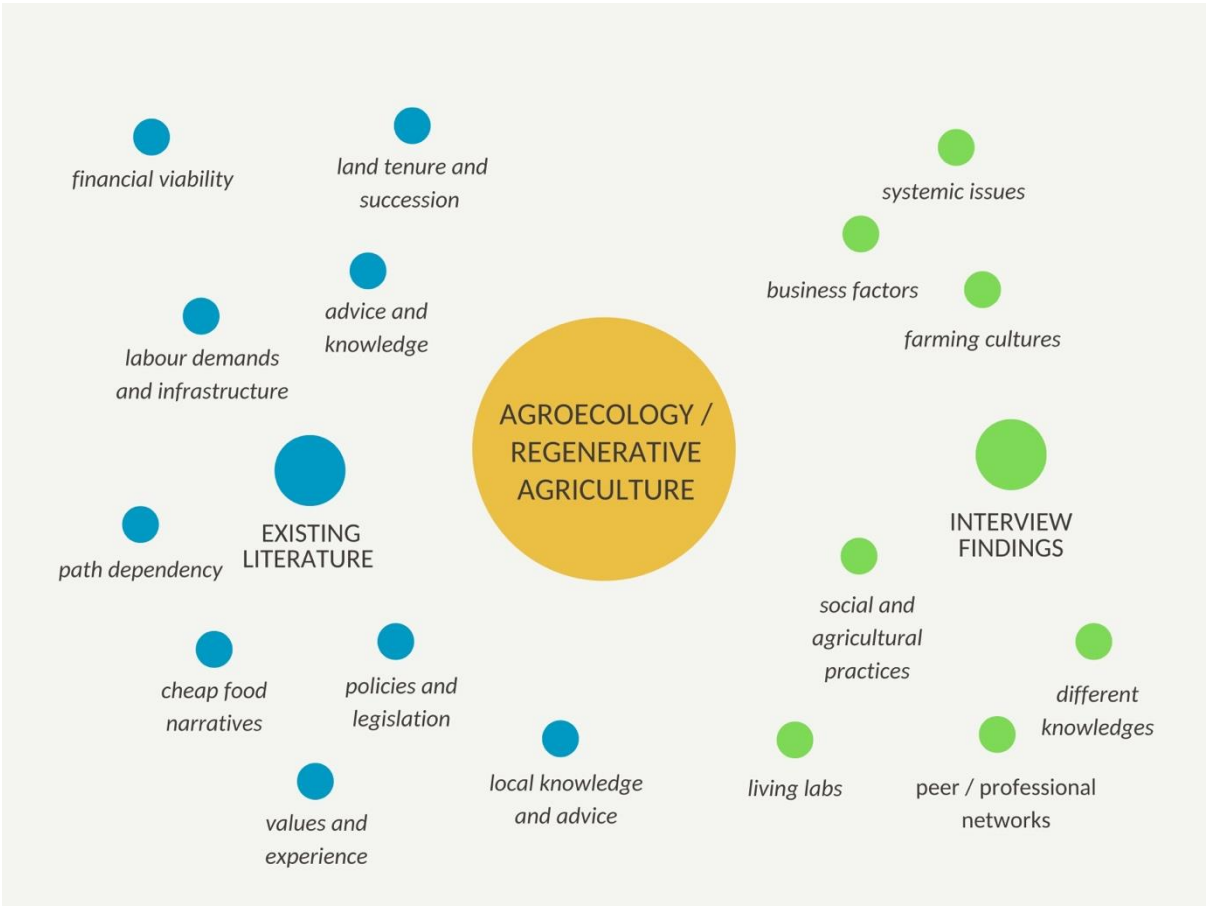

Figure 2. Graphic showing some of the important themes from a review of the existing literature and the interview findings

1 Introduction

The UK food and farming sector is in a period of considerable change. It continues to experience the economic and social impacts of the COVID-19 pandemic and war in Ukraine, a number of policy and trade uncertainties following the UK's withdrawal from the European Union in 2020, and extreme weather events such as increasingly frequent storms and heatwaves (Pope et al. 2022). Alongside government actions like those contained in the Agricultural Transition Plan 2021-2024 (Nov 2020) and the Government Food Strategy (June 2022), there is movement within parts of the agricultural sector towards the development of agroecological and regenerative food systems that are (more than) sustainable, productive and nature-positive.

In order to better support the sector in a transition towards such systems, we need to understand existing literature around the subject, and the perspective of UK agriculture stakeholders. In this context, Defra contracted Cranfield University and UKCEH to undertake an eight month study in 2022-23 that comprised three work-packages: 1) a rapid evidence review of agroecological farming systems (Burgess et al. 2023), 2) a series of interviews to examine farmer and stakeholder perspectives, and 3) an investigation of the potential role of 'living labs'. This report describes the results of the second work-package, which addresses three broad objectives:

I. To explore farmer and stakeholder definitions of agroecological and regenerative farming.
II. To understand the barriers to the adoption of agroecological and regenerative farming.
III. To investigate farmer and stakeholder views towards the concept of 'living labs' as a way to share research and learnings about agroecological/regenerative farming.

2 Methodology

2.1 Literature review

There has been considerable research interest in agroecological/regenerative transitions, including barriers to adoption. Although not asked specifically by Defra to do this in the tender, we agreed to do an extra piece of literature review work within the existing constraints of the project. We sought to capture learnings from previous research in a quick scoping review of the academic literature, supplemented by grey literature. For the academic scoping review conducted in November 2022, we used a search string in Scopus (Figure 3) to look for relevant research on farmer adoption of agroecology/regenerative agriculture in similar developed countries to the UK. The countries specified in the search string were selected after scanning an initial list of countries covered in the first set of results; before narrowing it down to only those countries with closer relevance to the UK (list continues past South Korea).

Based on our objectives, we then narrowed down this list based on titles and abstracts and only reviewed titles that substantively addressed the issue of farmer adoption of agroecological/regenerative practices. Our review is not comprehensive and is only meant to give a flavour of previous research to learn lessons. Our final list of articles also included some grey literature found by the project team via a Google Search or sent to use by Defra or project partners, as well as a couple of new academic articles that came to our attention published in late 2022 or early 2023. Our analysis approach was to specifically look in the papers for named barriers to farmers adopting agroecological/regenerative practice and to compile them thematically. It was a 'light-touch' review

focusing on extracting headline messages. Further detail can be gained from a more thorough review of the list provided in the reference list. In total, we analysed 27 written sources of information (academic papers, grey literature, interim project findings/reports).

Figure 3. An initial search returned 250 results, of which 27 were reviewed in detail

2.2 Interviews

We also carried out in-depth semi-structured interviews with farmers and farming stakeholders across the UK. The questions and format of the interviews were designed by the project team, and were reviewed by Defra before being approved by an ethics committee at Cranfield University. The full interview schedule can be found in Appendix A. Our sampling approach was purposeful. We asked for volunteers on social media (Twitter, LinkedIn, and the Farming Forum), as well as approaching known gatekeepers and our interviewees for further recommendations. Within the time and resource constraints of the project, there was neither capacity nor intention to generate a representative sample, which is rarely an approach used when employing in-depth semi-structured interviews.

