

AI Agroecological Intelligence

Establishing criteria for agroecologically appropriate technology



Agroecological Intelligence
Establishing Criteria for Agroecological Appropriate Technology (Interim Report)

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This project is supported by a grant from the A Team Foundation



Thanks to the farmers and growers who have given their time to this project so far and to the Biodynamic Association, the Soil Association, Organic Farmers & Growers, Organic Growers Alliance, the CSA Network, Landworkers' Alliance, Permaculture Network, Nature Friendly Farmers Network, Pasture for Life and Food, Farming and Countryside Commission for their initial input.

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We Need to Talk About Technology...

Agriculture is at a crossroads. With accelerating climate change, biodiversity loss and public health challenges, it is widely accepted that change is necessary and urgent. Inevitably this gives rise to the question of technology and whether and how it might help.

In the face of the need for change, a lot of energy and positivity is currently being directed into the concept of agroecological farming, which represents a counterpoint to the dominant industrial food system. So, while we need to talk about technology, we also need to talk about agroecology.

Agroecology is an umbrella under which a range of diverse strands or approaches to farming such as as organic, biodynamic, permaculture, food sovereignty, nature friendly, pasture-fed and regenerative (and even other more controversial alternatives, such as ‘sustainable intensification’), can exist. This broad and inclusive grouping is seen as desirable and as a necessary paradigm shift.

But it is also problematic in its assumption that more radical eco-friendly, low-input approaches can comfortably sit side-by-side with those that represent little more than the status quo given a green makeover.

Approaches that sit in this latter category, such as sustainable intensification focus on limited change and accept the existing social, economic, structural and cultural framework of food and farming.

They are still characterised by an establishment and agribusiness view that business-as-usual, with its focus on increasing production and opening up

global markets, can carry on indefinitely as long as they can be ‘greened’ through technology. This is where the real political will and power lies in the agricultural debate and, crucially, in the minds of policy makers.

As a result, farmers across the world – including agroecological farmers – are being heavily lobbied to adopt various technological ‘solutions’, such as automation and robots, temperature and moisture sensors, GPS tracking, aerial imagery via drones, blockchain and biotechnology, with the promise that these will make farming more productive, more profitable and more environmentally friendly.

Examples abound of the push towards what is variously referred to as innovative farming, smart farming, precision agriculture, sustainable intensification and nature-based solutions.

In its *Strategic Framework 2022-31*¹, the United Nations Food and Agriculture Organization proposes that systemic approaches like agroecology are “entry doors” through which “*biodigital and biogenetic technologies...can be developed and enter the wider farming system*”.

The FAO strategy does not address any of the conflicts inherent in using tools designed for conventional, industrial-scale agriculture in smaller, localised agroecological systems.

In the UK, the government has been pushing to strengthen the agricultural technologies sector for nearly a decade.²

¹ <https://www.fao.org/3/cb7099en/cb7099en.pdf>
² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/227259/9643-BIS-UK_Agri_Tech_



We are not yet at the point of assessing criteria, but our initial meetings revealed some priorities and themes in common across the groups

Lacking a clear and visionary strategy for the future of farming in the UK, it is the government's industrial and innovation strategies which have come to fill the vacuum.

Its Farming Equipment and Technology Fund does not mention agroecology at all while its Path to Sustainable Farming fund³, launched in 2020, supports the purchase of equipment, technology and infrastructure designed to improve agricultural, horticultural and forestry productivity in a sustainable way.

There is no parallel government investment in the means and methods of agroecological transition within UK government's Agricultural Transition Plan 2021-24.⁴ That kind of thinking is left to civil society, such as the Food Farming and Countryside Commission's proposal for an Agroecological Development Bank to help finance a transition to agroecology.⁵

The European Union's (EU) Farm to Fork Strategy – part of the European New Deal that aims to make the EU climate neutral by 2050 – is also predicated on the uptake of new technology throughout the farming sector. The strategy notes that:

“Research and innovation (R&I) are key drivers in accelerating the transition to sustainable, healthy and inclusive food systems from primary production to consumption. R&I can help develop and test solutions, overcome barriers and uncover new market opportunities.”⁶

“I have a deep-seated affinity with nature, and that connection is an important part of why I farm”

Nature Friendly Farming Network Group

Whilst the EU's New Green Deal aspires to 25% of agricultural land under organic farming by 2030⁷, time is running out and the pathway is not at all clear and is fraught with conflicting visions and values.

Within agroecology there has been very little open debate about the extent to which technologies in agriculture can, in fact, contribute to an

Strategy_Accessible.pdf

3 <https://www.gov.uk/government/publications/farming-equipment-and-technology-fund-fetf-2023>

4 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/954283/agricultural-transition-plan.pdf

5 <https://ffcc.co.uk/conversations/farming-smarter-agroecology-development-bank>

6 https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf

7 https://agriculture.ec.europa.eu/farming/organic-farming/organic-action-plan_en

agroecological future there has been even less consideration of which agroecological view is being represented.

A 2021 report published by the UK's Soil Association, *AgroEcoTech: How Can Technology Accelerate a Transition to Agroecology?*⁸, deserves credit for broaching a difficult and complex topic around a range of technologies including:

- Farm production technologies – genome editing, novel biological controls and inoculants, smart agriculture and robotics.
- Supply chain technologies – digital food hubs and dynamic food procurement, smart consumer technology and big data analysis and environmental footprint accounting.
- Alternative production technologies – cellular agriculture, controlled environment agriculture and bioenergy production.

But it also attracted criticism. The Landworkers' Alliance, one of several advocates of agroecology that took part in the review process for the report, expressed “serious misgivings” at the report's “lack of social and political analysis”⁹:

“The question of technology in agroecological systems requires a nuanced and rigorous social impact analysis, through which we are able to anticipate and actively curb pitfalls. Most of the technologies analysed in the report are not intrinsically ‘good’ or ‘bad’ – but it's how they are used, who controls them, who benefits from them, who has access and who does not and who bears risks which are cause for concern. Social justice is fundamental to agroecology; without a framework designed to anticipate and avoid inequity, we have no means to assert control.”