In our advertisements on social media and email, we specifically asked for volunteers with different attitudes toward agroecological/regenerative farming: those who had already adopted such practices; those that were considering adopting, and those with negative views about making the transition. Our final sample of 23 respondents included farmers (from a range of farm type, size and geography), estate managers, agronomists, academic researchers, people working for environmental charities, industry bodies, member organisations, government schemes, farmer networks and certification schemes. A number of respondents fitted into more than one category. Interviews were conducted by telephone or by video call, according to the respondent's preference, and lasted between 27 and 87 minutes. All were one-to-one, except for one interview, undertaken by two respondents together. After interviews were conducted, they were anonymised, transcribed and then coded thematically, to look for themes that addressed the research objectives.

As expected, the majority of those interviewed in this research work are working with, and supportive of, agroecological and regenerative networks and therefore the sample is more biased than an intentionally cross-sector survey would be. All respondents were digitally literate educated and able to speak critically about agriculture in the UK. Whether farmers or employees of organisations, they were also able to speak reflectively about their own experiences within the sector. The interviews provide valuable insights about experiences of adopting agroecological / regenerative farming practices and about barriers encountered or observed. The interviews also provided an opportunity to collect thoughts on definitions of agroecology / regenerative agriculture and on 'living labs'.

3 Results from literature review on barriers and solutions to adoption

Based on our literature review, Figure 4 highlights ten major barriers to farmers making an agroecological/regenerative transition, and these are detailed in Table 1. Key barriers highlighted in most (or all) of the studies were lack of perceived financial benefit, lack of knowledge and support networks, and lack of enabling policies and legislation. Common suggestions to overcome these barriers included building an evidence base to prove benefits (if they exist), support networks of peer-to-peer and advisor-peer learning in farming communities, and provide the right policy instruments to encourage and incentivise uptake. Barriers are not mutually exclusive and many influence each other. For example, the financial viability of agroecology/regenerative farming is affecting by policies and legislation, as well as societal values to pay more for environmentally-friendly produce and a countering of cheap food narratives. It is noted here that work led by Wade et al. (University of Leeds), which surveyed 166 UK farmers about barriers and solutions to regenerative farming adoption, as part of the 'Fix our Food' project is not yet published. This will be an important project to follow moving forwards. In addition, a project being led by the University of Cambridge (H3, https://h3.ac.uk) has also engaged farmers around barriers to agroecology. Results of this project should be sought when available.

- Financial viability/risk/lack of knowledge about benefits
- Lack of advice, knowledge, social capital
- Lack of supportive policies/ legislation
- Non-supportive personal values or lack of experience of being in agri environment schemes
- Labour demands/ infrastructure requirements
- Insecure land tenure and succession
- Local inflexibility or lack of agency
- Path dependency
- Barriers to entry for young and women
- Cheap food narratives

Figure 4. Major barriers identified in the literature

Table 1. Barriers to adoption of agroecological/regenerative farming, from literature review

Barrier	Description	Possible solutions	Key references
Financial viability/risk/lack of knowledge about benefits (affected by biophysical factors, scale, sector)	The cost of changing system and lack of information about viable economic return, including potential for lower yields, prevents adoption. May be affected by scale and sector of farm + whether buyers will pay a premium/share environmental values. Also may be affected by local climate and biophysical viability.	More evidence of viability. Supportive policies/grants. Challenge to cheap food narratives, address inequality.	Dipu et al. (2022) - Australia Esquivel et al. (2021) - USA Felton et al. (draft) - UK Jordon et al. (2022) - England Kenny and Castilla-Rho (2022) - Australia Langford and Taylor, CHAP (no date) - review Lozada and Karley (2022) - Scotland Magistrali et al. (2022) - N England O'Connor (2020) - USA Padel et al. (2017) - UK Palomo-Campesino et al. (2021) - Spain Prost et al. (2023) - review Polonio Punzano et al. (2021) - Catalonia Ryschawy et al. (2021) - USA Staddon et al. (2021) - UK Vermunt et al. (2022) - The Netherlands
Lack of advice, knowledge, social capital	Farmers struggle to know how to adopt new practices and lack access to advice.	Funded, joined-up advisory network. Peer-to-peer learning networks. Good decision support tools.	Dipu et al. (2022) - Australia EIP-AGRI (2020) - Europe Garbach and Morgan (2017) - USA Garini et al. (2017) - Italy Kenny and Castilla-Rho (2022) - Australia Langford and Taylor, CHAP (no date) - review Lozada and Karley (2022) - Scotland Luján Soto et al. (2021) - Spain Magistrali et al. (2022) - N England McGreevy et al. (2021) - Japan Mottershead and Marechal (2017) - Europe O'Connor (2020) - USA

			Padel et al. (2017) - UK Palomo-Campesino et al. (2021) - Spain Polge and Pages (2022) - France Prost et al. (2023) – review Polonio Punzano et al. (2021) - Catalonia Staddon et al. (2021) - review Vermunt et al. (2022) - The Netherlands
Lack of supportive policies/ legislation	Policies or legislation do not support this type of production.	Political and societal will to develop enabling policies and legislation.	Dipu et al. (2022) - Australia FFCC (2020) - UK Garini et al. (2017) - Italy Gonzalez-Rosado et al. (2021) - Spain Kenny and Castilla-Rho (2022) - Australia O'Connor (2020) - USA Padel et al. (2017) - UK Polonio Punzano et al. (2021) - Catalonia Vermunt et al. (2022) - The Netherlands
Non-supportive personal values or lack of experience of being in agri-environment schemes	Farmers/workers are more likely to adopt if they have stronger environmental values.	Shift values through social pressure, supportive policies, and helping new entrants with aligned values.	Felton et al. (draft) - UK Jordon et al. (2022) - England Mottershead and Marechal (2017) - Europe Padel et al. (2017) - UK Palomo-Campesino et al. (2021) - Spain Staddon et al. (2021) - review
Labour demands/ infrastructure requirements	A perception that a switch to new systems may have different labour or infrastructure requirements.	Potential to use and frame new technology as assisting agroecology/regenerative farming.	Jordon et al. (2022) - England Magistrali et al. (2022) - N England Ryschawy et al. (2021) - USA
Insecure land tenure and succession	Tenant farmers, or those without a successor, not able to make long-term system changes.	Engage landowners, address tenure issues.	O'Connor (2020) - USA Padel et al. (2017) - UK Staddon et al. (2021) - review

Local inflexibility or lack of agency	Farmers unsure which practices work for their farms and do not feel in control.	Evidence-base must support local tailoring of knowledge, advice must enable farmers to make and lead decisions.	EIP-AGRI (2020) - Europe Esquivel et al. (2021) - USA Lozada and Karley (2022) - Scotland
Path dependency	Farmer attitude favours the status quo and it is hard to get started with new practices/systems.	Shift values through social pressure, supportive policies, help new entrants with aligned values.	Padel et al. (2017) - UK Ryschawy et al. (2021) - USA Staddon et al. (2021) - review
Barriers to entry for young and women	Young and female farmers may be more likely to adopt agroecology/regenerative farming but face more barriers to entry.	Incentivise new people to enter agriculture, change image of industry, challenge stigma to improve diversity.	FFCC (2020) - UK Gonzalez-Rosado et al. (2021) - Spain Lozada and Karley (2022) - Scotland O'Connor (2020) - USA Palomo-Campesino et al. (2021) - Spain
Cheap food narratives	Inequality helps cheap food narratives to pervade.	Address societal inequality and change values	FFCC (2020) - UK

In addition to Table 1, we highlight key pieces of research that show the importance of addressing multiple barriers with multiple solutions working in combination. Two important pieces of research conducted in Northern England (Magistrali et al. 2022) and Scotland (Lozada and Karley 2022) are worth closer attention. With funding from the AHDB, Magistrali and colleagues from Newcastle University conducted workshops with farmers in Cumbria, Northumberland, and Yorkshire specifically based on overcoming barriers to regenerative agricultural practices. The project defined regenerative agriculture as "farming systems and field operations that minimise soil disturbance, use diverse rotations and cover crops, and integrate grazing livestock, to reduce GHG emissions, build soil Carbon, improve soil health and biology, enhance farm-scale nutrient use efficiency (NUE) and promote biodiversity and the ecosystem services that flow from it (Giller et al. 2021)." The most common barriers to uptake identified by farmers in Northern England were lack of knowledge, financial risk, and perceived labour demands (e.g. more regular moving of livestock) or expensive infrastructure/equipment (e.g. new drills) associated with regenerative practices. Policy uncertainty associated with the English agricultural transition was also a key factor. The most useful sources of information farmers used to find out about regenerative farming were from social media (e.g. Youtube), talking to fellow farmers (including in groups), self-teaching, or advisory groups. The importance of locally applicable knowledge was highlighted and there was an interest in the research community helping farmers to provide baseline data for their own farms, comparing and contrasting with others.

We also attended a webinar called "Agroecological Transition: reflections from recent research in Scotland" (Nature Friendly Farming Network 2022). Research presented there by Yoxall found that while some farmers referenced practical aspects of agroecology, social aspects (such as engagement with local consumers) were often more implicit. Researchers defined agroecology as a set of practices, and pointed to the need for an alternative term to refer to the broader 'agroecology movement' that is driving change in the sector. They made recommendations for policy in this area to be more flexible, and warned against focussing on quick gains at large scale, which risk measures being less effective on smaller (but numerous) farms.

Lozada and Karley (2022) conducted a survey of 192 farmers and crofters in Scotland on the subject of agroecology, as well as doing ten in-depth interviews. The report notes that agroecological approaches are knowledge intensive, and that future agricultural transitions could benefit from widespread availability of training and advice, tailored to different methods of learning and knowledge exchange. The authors note that more detailed analysis is needed to quantify where agroecological approaches are being applied, in order to understand where financial and social benefits could be gained and support can be targeted. They also point to the need for accounting studies of the social, economic and environmental performance of agroecology farming systems across different scales to inform stakeholder decision-making. Results showed that two-thirds of respondents obtained new information from their own research and experimentation, and through co-creation and sharing of knowledge with others. Interestingly, new entrants featured more strongly in adopting agroecological approaches and wider research indicates that it is these type of people (young, women) who face the most barriers to entering the industry. Many of those already practising agroecology were shortening the food chain by connecting directly with consumers. Overall, the report points to a need to better understand barriers to uptake of agroecology in Scotland, in order to know how to overcome them,

and to examine financial and non-financial incentives that could enable a transition to agroecological farming, in ways that current government strategies do not support.

Magistali et al. and Lozada and Karley, alongside the wider literature, support the recommendations made by Padel et al. (2017) over five years ago on how to support agroecological transitions in the UK. This report highlighted:

- The importance of 'inspiration and social capital' which is furthered at the end of this section. The value of sharing farmer experiences of what works and what doesn't between peers is seen as a key part of making transitions in what is regarded as a bottom-up movement.
- The value of providing access to practical information and advice about agroecology.
- The need to develop accepted indicators to monitor agroecology and its impact on sustainability across the three pillars, not least so individual farms can measure the process of their business.
- The need for the right policy instruments (e.g. grants, legislation, training) to encourage a transition towards agroecology.

As an example to follow, Mottershead and Marechal (2017) provide insights from France, where there has been joined-up policy support for agroecological transitions. The authors argue that in France, three areas of action have come together to foster a transition:

1. *A strong political will and leadership for agroecology* - For example, as an enabler for the agroecological project, a "2014 reform of the French Agricultural Law introduced a series of statements about the Government's role in promoting and establishing agroecology. There has been explicit policy support since 2012", including in fostering collaborative working.
2. *Social considerations (social capital, networks) were placed at the heart of the transition* - this included strengthening farmer networks and associations with the necessary funding to empower groups of farmers to deliver agroecology. New educational and training programmes were established "to raise awareness and skills about agroecology in the farming community and among the general public. The network of chambers of agriculture launched a plan in 2015 to train their advisers to develop their skills to advise farmers on agroecology. Advisers in this network collectively attended some 33,000 hours of training in 2015."
3. *Innovation and a strong involvement of the research sector in the transition* - ensuring that research programmes followed the French agroecological vision, supported by farmer unions. "Specifically, since 2014, a number of teaching programmes in agricultural colleges and universities have been revised to focus more on agroecological principles and practices, not only for students but also amongst teaching staff. The changes are part of a horizontal programme named "Teaching how to produce differently". There is not an equivalent level of integration between research and advisory networks in the UK.

A common theme throughout the literature review was the importance of farmer networks for agroecology/regenerative farming. As Dipu et al. (2022) write from an Australian perspective, regenerative farming is largely 'considered a grassroots endeavour' and it is important to bear this in mind when planning transitions. The role of the government needs to reflect this, and although top-down policies may be required, the powerful role of informal peer-to-peer networks, support, and autonomy should not be under-estimated; indeed, it should be empowered by policies. Strengthening farmer networks and knowledge exchange were the main recommendations from many of the papers.

The concept of 'living labs' discussed further in Section Four is relevant here alongside similar ideas such as networks of demonstration or trial farms or simpler ideas like farmer networks. A useful paper on this subject was written by McGreevy et al. (2021) referring to spreading knowledge about agroecology in Japan. Termed 'Farmer Lighthouses', the authors wrote that "individual agroecological farms can act as lighthouses to amplify the uptake of agroecological principles and practices by other farmers." They go on to write:

> *"Agroecological lighthouses and lighthouse farmers promote agroecological principles through networking, leadership, and teaching, and through the demonstration and dissemination of production and managerial practices at the farm level. Beyond dissemination of knowledge and practices, agroecological lighthouses and lighthouse farmers possess and create social capital in rural communities and can utilize this capital to create relationships with different local and extra local actors. Lighthouse farmers are effective leaders and use different types of social capital (such as bonding, bridging, and linking) to build trust and leverage cooperation, connect disparate networks to engage in collaboration, and create links between sections of society in which formal or institutionalized power play a role."*

The paper then made suggestions for the characteristics of farms/farmers that would be good lighthouses for agroecology, which included:

1. High social capital and existing participation in networks - so that farmers would be able to spread knowledge to more people.
2. A trusted position in the local community.
3. Degree of adoption of on-farm agroecological practices.

4 Results from interviews

In the UK, farming directly employs about 467,000 people on 216,000 holdings (Defra, 2022). The holdings differ greatly in terms of size, type, location, business, and land type. This diversity should never be overlooked. Our research involved in-depth interviews with a range of stakeholders, and provides detailed evidence with which to build a complex and current picture of agroecology / regenerative agriculture in the UK. As mentioned above, our sample of 23 respondents was not intended to be representative, and while the broad range of stakeholders (of role, of farm size and type, of location, etc.) produced some contradictory responses, some patterns were nevertheless discernible.

Respondents were incredibly generous with their time, reflective about the barriers they had faced and observed, and optimistic about the future of agroecology / regenerative agriculture in the UK. The findings from the interviews aligned with some of those found in the literature and diverged from others. This underlined for us the value of engaging with what is a shifting and diverse landscape of farming practice, and doing so in specific contexts within the UK.