But the idea that technology is values neutral is also contentious.

The economist EF Schumacher, a former President of the Soil Association dismissed this notion decades ago: *“People still say: it is not the technology: it is the ‘system’. Maybe a particular ‘system’ gave birth to this technology: but now it stares us in the face that the system we have is the product, the inevitable product, of the technology.”¹⁰*

8 <https://www.soilassociation.org/media/22821/agroecotech-soil-association-report.pdf>

9 <https://landworkersalliance.org.uk/lwa-responds-to-the-soil-associations-agroeco-tech-report>

10 Schumacher EF, Technology and Political Change, Rita Hinden Memorial Lecture, 1976. Not in print

In his ground-breaking book *Small is Beautiful*, Schumacher set out his ideas for a “technology with a human face” in more detail arguing that technology is far from neutral and values free and further that, unlike in nature:

“Technology recognises no self-limiting principle – in terms, for instance, of size, speed, or violence. It therefore does not possess the virtues of being self-balancing, self-adjusting, and self-cleansing. In the subtle system of nature, technology, and in particular the super-technology of the modern world, acts like a foreign body, and there are now numerous signs of rejection.”¹¹

Nearly fifty years on, Schumacher’s language may seem challenging to some, but the presumed neutrality of technology is a discussion that has never been resolved and is as urgent as ever in the modern era.

An agroecology – rooted in values such as diversity, resilience, efficiency, systems thinking, knowledge sharing and responsible governance – should be able to offer a considered response to the imperative to ‘tech up’ but is struggling to do so.

“I think there is a big danger that farmers will end up on leases for machines they don’t own, with centrally controlled digital platforms. That could easily represent a massive concentration of power, ownership and control in the food system...but equally an open-source community might develop the technology and all be freely available open-source code, and then I might be able to weld up my own robot and download the free software”

Organic Growers Group

In part, this is due to a focus on broad and shallow, overarching collective goals, e.g., personal empowerment and building agronomy and marketing coalitions in opposition to industrial agriculture, rather than on processes and strategies, which require a ‘narrow and deep’ focus.

But if agroecological farmers ignore or acquiesce to this techno imperative, it could make the scaling of principled, values-based agroecology much more difficult to achieve, particularly in more developed countries like the UK where there is an absence of information and understanding about agroecologically appropriate technology and where the ‘soft’ language of values and ethics is dismissed in the policy arena.

Without clear criteria for appropriate technology, proponents of agroecological farming will find it increasingly difficult to engage and where necessary push-back, in policy-level discussions about the future of agriculture.

In many ways agroecology has reached a point where organic was 40 years ago; a tipping point where it is being encouraged to either “scale up” or remain an outsider movement.

Scaling up without losing the values of the movement is a major challenge and there is good reason to question whether the idea that “scaling up” – a largely industrial concept – or “losing out” are the only two options open to the development and growth of agroecology.

Scaling up does not have to mean increasing farm size or output. It can mean connecting existing practitioners of agroecological farming in a way that extends their reach and normalises the principles, practices and values that underpin them.

The rapid growth of certain technologies in agriculture has the potential to accelerate the agroecological transition. However, it also poses many risks to agroecology, not the least of which is reducing a whole system approach to an à la carte menu of technology choices.

Wholistic or whole system approaches are easy to talk about and easy to damage. Improving ecological or biological function in, for example, soil microorganisms or natural pest/predator interactions can be achieved by internal system management or ‘appropriate’ agroecological inputs, or a mixture of both. But how does one judge? What are the criteria for assessing risk, benefit and whether or not the ecological “crown jewels” are being traded or sold off piece by piece?

In the face of the many challenges and to avoid being swept up in the vision of a high-tech agricultural future, it is vital that we start talking about – and more importantly take control of the techno narrative.

Opening the Discussion

In mid-2022, A Bigger Conversation launched a project aiming to investigate which technologies are and which are not appropriate for agroecology and how such decisions might be made.

The project brings together agroecological farmers and growers in the UK for a series of in-depth

¹¹ Schumacher EF, *Small is Beautiful*, published 1973, see Vintage, 1993 edition.

discussions about the role of technology in their farming systems and the main factors and trade-offs at play when making their decisions.

We began the process with a couple of assumptions. One is that choices around technology are not values-neutral. The other is that whilst the agroecological umbrella provides a narrative canopy made up of language and concepts such as ‘natural’, ‘holistic’, ‘food sovereignty’, ‘social justice’, ‘equity’, ‘health’, ‘small-scale’, ‘co-creation’ and ‘indigenous knowledge’, the strict allegiance to these concepts varies widely between the different strands of agroecology (something that could make consensus difficult).

Over the course of the project, we will be looking at the values and worldviews that inform technology choices. We will also be looking for the places where there is coherence amongst the various strands of agroecology as well as where there is divergence. At the end of the project our aim is, if possible, to have identified a set of basic criteria to inform decisions about technology use in agroecological systems.

Given the diversity of approaches that sit under the agroecological umbrella, we recognise it may be challenging to produce criteria acceptable to all. Some differences between, for example, a food sovereignty approach and pasture-fed livestock or nature friendly farmers approach may be difficult to bridge with a single criterion.

We therefore see these eventual criteria not as the final word on agroecologically appropriate

technology but as a tool to facilitate discussion and debate amongst agroecological farmers and growers (and the organisations that represent them) and enable them to think through the topic and make informed decisions.

Having recently concluded our first set of workshops with farmers from each of the different strands of agroecology, we are approximately halfway through the project. This interim report captures, in broad strokes, our observations so far.

Methods and Participants

The Agroecological Intelligence project has several phases. In phase 1 we met with representatives from 10 organisations across the agroecological umbrella: the Biodynamic Association, the Soil Association, Organic Farmers & Growers, Organic Growers Alliance, the CSA Network, Landworkers’ Alliance, Permaculture Network, Nature Friendly Farmers Network, Pasture for Life and the Food, Farming and Countryside Commission.

Our goal was to understand what the organisations’ “world view” was, how this related to their ideas about appropriate technology and whether this approach was codified in some way, for instance into standards or guidelines. During this phase we also began our outreach to individual farmers and growers across the UK, inviting them to participate.

Phase 2 comprised eleven virtual workshops to explore how farmers and growers who identify with the different strands of agroecology think about a wide range of technological approaches to farming.

A total of 62 farmers/growers responded to our invitation to participate in the workshops. Of these, 48 attended one of the first set of workshops. We have recently completed this phase and our work to date forms the basis of this interim report.

In phase 3, we will conduct a second set of in-person and more-in depth workshops to follow up the issues raised in phases 1 and 2 and dig deeper into the relationship between the narrative of agroecological farming and its implementation both in day-to-day on-farm practice and in policy. From this we hope to create an initial set of criteria (for more on this, see Appendix 1).

Who we talked to

In addition to the workshops, we also asked participants to fill in a short survey to provide more information about themselves and their farms.

Age of participants

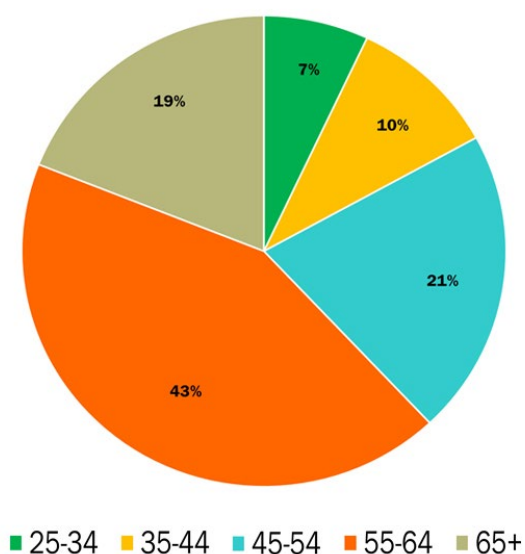


CHART 1 Participants were generally younger than the sector average, but this reflects that agroecology generally attracts younger people.

Type of farm

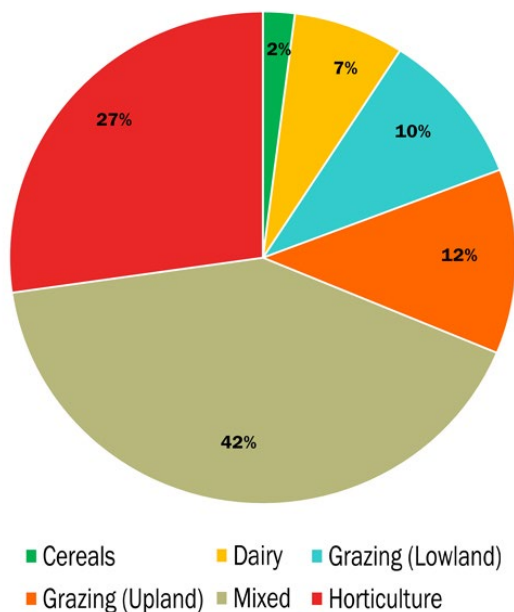


CHART 2 The majority of participants identified their farms as mixed (41%) or horticulture (27%).

Forty-two participants filled in the survey, enabling us to get a better picture of who they were and how they farm.

Based on the survey data, participants were generally younger than the sector average (see Chart 1, p7). The most recent figures from Defra – from 2016 – show that 40% of UK farmers are aged over 65, whereas amongst our participants only 19% fit into this age bracket. This corroborates research by the Landworkers' Alliance which found that agroecology is generally attractive to younger people¹².

Our participants come from diverse backgrounds. Many do not come from agricultural (or, at least, mainstream agricultural) backgrounds; some have chosen to take up farming as a second career, while others have sought to find a practical outlet for their interests in conservation and the environment.

With land access and farm profitability continuing to be major issues, new entrants who do manage to establish businesses tend to be seeking different ways of farming and growing.

Other participants had taken on the family farm and either continued working in the way their families had always worked, or had changed direction through converting to organic or adopting new approaches.

¹² <https://landworkersalliance.org.uk/new-report-the-attraction-pf-agroecology-2022>

Most participants identified their farms as mixed (41%) or horticulture (27%). We only had one cereal farmer and no pig or poultry specialists. This is unsurprising, given that these types of farms are likely to be more 'industrial' in their setup and therefore incompatible with agroecology's emphasis on localism, smaller scale and diversity (see Chart 2, opposite).

The average farm size of our participants is 176.8 hectares. This is significantly larger than the UK average farm size of 81 hectares. However, our survey data is skewed by one very large farm of 1550 hectares and four others above 500 hectares.

Without these large farms, the average farm size was more aligned with the national average. In addition, 45% of survey respondents had farms under 20 hectares, which is also close to the national average of 50%.

We were keen to recruit participants from across the UK. As the map below shows, we have largely succeeded, although the East of England and Scotland are under-represented. Having said that, there is no existing map of agroecological farmers in the UK and so there is no reliable way of judging their true distribution in relation to our core group.

We are actively trying to recruit more participants for the next set of workshops.



Map Farmers and growers who agreed to take part in the project came from most areas of the UK

Meetings with organisations

Our initial meetings with UK organisations sought to understand their approaches to assessing the appropriateness of different technologies

We did not press the question as to whether or not the organisations had considered technology use in the context of their declared or perceived underlying principles or philosophies. Our assumption had been that this would emerge from the discussion. In fact, in most cases it did not clearly emerge.

There was also not much evidence of the framing of technology against agroecological concepts such as 'nature', 'whole system', 'health' and 'equity'.