4.1 Definitions

We asked respondents about their experience of the terms 'agroecology' and 'regenerative agriculture', and their understandings of the differences between them – both in definitions and usage. All were familiar with the term regenerative agriculture, and slightly fewer were familiar with agroecology. Definitions of 'regenerative agriculture' and 'agroecology' vary, both in how they are understood by different stakeholders and how they are used. The two terms are employed interchangeably by some, and sequentially by others (with regenerative practices seen as steps towards a bigger whole-farm agroecological system) or divergently by others (who recognise the social justice, economic and political aspects of agroecology).

A number of respondents talked about regenerative agriculture as a movement that had gained significant momentum in the last five to ten years:

> *"I think this movement is very much a farmer-led movement. And it's like, well, you become a bit of a disciple."* (R3, upland owner occupier, livestock, NW England)

Partly because of this increased exposure – with some pointing out that "regen ag" was regularly receiving coverage in the mainstream farming press, and by growing events such as Groundswell and Carbon Calling -, it was considered a term that might be more accessible to farmers than agroecology:

> *"Most people don't understand the agroecological piece, but they've kind of got their head round regenerative, and they might mean different things by it."* (R1, owner occupier, tenant and contract farmer, arable, E England)
>
> *"Lots of farmers that I talk to don't really know what agroecology is unless you describe it."*(R7, head of research, national environmental farming organisation, livestock famer and researcher)

As ways of approaching farming, some farmers considered little difference between the terms, while others considered it a more advanced or comprehensive system:

> *"My colleague prefers agroecology and I prefer regenerative. And I do think that they are interchangeable. I guess that my preference for the word regenerative is it's easier to understand, because it demonstrates a desire not just to restore, but to improve."* (R4, estate manager, livestock, NW England)

This sense of agroecology doing more than regenerative agriculture was echoed by somebody working for an environmental farming organisation:

> *"I'd say that in the general regen is often used more as a language than agroecology. And I think that's because agroecology, well, I mean, it is the sort of definition of it as almost a step on than regen.*" (R2, technical and knowledge exchange officer, national environmental farming organisation.)

The ambiguity exposed in the interviews around the definitions of the two terms also relates to their usage – as referents for movements, for ideologies, or for sets of specific practices:

> *"So you can have two regenerative farmers, one who thinks that if Roundup was banned tomorrow it's the end of the world, and one who thinks that Roundup should be banned*." (R5, agronomist, SE England)

Another respondent positioned agroecology in relation to organic farming practices, and to social and political aspects that can sometimes be overlooked. This seems noteworthy in relation to some of the statements above that focus on the scientific and practical elements of agroecological / regenerative farming, but overlook the broader food system contexts:

> *"So it's organic farming plus all the social and food justice dimensions. But there is a real risk that farmers who are not really understanding that, it could actually become a greenwashing term*." (R16, organic grower and coordinator of national agriculture member organisation)

Greenwashing was raised by other respondents, in relation to the imprecision of existing terminology:

> *"I think maybe that's one of the risks when there isn't such a formulated, solid definition of what regenerative farming means. […] There's a risk that this is starting to suffer from greenwashing because it is used so much."* (R13, programme team leader, large national estate)

As well as from ambiguity of overuse, some respondents noted that corporate stakeholders in the food system (e.g. McCain, Nestlé) were engaging with regenerative agriculture.

> *"And it's starting to be used by, sort of, some of the bigger players in the industry. I think I saw that McCain's are on about regen chips or what have you."* (R19, tenant farmer, livestock, central England)

Another respondent comments:

> *"You know, there's a political element to our farming. It's really important to us, which is probably why I identify as an agroecologist as opposed to a regenerative agriculture practitioner."* (R7, head of research, national environmental farming organisation, livestock famer and researcher)

Many of these factors contribute to the adoption of regen or agroecological farming, and will be discussed in the following sections.

4.2 Barriers and enablers to adoption

The interviews provided a space for respondents to not only speculate on barriers and enablers that they had observed, but - if they were farmers – to reflect on those they had encountered in their own farming practice. Responses were rich and presented experiences that reflected the diversity of farm sizes, types and locations, as well as of expertise from organisational respondents. Some patterns were discernible, which we have illustrated in Figure 5 and clustered around the themes below.

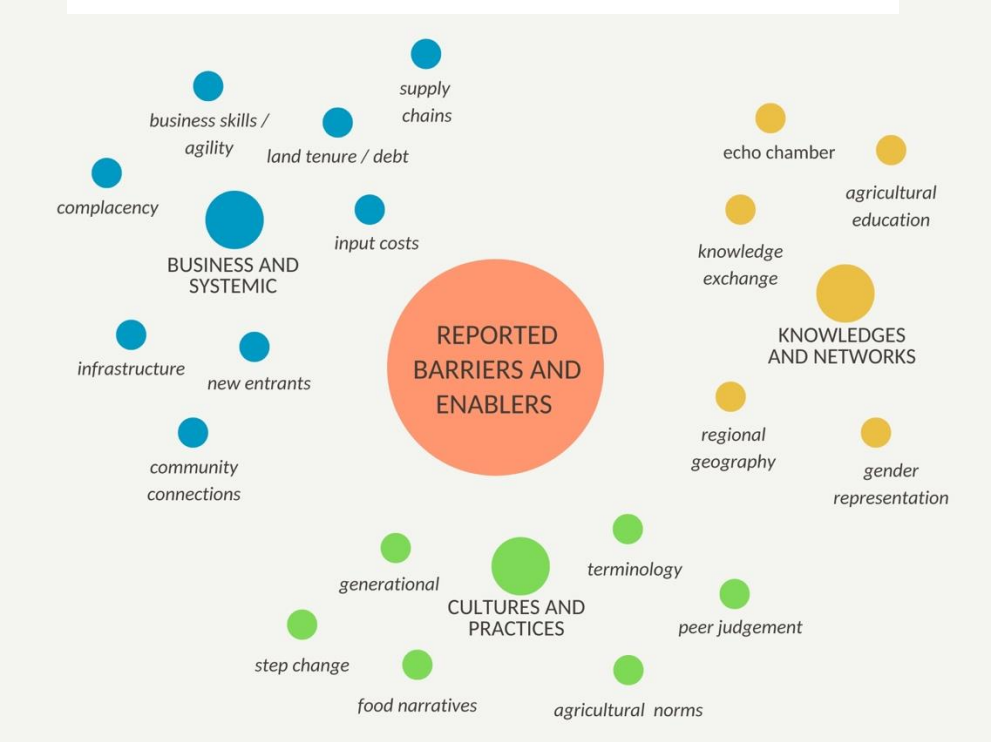

Figure 5. Reported barriers and enablers from interviews

4.2.1 Business and systemic factors

Although no two farms or farmers are the same, there are certain common factors more likely to present certain barriers or enablers to adopting transition. The majority of farmers we spoke to were owner-occupiers, which some recognised as an advantage in having greater and more secure agency over their land (e.g. enabling them to commit differently in the environment and infrastructure of the farm) and different fiscal responsibilities (e.g. in levels of debt):

> *"So I think if you're, you're an owner occupier, or tenant, how much are you in debt for? Because if you're backed against the wall, you're scared of doing much changes because somebody's chasing you for a bill all the time."* (R1, owner occupier, tenant and contract farmer, arable, E England)

> *"You know, when you're living on an overdraft, you aren't going to readily embrace something new that could lose money."* (R10, owner occupier, arable, E England)

Another owner-occupier reflected on their experience of losing an arable crop to pests:

> *"I'm fortunate enough that I'm in a position that I could absorb that and move forward. Not everybody would be able to take, and I know I'm taking some risks and not everybody's maybe as secure as I am to take those risks.*" (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

Some respondents observed a complacency among low-debt owner-occupiers who might be farming conventionally without an awareness of or interest in doing things differently:

> *"Well, they [neighbouring farmers] think that they're okay cause their milk buyer has done some soil testing. […] And if you stopped one of those lads [farmers] on the road and said 'Can you tell me about how grass grows and tell me a few things about soil?' They wouldn't, they wouldn't know. They just, they wouldn't know anything at all."* (R3, upland owner occupier, livestock, NW England)

The same respondent pointed to some tenant farmers' capacity for risk taking and change, as a result of their tendency to be resourceful: "*Farmers are often much better business people than land owners*"(R3, upland owner occupier, livestock, NW England). Transition to regenerative or agroecological farming often involves a financial investment for some (in equipment such as a direct drill, or fencing for rotational grazing) and many report short term yields drops (but increased margins).