There were some differences in the extent to which the organisations had grappled with the questions surrounding new technologies. Some, for example Landworkers' Alliance, have considered their approach based on principles of agroecology and food sovereignty, prompted by a specific perceived threat posed by gene editing and the opportunity to respond to a government consultation. Others did not see it as their role to provide guidance on the adoption of new technologies.

"For me, tech has to be human scale. I'm about humans being involved in the food system, humans being able to access the food system and humans being able to access land in order to grow food as a dignified means of making a living"

Landworkers' Alliance Group

The Nature Friendly Farming Network, for instance, represents a diversity of farms and farmers so prefers to work with broad principles over guidelines. Likewise the Biodynamic Association recognises that each farm is unique and what works for one may not work for another.

Organic Farmers & Growers, an organic standards body, said it did not feel able to make such fundamental decisions alone and expressed a desire to see a sector-wide approach within organic.

None of the organisations had specific written guidelines to help their members assess the appropriateness of technologies, though many expressed that they felt the necessity of this was becoming more urgent.

Some common priorities

While it is easy to think of individuals who identify with or are members of particular strands of agroecology as being tied to that identity, we saw little evidence for that kind of rigid boundary.

As with their approach to farming practices, even when participants identified mainly with a single group, most of the farmers in our groups felt a resonance with other organisations and approaches as well.

This suggests that, even if some strands of agroecology have a strong identity and unique focus, there are at least some potentially pliable boundaries between the different strands.

Common themes that emerged during these initial discussions on possible criteria for assessing technologies included:

- Whether it works for small-scale producers growing food for local populations
- Whether it promotes a transition to agroecology or further locks farming into industrial farming models
- Whether the benefits and harms have been sufficiently weighed up
- Whether it will further disconnect consumers from nutritious food and the land
- The social impact of technology, for instance on jobs and skills
- Whether it promotes the kind of future world we want to live in.

Initial Workshops, Emerging Themes

Our initial workshops were designed to tease out the values that underpin individual farmers' thoughts and choices around agricultural technology and how those relate to their farming practices.

Our questions centred around two main topics: the most important values they apply to their own technology decisions and what factors they consider when assessing new technologies. We also spent some time with each group discussing where they thought they fit along the agroecological spectrum and whether they felt part of a "movement".

Agroecology means...?

There is no agreed definition of agroecology and descriptions of what it is are a moveable feast. Different groups and individuals may emphasise or de-emphasise different aspects of its 10¹³ (or

13 <https://www.fao.org/3/i9037en/i9037en.pdf>

13¹⁴, depending on which text you read) accepted elements to try and articulate what agroecology means to them.

But, equally, some individuals in our groups expressed uncertainty as to what the term agroecology meant.

“If you look at the genuine definition - which involves science, involves ecology, involves the social movement and people - then we’re part of the agroecological movement. The danger is that it loses that definition”

Organic Farmers Group

Nevertheless, the variety of organisations and approaches represented in our workshops appeared to sit reasonably comfortably together under the agroecological umbrella. In addition, this range of approaches (biodynamic, organic, pasture-fed, permaculture, etc) was mainly felt to be a strength; indeed, inclusivity was a strong theme of the discussions.

Positively, participants felt it offered room for farm businesses to find a way of working agroecologically according to their priorities and with a community of people that suits them best. For example, an owner of a 2-acre vegetable plot may consider becoming a CSA or running a box scheme, which may be biodynamic, organic, follow permaculture principles or none of these.

On the other hand, there was concern that a lack of firm principles can lead to practices in one area that can cause difficulties for others.

For instance, the herbicide glyphosate is used by some regenerative farmers as part of the effort to reduce or avoid tillage. This is problematic for many other strands of agroecology and, indeed, for some other regenerative farmers.

A lack of definition can also hinder the development of a strong identity, with the associated risk of practices and terminology being used differently by different people or being hijacked and potentially used for ‘greenwashing’ by government, large corporations and industrial farming businesses.

Amongst our groups, prominent concerns expressed about this were aimed at regenerative farming, the definition of which was felt to be even more vague than that of agroecology.

In essence, this could be summarised as a tension between definition and regulations (which was seen

by most as a strength of organic) and variety and flexibility (described as a strength of Community Supported Agriculture). This may have implications for how technologies are assessed for their suitability for agroecological systems.

At this early stage, examining participants’ values and worldviews resulted in a lot of ‘on the one hand/on the other hand’ thoughts, though certain common themes did become apparent.

Connectivity and whole systems

Across the strands there was a strong desire to foster connectivity. Many participants said they valued agricultural systems that were more than merely systems of production.

Whether you call this ‘holism’ or ‘wholism’ (referring more to whole systems), these connections include the natural elements of the land, soil, wider nature, workers (including themselves), neighbours, customers and wider society; nutrition and nourishment; fairness in society and particularly in access to good food and nature; dignity and enjoyment in work; self-worth and good mental health; and spirituality.

Because of this, participants expressed scepticism about technologies that disrupt or sever these connections.

For example, most participants saw connection to the land as a key to agroecological practice and therefore systems like hydroponics were seen as either undesirable or only appropriate when no other systems are available (e.g. urban food deserts).

However, even with those technologies that foster connectivity, trade-offs between benefits and downsides quickly became apparent.

“When we went digital with part of our farm shop it made our production much more accessible and has been an incredible experience”

Biodynamic Group

Digital hubs, for example, can make shopping easier for customers and allow the farmer to tell their story, but this form of mass communication was also seen as replicating the supermarket approach to shopping, at the expense of building personal relationships.

Drones can collect vast quantities of data to help farmers understand their soil and crops better. However, an essential connection to the land which many spoke of, fostered by walking their fields, would be lost.

¹⁴ <https://www.fao.org/3/ca5602en/ca5602en.pdf>

Learning from experience and experiments

Some participants expressed the idea that more data can be useful under some circumstances, but acknowledged that collecting data is not the same as learning. For many, learning from the land is a key element of how they farm.

This may include learning from their own experience or those of neighbours, friends, other farmers and growers (including via exchanges on WhatsApp and email groups) and trusted information sources.

“Once you start looking at farming differently, the only place you can really get advice is peer to peer. It’s from other people that are doing it”

Pasture for Life Group

While many emphasised the importance of localism in their approach, some said they were influenced by people and projects from abroad, sometimes by visiting or working in other countries and acquiring new ideas there.

Learning may also take the form of experiments, either on their own farms, as part of funding schemes such as the Innovative Farmers network¹⁵ or through reading books and scientific papers and adjusting their practices accordingly.

Some noted that ongoing refinements within the range of acceptable technologies, such as biodynamic practices (if, indeed, these may be termed technologies) are often assessed through applied experimentation.

A strong theme which emerged in all groups was the difficulty of accessing advice on non-conventional methods in the mainstream system, despite the UK and devolved governments’ current stated focus on sustainability and environmental benefits.

Those who had attended agricultural college commented that they had learned only conventional methods of production and farm management and that even newer ‘sustainable’ agricultural courses are at odds with some understandings of what is meant by sustainable. It is notable that apparently only one participant, who did a geography degree, learned about agricultural productivism, as well as critical thinking.

Away from those potential sources of information, several farmers appreciate that some of their support organisations, such as organic certification bodies, do try to give impartial advice, if asked.

This is something that conventional farmers often lack, as they tend to be advised by company representatives whose aim is to sell a product or are guided by private consultants or government schemes with a productivist outlook.

Although none of the organisations we spoke to had a formal process for evaluating and disseminating information about new technology, it seemed clear from these initial workshops with our farmers and growers, that formalising such processes would be a useful addition to the ongoing learning process.

Scale

Amongst the agroecological farmers in our groups the question of scale had many facets. For instance, agroecological farms are generally small and diverse and many participants suggested that the vision of technological farming was more suited to large, industrial monoculture farms.

Some expressed the view that tech which simply focuses on increasing yields, missed the point about whole system productivity in a future farming vision. Still others were not moved by the idea of scaling up agroecology, in the sense of more and larger farms.

Participants, for the most part, expressed satisfaction with the scale of their farms and businesses and were more interested in ways of maintaining a viable business at their chosen scale.

Some felt that the idea of scaling up to “feed the world” was largely an industrial or corporate concept and expressed the view that their operations were not intended to nor designed to feed the world.

“It is important for me that it is fixable by people who have craft skills, not people with computer skills”

Landworkers’ Alliance Group

Instead, their goals were to improve their land and soil and the quality of their food and therefore their service to the local community and the environment. Inasmuch as this is true, a sense of place and/or belonging is an important modifier to the notion of ‘scaling up’. This was a strong preference of those working in Community Supported Agriculture.

Balancing ideology and practicalities

All the participants found themselves, to a greater or lesser extent, in a balancing act between ideology and practicalities, with the balance point varying significantly.

¹⁵ <https://www.innovativefarmers.org>

However, the vast majority need to at least break even financially. While several stated that making money is not their main objective and a very few were in the fortunate position of not needing to maximise profits, most have (or had) responsibility for a family and sometimes employees.

The need to make a set amount of money was felt even more acutely for tenants.

The cost of new technology weighed against uncertain benefits was also a factor that made several of our participants wary.

Feeling part of a movement

When asked if they felt part of the agroecological “movement”, answers were mixed.

Although most felt they had a reasonable idea of what agroecology was, others were uncertain. More established practices such as organic and biodynamic, which have firm standards, tended to welcome the idea of agroecology but were wary of a lack of clear standards and identified themselves primarily in relation to their strand.

Those representing younger organisations, such as Landworkers’ Alliance members, embraced the idea of a movement. Nature Friendly Farmers, however, were less inclined to see themselves as being part of the agroecology movement.

We're tenants and have a mortgage, so any choices I make I'm always very conscious that I can't afford it to fail because that's the family business gone potentially very easily. So everything I do at the moment, I trial the year before. By doing this I learn how far I can push it before it goes too far.

Future Farming Group

Our initial survey also included a question asking respondents to consider these various ‘strands’ of agroecology and rank them according to how closely they aligned with their own values and approaches to farming.

Most participants ranked agroecological or organic first or second. Regenerative and nature friendly farming also scored well and pasture fed was ranked fairly highly amongst those who keep livestock.

Biodynamic and permaculture were most commonly ranked last, which is unsurprising given their strong philosophies and specific practices and the fact that neither is widely practised in the UK (see Chart 3 above).

Approaches to farming

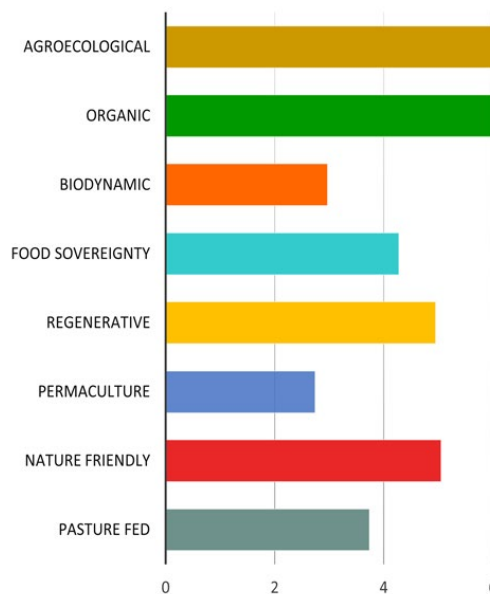


Chart 3 When asked about their approach to farming, most participants saw themselves as either agroecological or organic. The chart above, which represents a weighted average of responses, aligns well with the workshop discussions. The raw data, however, showed more nuance according to what their primary alignment was.

Technology Choices

During discussions on specific technologies, we looked at some broad categories of technology currently being proposed to help boost productivity and efficiency on agroecological farms. These included:

- Precision agriculture – remote sensing (soil testing etc) and data collection (machine learning, algorithms and AI)
- Robotics
- Gene editing
- Digital food hubs and supply chain innovation
- Hydroponics

Overall, our farmers and growers were interested in technology, wanted to know more and saw benefits in the use of at least some technologies (although none were unanimously agreed upon).