One respondent reflected on their experience as a new entrant with little capital as being a factor in choosing a low input system:

> *"So our whole kind of decision making was like: right, we need to be good for ecology and we can't spend money on the system*." (R7, head of research, national environmental farming organisation, livestock famer and researcher)

The same respondent described some of the pressures of working with landowners:

> *"This isn't like it's our own land and we are just doing this thing and you know, if it goes wrong it's down to us. We are having to kind of monitor and, and ensure that what we're doing is working and that we can demonstrate return, whether that's financial or ecological or social return to the landowner*." (R7, head of research, national environmental farming organisation, livestock famer and researcher)

Another farmer, also a new entrant reported the positive impacts that a landlord can have on opportunities to transition land into non-conventional systems:

> "*And I'm lucky my landlord, that I rent from, actually approached us. When his old tenant left, he said, 'I like the way you're doing things, you know. Will you come and farm at mine?' I said 'Yeah, please'."* (R19, tenant farmer, livestock, central England)

A number of respondents mentioned that the field of agroecology and regenerative agriculture in the UK seems to be dominated by new entrants and by younger farmers. While this offers optimism for

the future, it points to fewer older farmers undertaking the transition, even though they remain a large population. One respondent proposes a possible solution:

> *"There's a few older farmers who are very much doing the sort of like, you know 'can't change, won't listen', because they don't have the energy to understand how, or the investment potential to know how to change. And there's a huge potential there to buddy up young, new entrants with older people to connect.*" (R17, conservation adviser, national environmental farming organisation, SW England)

Relationships can be important barriers and enablers in agriculture. A respondent who is an owner-occupier gave an example of productive relations they were fostering with other local farmers:

> "*I'm working with a local shepherd - new entrants -, bringing his sheep in, and it's about stacking that community. Using the land asset I have."* (R1, owner occupier, tenant and contract farmer, arable, E England)

Another owner-occupier we spoke to had previously been share farming with conventional methods but had recently taken back their land to manage it themselves and to "go down this biological route" (R8, owner occupier, mixed enterprise, NE England), and was enjoying seeing the positive impacts it was having on their land. An agronomist who was interviewed recounted a less favourable situation between a conventional farming contractor and regenerative agriculture landowner whose contradictory beliefs caused ongoing conflict and difficulty for multiple parties involved.

As well as presenting different economic challenges, different farm types also created practical barriers to transitioning to different systems. One respondent explained the challenges of adopting new livestock practices:

> *"With the, with the rotational grazing, you've just, there's quite a lot to learn there and there's quite a lot of infrastructure you need to put in place."* (R3, upland owner occupier, livestock, NW England)

A farmer with a mixed enterprise recalled their experience of changing their business to incorporate new regenerative practices:

> *"The first interaction with agroforestry was, you know, you came out of it quite enthused about the idea of growing apples. But it's like - then the reality kicks in. Like, what do I know about apples? What do I know about selling apples? What do I know about turning them into a product?*" (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

Similar challenges beyond the farm gate are illustrated by another farmer, mostly arable, who moved from single cropping wheat to a more diverse system. They see collaboration as a key enabler:

> *"I can't make a bottle of beer and I can't make a loaf of bread. But how do I then, if I, if I can't do that, join up with a trusted organizational partner or miller or something, so that I can join those products together*." (R1, owner occupier, tenant and contract farmer, arable, E England)

While much of respondents' focus around agroecological / regenerative agriculture practices was on the technical, some respondents foregrounded the social and community value of agroecological farming:

> *"Maybe a small market garden that's engaged with community supported agriculture schemes, and does quite a lot of engagement, maybe with a local food bank and they're kind of no dig and companion cropping, would probably be more agroecological in my mind than, for example, a big scale horticultural producer in the east of England who's using min till or zero till and companion cropping or integrated pest management*." (R7, head of research, national environmental farming organisation, livestock famer and researcher)

A number of respondents considered agroecology / regenerative agriculture as part of the wider food system, highlighting the importance of engaging cross-industry stakeholders to deliver long lasting impact:

> *"The economics of supermarkets just don't, sort of, mesh with agroecology. So the changes actually need to be a lot more radical than just changing one farming system for another."* (R16, organic grower and coordinator of national agriculture member organisation)

There was, perhaps predictably, disagreement about how this system change at scale might take place. Some farmers perceived the involvement of corporate stakeholders as a threat to the approach of regenerative agriculture:

> *"A significant risk I see is that, is that big companies are gonna come in and start creating regen products and then selling them sort of wholesale to farmers when the whole point of going regen is that it's like a cyclic system within your farm."* (R11, owner occupier, arable, E England)

Others foresaw such involvement as unavoidable:

> *"So, you know, at Groundswell, there was a bit of sort of a kickback that big ag was starting to get in, but I don't think you'll get that scaling up without big ag."* (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

The size and complexity of agriculture, and of all of its stakeholders, should not be overlooked.

4.2.2 Cultures and practices

Central to an understanding of barriers and enablers to potential uptake of new agricultural practices is an understanding of people, and of the cultural practices that make up their world. Such practices might include the formation and exchange of knowledges, attitudes and opinions, and the performance of actions in relation to the self, other stakeholders and the environment. A respondent working for an agricultural industry body suggests that:

> *"A lot of farmers are stuck in what they have done for generations or decades and not actually looking beyond what could be possible."* (R12, land management adviser, national agricultural industry body)

An owner occupier spoke of the role of community, or social norms, around how people think and therefore relate to possible farming practices:

> *"So it could be lack of confidence, it could be lack of knowledge, it could be, cultural, you know? Everybody's been to the same young farmer's club and they all think in the same way."* (R8, owner occupier, mixed enterprise, NE England)

One respondent spoke of their experience of overcoming some of these barriers:

> *"If I go literally to my neighbour next door and say, 'Right, I want you to be an agroecological farmer'. In his 600 horsepower tractor and his, you know, ruddy great sprayer and everything else, he won't get it. But if I can talk about the principles of regenerative or even conservation, the regenerative farming, he may get some of that*." (R1, owner occupier, tenant and contract farmer, arable, E England)

As well as the barriers that peer relations can present, one respondent spoke of the risks of judgement that can go with them:

> *"And also you just, you're doing something that none of your neighbours probably are doing. And if you make a cock up, everyone can see it."* (R3, upland owner occupier, livestock, NW England)

As well as the attitudinal barriers that some farmers face, others spoke of challenges around knowledge needed to adopt new agroecology / regenerative practices:

> *"There's the actual practical challenge, whether that's buying equipment to transition into more regenerative practices, sort of buying a direct drill, and, you know, actually working out the strategy on your farm. […] But then there's also the more social and sort of knowledge side of things, which is a challenge. […] 'Regen isn't resource intensive, but it's knowledge intensive'."* (R2, technical and knowledge exchange officer, national environmental farming organisation)

The way in which agroecology / regenerative agriculture are not clearly proscribed from outside presents both challenges and ways in for some farmers.