Among these, open-source data systems and online marketing platforms were felt by some respondents to be very useful, particularly those developed by farmers for farmers.

“If we don't have data and science behind what we're doing as innovative farmers, we have no argument to the naysayers”

Food Farming and Countryside Commission Group

Improving data capture was felt to be important in helping to support agroecological systems by helping to prove the benefits of these types of production. Some farmers and growers stated that digital food hubs had been beneficial, although others queried whether they, ultimately, reduce genuine person-to-person contact.

GPS in cattle collars and on tractors was also appreciated, albeit with the recognition that these lead to a dependence on external companies.

Although very much a minority view, even technologies as divisive as gene editing were considered to have theoretical benefits (except within organic and biodynamic systems) with caveats, such as ownership being devolved to users. That said, there was little appetite for genetically engineered/gene edited crops or animals, which most felt had little to offer and were fraught with uncertainty.

"I think there's a big danger of using sophisticated technologies like genetic engineering to solve problems which aren't problems"

Pasture for Life Group

Many participants were aiming for a low-input system so did not see the need for biological inputs. However, some diverged from this view.

One participant has seen the benefits of microbial inoculation to silage to enhance the fermentation process and another was breeding beneficial insects for release on the farm.

While F1 hybrids are by no means a new technology, they are a technological choice. While most growers are theoretically supportive of open pollinated seeds for their vegetable varieties, many had found organic OP seed to be either unavailable or prohibitively expensive, while also providing lower yields.

Similarly, while many in our groups dismissed the idea of hydroponics because they felt that soil was an important part of an agroecological system, some felt that vertical farming in a properly integrated system may have a place in highly urbanised areas where no other types of growing are possible. Nevertheless, both were considered concessions of last resort and, for some, indicative of a failure of the food supply system.

Alignment with agroecological values

The idea that technology should support the values and goals of agroecology led to two overriding questions: 1) does the technology align, at

least in theory, with the values and goals of an agroecological system and 2) is it a realistic option in practice?

The first question raised issues of appropriateness, purpose and potential trade-offs including how a particular technology might affect things like farmer autonomy. The second question brought out issues around affordability, adaptability and acceptability – not just to the farmer but to their customers – issues that affect farmers at all scales but are of particular concern to those working at smaller scales.

What problem is it trying to solve?

Participants queried whether the technologies under discussion solved a legitimate problem; whether they were a 'must-have' or a 'nice to have'. There was a feeling that 'problems' can often end up being defined by those that have something to sell or by start-ups looking for short-term gains, when time, observation and nature might provide a more helpful and longer term, solution.

Amongst the 'problems' that technologies aim to fix is burdensome human labour. Farming is physically hard work and many agreed that there were jobs on the farm such as weeding "*acres and acres of carrots*" that they would happily leave to a robot given a choice (reduction in the use of pesticides and difficulties in finding workers for this kind of job was also a spur).

Some farmers felt positively about robotic milking systems which they said cows seem to like (others expressed uncertainty about what cows like) and which could theoretically free dairy farmers up to take on other tasks.

"Weeding is one of my favourite jobs. It's a time that my hands are busy, but my brain is free, and it's when I think about a lot of things. It's kind of meditative"

Community Supported Agriculture Group

But as the discussions progressed, interest in robotics began to be balanced by a need to value jobs, foster some dignity in work, wishing to see more connection with the land and/or animals and the provision of opportunities for those who want it to have access to employment on the land. Settling on a 'sweet spot' where robotics enhanced rather than took these things away proved challenging – and that spot was different for most.

How does it impact farmer autonomy?

For the agroecological farmers and growers in our groups, being 'hands on' in their businesses was

important and raised questions about how some new technologies might stifle or enable the need for an experience of autonomy.

Several participants stated that farmers are already at the mercy of factors out of their control. Not just the weather, but the knock-on effects of the invasion of Ukraine and the subsequent rise in the costs of many agricultural inputs, as well as the continuing effects of Brexit.

For these and other reasons, some measure of control on their own farms and in their own businesses was perceived to be important. The most common concerns around technology and autonomy included:

- **Power and control** Where the power lies within the wider food and agricultural system was a major issue for many participants, particularly those with links to food sovereignty such as Landworkers' Alliance members and those running CSAs. Some questioned whether the tech would further concentrate this power. For instance, how would gene editing and the consolidation of seed ownership amongst large corporations impact small-scale farmers and growers, including community growing groups? Related concerns, extended to food sovereignty and the need for more community ownership.
- **Data collection and ownership** Nearly all groups raised some concern about this. Although it was also noted that data collection could be useful to help build the case for agroecology, there was a marked preference for open-source technology which allows for farmer or community ownership of data. One pasture fed livestock farmer who uses GPS collars for managing grazing noted that they were totally reliant on a tech company – and should that company cease trading (always a risk with so many young start-ups on the marketplace) they could potentially lose essential data.
- **Dependency on external companies** Several participants already use tech which they find helpful. Notably, almost all reported having a phone with various apps that they used regularly to aid their work. But some expressed concern that a reliance on tech can also mean a reliance on the companies behind it for continued service and updates, which most found uncomfortable. Others stated this as a reason that they are avoiding such technology.

Related concerns, especially for those with links to organisations such as CSA or Landworkers' Alliance, extended to food sovereignty and community ownership.

Threaded through all the workshops were concerns around corporate over-reach, throughout the agricultural and food system, for instance should a large conglomerate, through a vertically integrated supply chain, specify which pesticides or seeds must be used or how intellectual property rights, in relation to genetic technologies might impact small-scale farmers and growers.

What kind of farming system does it support?

Many of our farmer and grower participants saw their work as an extension of their personal values around food, soil, nutrition and ecology. For those who were relatively new entrants to farming, there was often a desire to take a long-standing interest in ecology and conservation and put it to some practical use.

Most had diverse ideas about what constituted an agroecological or sustainable food system and it was against these, at least in part, that technology choices were measured. Given this, those technologies that did not align with environmental values, or which were seen to prop up the industrialised farming system were more likely to be rejected.

For example, robots in dairies, whatever their perceived benefits, also make it easier to continue the practice of separating calves from cows (rather than encouraging calf-at-foot dairies).

“As a subscriber to the food sovereignty movement, what we want to see is more people working the land and having fulfilling jobs. And for the food pounds actually supporting livelihoods rather than going to research and development for robotics companies”

Community Supported Agriculture Group

Similarly, automated systems, it was suggested, are better suited to regular environments and monocrops rather than the biodiverse fields found on organic and biodynamic farms (although it was acknowledged that robotic technology and artificial intelligence are moving beyond this).

Gene editing of certain traits and disease resistance in animals allows livestock to continue to be kept intensively (rather than in more extensive systems) and hydroponic and vertical farming encourages niche high value products produced in

high-input systems rather than encouraging change in the wider food distribution system and ensuring a diverse diet of high quality food for all.

Overall, it was felt that much of today's aspirational technology was driven by the idea that we need to produce more food but not necessarily better food – an idea that most farmers and growers in our groups did not support.

This productivist mindset, however, is still firmly entrenched, both in the developers of technology and in many, if not most, farmers – and, crucially, in government outlook and policy.

For this reason, many of the technologies discussed were felt to be irrelevant to small-scale producers, as their business priorities tend to focus on soil health and animal welfare and on satisfying local markets rather than maximising yield for global consumption.

The three 'As'

Having decided whether a technology is worthwhile and is likely to solve a problem, its chances of being taken up by agroecological farms are also affected by several additional factors:

- **Affordability** Quite simply, most of the participants felt that such technological advances would be too expensive for smaller enterprises to afford. This increases the likelihood of further divergence in agriculture into large, high-tech operations versus smaller, human-scale businesses, struggling to compete. At one time, this might have been seen as a choice between paying a one-off fee for a piece of equipment or paying continual labour costs, but digitisation – with its need for frequent updating – has somewhat changed this discussion.

"I feel like affordability is the elephant in the room for any scale other than thousands of hectares"

Organic Growers Group

Affordability was most often mentioned in relation to existing technology choice, for instance different types of seed rather than new technologies. Whether this is due to their remoteness from current farming practice or due to some other reason, needs further exploration.

- **Acceptability** Particularly for those with close relationships to their customers, such as CSA participants, the issue of what is acceptable

to consumers is essential. This is likely to be felt more in small-scale businesses, although larger operations with supermarket contracts are also keenly aware of this.

- **Adaptability** Participants expressed the greatest interest in technological solutions that could adapt to how they wanted to farm rather than technology that demanded a change in their approach. This raised several questions that underpinned technology choice including: Does the technology fit the scale of the farm? Can it be easily repaired or modified by the farmer to suit their farm? In fact, the ability to fix farm equipment oneself or get it mended by a local mechanic was flagged up as important for several of our farmers and growers.

The number of older tractors and other items of equipment still being used by the farmers in our groups was notable and links back to issues of power and control. The ability to mend things was seen as helpful to business resilience and control, while having technology that can be repaired or modified locally is often more convenient and helps with local employment and social cohesion.

Where next?

Participants in our phase 2 meetings gave generously of their time and insights, although we were aware, as the workshops progressed, that we were only scratching the surface of some very important issues. Nevertheless, these foundational sessions have provided a good indication of where the project will go in its next phases.

In truth, there is not yet a template for this kind of discussion within agroecology. It's clearly not helpful to either thoughtlessly embrace new technology or thoughtlessly rejected. But if agroecology believes itself to represent a radical transition in farming, then the way that agroecological farmers and growers – and the organisations that represent them – approach new technology should reflect that paradigm shift. That means asking more and better questions.

Building on the themes that arose, our next set of workshops will aim to dive deeper into the meaning of agroecology. Not just its 'elements', but how it plays out in the day-to-day practices of individual farmers:

- Which are non-negotiable and which are open to compromise? What are the most important elements?

- Which are non-negotiable and which are open to compromise?
- Where is there overlap and consensus on principles and their application between the different strands?
- What is the dynamic of trade-offs?

Aligned with this is the weight and meaning of words and concepts within the agroecological narrative. For instance:

- What is meant by “working with nature” or biodiversity and ecological as these relate to actual farming and technology choice?
- How do these concepts or notions sit with the character, frequency, intensity or source of inputs and technological interventions?
- How do notions like food sovereignty, social justice and equity relate to farm practice?

The question of scale, which arose again and again in our workshops, is clearly also worthy of deeper exploration:

- Is there a desire amongst our participants to scale up? What does “scaling up” even mean?
- Is there a minimum or maximum scale at which agroecology can operate – or is the key factor something else, such as labour or land ownership? Does this affect tech choices?
- How can we make sure smaller farms are not further disadvantaged by technology uptake?
- How can the food supply chain work better in support of small- scale producers who care for the environment and consumers?

Similarly, the connection between ‘innovation’, technology and sustainability in terms of investment is important. It seems clear that agricultural innovation is, increasingly, defined by the amount of investment it can attract and the envisioned markets it can create and not necessarily whether it is necessary or appropriate.

It is therefore worth considering how government grants, aimed at technological ‘innovation’, influence on-farm technology choices. In addition:

- Where should government finance be directed in order to advance agroecology?
- Do financial pressures discourage farmers from changing to agroecological systems where a decrease in return is likely in the early stages?

In the final phases of this project we will also be working with farmers and organisations to develop case studies for the final report.

Whilst striving for clarity over criteria for technology choice is the headline goal of the project other goals such as information and empowerment are equally important.

If this work can facilitate a deeper conversation and the emergence of individual and organisational consciousness that supports a truly agroecological mindset that becomes the cultural and intellectual norm, this would, arguably, be its most dynamic and possibly most important outcome.