> *"My problem with it [organic], it's an all or nothing process, either or in or out. The nice thing about regen is that you, you can take a very small step, but for me that very small step is the hardest step."* (R4, estate manager, livestock, NW England)

That small first step is often hard because of the skills needed to source and to understand relevant information, and to apply it to a specific farm context:

> "*You know, it's not prescriptive. It's not like, plant this crop in this way at this time, manage these animals in this way, wean them at this way. It's about being open to understanding information, assimilating that, processing it, and then applying what's relevant at that time, and also being okay with the fact that you're probably wrong and dealing with that and, and like having the resilience to cope."* (R7, head of research, national environmental farming organisation, livestock famer and researcher)

A number of respondents mentioned the historical pressure that farmers have experienced to generate high yields, and that this has produced a strong sense of identity of the farmer as food producer – an identity to which farmers and some industry bodies are strongly attached. While this was perceived by some as a barrier, others saw the potential of agroecology and regenerative agriculture as 'win win' systems that could be both productive and ecological:

> *"And you, you know, it's about how you get soil to work, your environment to work. The agroecological system you really, I think, take another step and you start looking at your food, your community, and all the other bits because you're actually trying to connect, you're trying*

> *to produce food that feeds people and, and, and nutritious food."*(R1, owner occupier, tenant and contract farmer, arable, E England)

Farmers' drive to produce food was often reported as being in contradiction to caring for the environment, and seen by some as a source of antagonism towards NGO or government attempts in that direction:

> *"Seeing anything that has a slightly green tinge to it as being something 'we, we don't get involved with'. Despite them [farmers] always saying they love seeing the birds on their farm and all that kind of thing, they, they don't like to be told what to do."* (R12, land management adviser, national agricultural industry body)

Cultural shifts around how a farmer relates to their environment (in the practices they might perform, such as hedgerow management, as well as in their wider *modus operandi*, being less interventionist and productive) may take time to be normalised, as one respondent observed:

> *"Yeah, so this, this idea of like reduced intervention is quite difficult. So within agroecology, for example, actually you might just wanna like shut the gate and not interfere and not faff and not reseed and you know, not do all these kind of interventions that have become so normalized.*" (R7, head of research, national environmental farming organisation, livestock famer and researcher)

The role of government in leading some of these changes was noted by several respondents in relation to historical agri environment schemes. One, a mixed enterprise farmer, recalls:

> *"I can remember when Defra, it was sort of mooted that farmers would have to put cover crops on all their fields. And it was like, well, how ridiculous is this? And we did the first cover [in 2010/2011] and now it's like, nobody bats an eyelid about the idea of having cover crops."* (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

And while the normalisation of agroecological or regenerative farming practices was generally seen as something to aspire to, a number of farmers accepted that they had failed in some practices or made decisions that ran counter to some of the principles that they understood as 'regen rules':

> *"So this year we've actually got more wheat after wheat, which is probably not embracing the regen rules, but it might make money. […] I felt I've lost quite a lot of money over the last two years or three years, trialling these crops that I thought would eventually I would master and I haven't."* (R10, owner occupier, arable, E England)

4.2.3 Knowledges and networks

Knowledge was referred to by all respondents as something key to the development of agroecology and regenerative agriculture. The latter was particularly interesting in terms of the highly visible and active networks of knowledge exchange that respondents observed or participated in. These included the consumption of media such as books and YouTube videos, active engagement in WhatsApp groups and Twitter communities, and participation at in-person events such as Groundswell and Carbon Calling as well as local groups and activities.

While respondents felt enthusiastic and empowered by being part of dynamic knowledge sharing networks around agroecology and regenerative agriculture, it must be remembered that they represent a specific group of people who are already engaged with these practices. As such, they do not represent other demographics within farming who might be older, have less social and cultural capital, and might be socially or digitally isolated. One farmer and employee of an environmental agriculture organisation raised concerns about the limits of those engaged in the conversation about agroecology and regenerative agriculture, but on a practice and policy level:

> *"I really worry that we are not connecting with the people in the bottom of those valleys who frankly are, are left out of this conversation. And there's plenty of you and mes out there doing what we do, but I just, you know, I'm not sure of percentage, but it's a pretty high percentage and not engaging in this conversation and we need to.*" (R15, farmer and founder environmental farming organisation, SW England)

One farmer spoke critically of the limited educational opportunity of some conventional farmers in the sector:

> *"And I, I think that the, one of the biggest problems we've got in the, in the agricultural thing is that kids quite often farmer sons, mainly sons leave school, do some half-hearted course at a local college and then they come back home, then that's them done."* (R3, upland owner occupier, livestock, NW England)

Another respondent, also a farmer, made a similar comment, which also located some of those knowledges historically, in relation to farming practices:

> *"So you've got people coming out of college who are still being taught what we were taught in the 1970s about nitrogen, phosphate potash, and, you know, the modern scientific way to do it. We're actually, we're actually traveling in an opposite direction now."* (R10, owner occupier, arable, E England)

Some agroecology / regenerative agriculture practices require specialist equipment (such a direct drills), for which some funding opportunities have been provided by government, but concerns were raised by one farmer that such grants are not supported by knowledge exchange:

> *"Just buying a new shiny bit of kit doesn't mean you've changed your practices. It just means you have new tool to use and you'll probably mess it up because you're not understood the limitations of that tool or the, the advantages. So I think Defra are really missing out on that knowledge exchange part."* (R1, owner occupier, tenant and contract farmer, arable, E England)

A number of respondents talked about a need to support farmers to acquire technical knowledge, but also to undergo a transition about the way in which they farm. (Indeed, a number of the farmers interviewed had themselves undergone such a conversion). An owner occupier farmer explains:

> *"And it's a scientific problem. If you are doing a, a regenerative mindset, science is important, but the art is important as well. And it's all about… to actually inform that you need to have situational awareness*." (R8, owner occupier, mixed enterprise, NE England)

Mindset was something that came up repeatedly, and is addressed in this section as we believe it an essential part of knowledge exchange and the peer networks with which farmers are engaged. Two of

the farmers interviewed made interesting comments regarding gender. The first of which concerned 'primary sources' of information about regenerative agriculture (many of which were cited repeatedly and loyally by respondents) and agroecology:

> *"Maybe this is unfair, but a lot of proponents of regen ag are kind of like middle-aged white guys from America who look like the people that in the UK, you know, make up the majority of farmers. Whereas a lot of agroecology might be women, they might come from the global south. They look different. And so there is something about, you know, being what you see and needing to be influenced by people that look like you."* (R7, head of research, national environmental farming organisation, livestock famer and researcher)

Another farmer made an observation about the capacity of different farmers to action uptake of agroecological / regenerative farming practices. The reasons for this are unclear, but the remark warrants note:

> *"A lot of the farmers, the male farmers are, wanting but wanting to do something but lacking the confidence. A lot of their wives and a lot of the lady farmers are much, much more receptive."* (R8, owner occupier, mixed enterprise, NE England)

Peer-to-peer knowledge exchange was widely cited as the most effective and common mode of knowledge exchange between farmers. It might take the form of regional- or interest-specific WhatsApp groups, YouTube videos, informal face-to-face conversations between neighbours, self-led groups or clusters, or facilitated events such as talks or farm visits. All of these perform different functions and do so for different groups, and are not without limitations. There is definite scope for more research to better understand the complex knowledge exchange landscape that currently exist. One respondent coordinates facilitated events for a national organisation:

> *"I think geographically, there's always a bit of a problem. You know, a lot of [knowledge exchange] is just concentrated around the easy-to-access bits of the country, you know.. When events are run, they're normally run in either the Southeast or sort of Midlands and Cambridge and things like that*." (R2, technical and knowledge exchange officer, national environmental farming organisation.)