Appendix 1 - Methods

Phase 1

In the first phase, which ran in the second half of 2022 and into 2023, we engaged with representatives from across the agroecological umbrella to begin to understand their priorities and approaches to technology choices. Their input also helped us to design a research programme which gives farmers a voice in the next phase of the process.

During this phase we spoke to the Biodynamic Association, the Soil Association, Organic Farmers & Growers, Organic Growers Alliance, the CSA Network, Landworkers' Alliance, Permaculture Network, Nature Friendly Farmers Network, Pasture for Life and the Food, Farming and Countryside Commission.

Also during this phase we ran workshops at two conferences: the OGA conference in October 2022 and the ORFC conference in January 2023, to start the process of interacting directly with farmers and growers to begin to understand their main thoughts and concerns. For notes on these see Appendix 2.

Phase 2

For the second phase, we identified approximately 62 farmers and growers willing to participate in a workshop designed to understand their thoughts and feelings about different agricultural technologies as well as the practical and philosophical underpinnings of the technology choices they are making. We recruited the farmers through a combination of reaching out directly and with the help of the organisations we worked with in phase 1.

It was important to us to get good representation from each of the different agroecological farming approaches ('strands').

This is to enable us to interrogate the values and worldviews underpinning farmers' decisions on how they farm, as well as their understanding of and relationship to the term 'agroecology'. This, we hope, will contribute to a clearer picture of shared, separate and mutually supportive criteria across a range of farming disciplines.

These phase 2 workshops were held on zoom from March - May 2023. Forty-eight farmers and growers participated in 11 workshops in total, of which 9 were separated into self-identified strands and the final two were mixed groups for those unable to make their original date. The final strands for the first workshops were:

- Biodynamic
- Community Supported Agriculture (CSA)
- The Food, Farming and Countryside Commission (FFCC)
- The Nature Friendly Farmers Network (NFFN)
- The Pasture Fed Livestock Association (PFLA)
- Landworkers' Alliance (LWA)/Food Sovereignty
- Organic Farmers
- Organic Growers
- Future Farming (comprising a broad group of those who didn't easily fit into one of the others).

Participants were given an initial written information briefing on the project which included links for further reading and asked to fill in an online survey about their farms. Response to the survey was high – 42 participants completed it. The recordings and notes of the sessions were made available to each group and we encouraged and received further feedback.

Phase 3

The next phase will comprise a second set of workshops to be held from July 2023. They will be longer, largely in-person and will be mixed groups from across the strands. We hope that the mixed groups will allow for greater debate and further interrogation of the areas of overlap and difference from across the strands.

Phase 4

The final phase of our project will involve analysis and write-up of all the workshops with further exploration of differences between a) narrative and practice and b) between organisations. In addition to our core group, we will seek to involve key players and farmers/growers who have been particularly engaged and/or hold "outlier" views in a wider discussion.

In this phase we hope to produce a final report detailing an agreed set of criteria (or to examine why this hasn't/can't be achieved and what can be done about it) that the agroecological movement can use as a platform for discussion and/or to engage on a more equal and democratic footing with industry, policymakers, civil society and researchers.

Appendix 2 - Conference Workshops

OGA workshop, October 2022

The workshop, at the Organic Growers Alliance annual conference, was attended by approximately 45 in-person attendees and 7 online. It involved a series of discussions in break-out groups of the main ethical considerations which factor into on-farm decisions about a range of technologies.

Technologies discussed, which were selected to span the spectrum of low to high-tech were seed choices, biological inputs, robotics and GM. The conclusions were:

- **Seeds** Important ethical considerations included local companies and production, organic, the presence of patents and local adaptation. However, the discussion tended to gravitate towards the conflict between their preferred seed choices and practical considerations such as availability, cost and yield. Overall, participants felt that the market (e.g. cost and availability of good quality seed) dictated their choices.
- **Biological inputs** Environmental considerations such as contribution to circular systems and local sourcing (to reduce transportation and support local economies) were the main ethical considerations raised in relation to outside system inputs.
- **Robotics** Many participants felt that robotics were not inherently unethical. The positive ethical and practical considerations mentioned were 'people-friendliness' (reducing hard labour and unfulfilling work, supporting bodies) and reduced compaction. Resistance to robotics centred around the issues of deskilling and further disconnecting us from the land and our food. Questions of ownership, patents and control were raised, as was the issue of affordability for small-scale growers. Finally, there was a concern that robotics would promote non-agroecological systems as they are unsuitable for small-scale, diverse cropping.
- **Genetic modification** This discussion was more theoretical than the others, with many participants expressing a lack of knowledge and desire to know more before making any decision. Many concerns were raised, including the issue of corporate control, whether we need it or not, the risks and incompatibility with agroecological principles.

In summary, at the lower-tech end of the spectrum, ethical considerations tended to be more locally-oriented, such as impacts on the environment and locality of sourcing and focussed more on the trade-offs between ethical ideals and economic realities.

The higher-tech options discussed prompted more system-level concerns, such as ownership and control and compatibility with agroecological systems.

ORFC workshop, January 2023

Approximately 42 attendees joined us for this workshop at the Oxford Real Farming Conference, which involved a wide-range of discussions both in the full room and in the break-out groups.

Considering possible principles that might inform the choice of agroecologically appropriate technologies, participants suggested:

- Minimal cost, financially accessible
- Technological sovereignty – ownership and control
- Participatory tech development – developed with ethics of care
- Empowering – can it be maintained or repaired in the local area?
- How much waste does it generate?
- How can we monitor tech and how can we withdraw it?

There was some discussion about trade-offs and possible limits/boundaries to the tech. A wide variety of opinions and concerns were raised, including questions about the overall vision (what world we want our children to inhabit) and the concept of 'exponential tech' (i.e. going beyond what we can control) and the need for democracy as safeguards.

In the break-out groups there was a sense of a lack of cohesion between the different strands and no easy agreement on the appropriateness of specific technologies.