Another respondent, a farmer, emphasises the need for relatable and practical farmers to take centre stage at such events.

> *"Just make sure it's practical farmers that are doing the key part of the talking. You still need conservationists, you still need some scientists to come in, but actually […] I wanna hear from farmers in how that, how did they do it wrong? And then how do they get it right*." (R1, owner occupier, tenant and contract farmer, arable, E England)

4.3 'Living labs'

As with definitions of 'agroecology' and 'regenerative agriculture' presented above, the term 'living labs' is one that means different things to different people. Respondents pointed to a range of existing and potential activity, and reflected on the needs and value of a 'living labs' network. Existing networks were cited, including farm clusters and networks run by national environmental farming organisations, although it was noted that resource would be needed to develop capacity among these to deliver a wider 'living labs' network. Respondents suggested a range of research gaps, including in scientific research like soil sampling and microbial inputs or selective livestock breeding and seed cultivars, and in non-technical topics like the economics of different agroecological / regenerative farming practices or logistics of community infrastructure (such as local abattoirs). It was noted that while limited data exists around some of these practices, not enough of it is specific to the UK or to particular regions and environments within the UK.

4.3.1 Research needs

Research can provide scientific data that is not only valuable for government or other organisations, but can help agroecological or regenerative farmers maximise the benefits of their farming practices:

> *"So if I've stripped the nutrients out of a part of a field, I don't wanna treat the whole field, but it, having the data tells me that that part I need to do, additional top up or something or manage it. And I think for me that's really important. I think for some agroecological farmers and some regen farmers, probably they don't do anything. They just do the principles and it kind of works out."* (R1, owner occupier, tenant and contract farmer, arable, E England)

Another sought reliable evidence regarding yield:

> *"We all know what the cost benefits are, but what are the negatives as well? Are they seeing a yield drop? And if we look at a good range of farming, what's the, as I start doing this, what is my yield drop? And then how long is it before it recovers or does it ever recover?"* (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

Such data could also aid government in mapping land and agricultural holdings across the UK, and in thus being able to monitor and identify farming practices to best improve the soils.

> "*My dream for this would be, as I say, every field has a soil sample that goes annually to a laboratory, which comes back with some data, which can educate us on to how we should be conducting our various farming practices.*" (R4, estate manager, livestock, NW England)

Others forms of data, such as those around profitability and value of different interventions, would also be invaluable for farmers undertaking informal knowledge exchange:

> *"I can show the bottom line in my business, the reason I did it, but also some science and there's some trials that backs up what I physically see. So to get you street cred from your other farmers, they'll just say, 'You were just a sandal wearing farmer', but if I can turn, answer 'Actually, this is why, and this is what I've saved', the kind of light bulb switches on for them and it's something they could pick up and put straight on their farm."* (R1, owner occupier, tenant and contract farmer, arable, E England)

As well as technical and economic research, respondents suggested further research gaps and projects:

> "*If someone said if you can get 10 farmers. If, if, where we'd be interested in helping you have a have a centralized butchery thing. It would have to be subsidized, I think, because it just… It's a place where someone just packs meat, cuts meat. Does that, that is the kind of thing that's, that's needed. Or a centralized killing, chicken killing facility. That's the kind of thing*" (R3, upland owner occupier, livestock, NW England)

4.3.2 Current collaborative research activity

The interviews provided an opportunity for farmers and those working with them to assess and evaluate current research activities and agroecological / regenerative practices:

> *"One of the things that's holding all this back is everybody's trying to find the holy grail of calculating carbon and actually, we're still some distance away, so let's not worry too much. Let's just talk about organic matter, cause that's just easy.*" (R4, estate manager, livestock, NW England)

Others pointed to the need for evidence around the potential harm that some agroecological / regenerative practices (such as the addition of microbes to soil) might be having:

> *"Whereas my concern is, are they creating the grey squirrel effect? You know, that you keep adding something and will you actually change it? You think you're doing something better, because it's biological, and biological has got this current terminology 'biological's good, chemical's bad'"*. (R5, agronomist, SE England)

A number of respondents interviewed were already engaged in collaborative research activity:

> *"And like I say, these 10 farmers, which we are actually one, to develop specific grass herbal lays that are farm specific to our farm systems. And then monitoring that in economic performance, but more importantly their environmental performance"* (R9, owner occupier, mixed enterprise and regional coordinator, environmental farming organisation, NE England)

Another has been involved in a trial using foliar fertiliser:

> *"And as a result we are actually going to apply for research, tax and development with the inland revenue because we feel that, you know, we are the guinea pig in so much, you know, we can't get this information anywhere else."* (R10, owner occupier, arable, E England)

4.3.3 The case for a 'living labs' network

Learning from these and other experiences, most respondents were optimistic about what a 'living labs' network might involve:

> "I think that, you know, connecting people together around shared learning or whatever, whatever the topic is, is, is really, really important." (R17, conservation adviser, national environmental farming organisation, SW England)

Others identified the importance of participation and funding mechanisms within such a network being effective, responsive and accessible, including around issues of scale and pace:

> *"I suppose it's about getting a system in place in which farmers can, or whoever can, apply for research funding in a way that is like relatively quick. […] They, they seem to take an awful lot of time and often - understandably - the larger scale ones require an awful lot of legwork to put together, applications and things. […] If there's ways of accessing small amounts of funding to do those things, I think you could get lots of very interesting information out."* (R6, agricultural relationship manager, international environmental farming organisation, E England)

A land management adviser proposed that engagement with farmers, both in research and in knowledge exchange is key to what a living lab might look like:

> *"And actually, it's not just a whole load of academics sitting in a university or a research lab thinking 'this will solve agriculture's problems', without actually talking to a farmer. How you actually talk to the end user and engage with them I think is key. And that, that there is some sort of knowledge and not just to bolt it on."* (R12, land management adviser, national agricultural industry body)

The demand to put farmers at the centre of labs was underlined by another respondent:

> *"And so 'living labs' need to be farmer driven as opposed to kind of Defra saying 'Well, there must be some sort of fancy tech involved in this, and you can only have funding for a living lab if you include a robot, or some other, you know, technical advance'."* (R7, head of research, national environmental farming organisation, livestock famer and researcher)

The role of government was discussed, with a range of opinions voiced about their potential involvement. Given the uneasy relationship between some farmers and Defra, some were predictably resistant to their direct involvement:

> *"I don't think that government is the right people, is the right level to be doing that [coordinating living lab network]. […] The real challenge that Defra has got is that they've produced very detailed doctrine, which they are deploying strategically. As a result, the doctrine is actually irrelevant to the majority of the people reading it."* (R8, owner occupier, mixed enterprise, NE England)

More respondents were supportive of government involvement than not, and a number saw a central role in providing resource for such a network:

> "*If you really want to put something behind this and transform this system, you need a big collaboration between a load of farmers, a load of researchers, you know, and it needs government money behind it*." (R14, Academic researcher, biology, NE England)

Government participation would also bring valuable leverage to the sector and inform policy-led change in agroecological / regenerative farming transition:

> *"I think Defra need to be involved because they've got all the purse strings and you know, they can make big changes to how people farm and what they demand of farmers. So, you know, they've got to be involved."* (R18, farm manager, arable, central England)

Another respondent pointed out the need for government participation to involve not just Defra, but other departments in national government and local authorities, to ensure that any such transition within the food system responds to social and economic challenges as well as ecological ones:

> *"And it's, it's just like, we don't have the time for more of this procrastination. You know, what they need to do is if they wanna do something like 'living labs', is to link it to the other agendas that it could help solve and just say "We've decided it'd be a really good idea for there to be some food resilience that's grown agroecologically in every community.""* (R17, conservation adviser, national environmental farming organisation, SW England)

We reflect on the possible role of Defra in light of these quotes in the following section, and engage with it in depth in the parallel report on Work Package 3 of this project (Staley et al. 2023).

5 Conclusions

We reflect on five key barriers/enablers in the concluding section, before reflecting on the potential role of Defra in a 'living lab' system. Three prominent barriers to farmers making an agroecological/ regenerative transition, amongst others, were:

1. Business risks
2. Lack of supporting policies
3. Lack of knowledge and advisory support

Farmers in our study, and in the wider literature, raised concerns about the financial viability of making the transition. Possible costs of making the transition include buying different machinery and changed labour requirements, whilst the implications for yield and profitability is not clear to all farmers. Financial viability is linked to the policy and industry environment in which farmers operate, which is the second prominent theme. If government policies or corporate retailers support agroecological and regenerative farming, then farmers can be better incentivised for producing food in an environmentally-friendly and socially-just manner. Wide uptake of agroecology/regenerative farming can only exist viably within a supportive wider food system. A range of policy instruments could be useful to incentivise adoption, as shown in countries such as France; these include direct grants to farmers for machinery, free and accessible advisory support to support cultural shifts in attitudes (third major theme), enabling regulations, support for farmer-led innovation and collaboration between farmers, industry, and researchers to share knowledge, and support for new entrants into agriculture (e.g. young, women) who are more likely to practise agroecology/regenerative farming. The security of land tenure and the involvement of the landowners are also vital for enabling long-term agroecological transitions.

Regarding 'living labs', although farmers and organisational stakeholders in our study used different terminology to describe the kind of knowledge creation and sharing under its umbrella, it was clear that the concept itself is vital to enabling agroecological/regenerative transitions. Respondents in our study wanted more information on the yield implications and financial viability of agroecology/regenerative farming and generating/sharing this knowledge from a 'living labs' network is crucial. The role of Defra in this 'living labs' is open for debate. As with previous literature on engaging 'harder-to-reach' farmers and the co-design of Environmental Land Management scheme (ELMs) (Hurley et al., 2022), Defra may not have to take on a leadership or co-ordinating role. In the ELMs study, it was argued that skilled intermediaries (local trusted advisors) should take the lead in co-designing ELMs with Defra (less trusted amongst some farming communities) taken more of a backseat role, providing financial support and flexibility for local collaboration.

Recognising that the agroecology/regenerative agriculture is largely a bottom-up movement powered by a groundswell of farmer-led innovation and active peer networks, the imposition of Defra in a leadership role for a 'living labs' network may well challenge the grassroots principles that have inspired the movement. However, respondents in our study were keen to point out that many of those engaging most have been prominent in the movement for some time. Whilst peer-to-peer, farmer-led knowledge sharing is important in building social capital, there may be some aspects of 'living labs' which require a co-ordinating role from government; for example, fostering collaboration between farmers and the research community, standardising data collection and sharing, helping England make

the most of existing demonstration sites belonging to different institutions, and encouraging sharing and use of data.

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Appendix A – Interview guide and participant information sheet

Participant Information Sheet

Project: Evaluating the productivity, environmental sustainability and wider impacts of agroecological compared to conventional farming systems

We are hoping to interview you as a farmer or farming-related organisation in the UK (focus on England, but not exclusively) to talk about barriers and solutions to achieving agroecology and regenerative farming. We are keen to hear from those supporting and not supporting this type of farming.

This work is being undertaken by Cranfield University (Dr Paul Hurley and Prof David Rose) on behalf of Defra (received Defra funding). CEH are the other project partner.

We are hoping to conduct phone/online interviews lasting up to an hour.

You do not have to take part in this study. If you do, interview data will be used in a project report for Defra and potentially academic publications. Interviews will be anonymised such that no identifiable information about you is given to Defra or others reading the report or other publications. The interview will be recorded with permission, but the recording will be destroyed as soon as it is transcribed. Transcriptions will be stored on password-protected institutional computers and destroyed once academic publications are finalised. We will not archive any data publicly.

After you have taken part (or during), you may withdraw your contribution up to 31st December 2022 by emailing either Prof David Rose (David.rose@cranfield.ac.uk).

This study has received ethical approval from Cranfield University.

You can find the interview questions on the following page. Findings will be used by Defra to inform policy. By participating, you are agreeing to the details outlined above.

Thank you.

Interview Questions

Agroecology and/or regenerative agriculture (c. 10 minutes):

1. Have you heard of agroecology and regenerative agriculture, and if so, where from?
2. What do you think the difference (if any) is between the two terms?
3. Present definitions below in turn (share screen?). Do those terms resonate with you? Is anything missing? Have you noticed anything about how they're used within the sector?
4. What is your own experience of working with agroecological / regenerative farming?

Term	Example definition
Agroecological	"An integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems" (FAO, 2018)
Regenerative	"Regenerative agriculture aims to go beyond the "do no harm" principles of sustainable agriculture" "A system of principles and practices that generates agricultural products, sequesters carbon, and enhances biodiversity at the farm scale" (Burgess et al. 2019)

Agroecology (c. 10 minutes):

5. What specific on-farm practices would you associate with agroecology?
6. (FARMERS ONLY) Do you do these agroecological practices on-farm? Why, why not?
7. (FARMERS ONLY, if yes) How easy has it been to do these practices and make the transition? Were there any challenges?

Regenerative agriculture (c. 10 minutes):

8. What specific on-farm practices do you associate with regenerative agriculture?
9. (FARMERS ONLY) Do you undertake these regen ag practices on-farm? Why, why not?
10. (FARMERS ONLY, if yes) How easy has it been to do these practices and make the transition? Were there any challenges?

Risks (c. 10 minutes):

11. Which are the most significant risks for the UK, in developing and implementation more agroecological / regenerative farming?
12. Are there any risks that have been overlooked by the sector or by government?
13. How do you think these risks will be experienced differently across the sector / country? Can you give any examples?

Research capability and networks (including 'living labs') (c. 15 minutes):

14. What are the different ways in which you think farmers find out about agroecology and regenerative agriculture? Can you give specific examples?

15. Are you involved in any methods of research and knowledge exchange about agroecology/ regenerative agriculture that is aimed at farmers? What are these? What do these involve? What was your role? What worked and what didn't?
16. Defra are considering the role of a 'living labs' network to scale research and KE about agroecology/ regenerative agriculture. What do you think a living lab looks like in this context?
17. Do you think that we need a 'living labs' network for agroecology/ regenerative agriculture and what role do you think there is for Defra, if any?
18. What lessons could they learn from existing research and knowledge exchange in this area to hone their 'living labs' approach?

Anything else (c. 5 minutes):

19. Is there anything else that you'd like to talk about?
20. Is there anything you'd like to ask me?