Identifying Agroecologically Appropriate Technology

Background & Information for Participants

A Project of A Bigger Conversation
2023

Introduction

Throughout 2023 A Bigger Conversation will be gathering agroecological farmers and growers together for in depth discussions on technology choices in a variety of agroecological systems. The project which is formally called '**Identifying the Core Principles and Criteria for Agroecologically Appropriate Technology**' will be looking at different types of technology choices on agroecological farms and how farmers and growers make decisions around these.

Agroecology is, of course, a broad umbrella which sits over a number of different approaches to farming including organic, biodynamic, nature friendly farming, permaculture and others. We will be looking at the values and world views that inform technology choices - and indeed our starting assumption is that choices around technology are not values-neutral. We will also be investigating where there is coherence amongst the various strands of agroecology in regard to technology choices, as well as where there is divergence.

What we hope to draw from this is a co-created, broad criteria for technology choices in agroecological farming which will be published at the end of the project.

This document gives some background to the project, including some suggested reading and information on what participants can expect.

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What is Agroecology?

Agroecology is a holistic, systemic approach to food system transformation. It is an umbrella term which encompasses various approaches, such as organic, biodynamic, permaculture, regenerative agriculture and the food sovereignty movement. It is a science, a practice and a social movement, with the three strands as inextricably linked and interdependent as the living systems on which we depend.

As a science, agroecology applies the principles of ecology (the relationships between living organisms, including humans, with their physical environments) to the design and management of sustainable food and farming systems. These scientific goals include maximising biodiversity and stimulating interactions between different plant and animal species to build long-term fertility, reducing pests and diseases, protecting freshwater systems, and securing pollination services. Scientific understandings of agroecology have broadened beyond environmental concerns to incorporate the ecology of the entire food system.

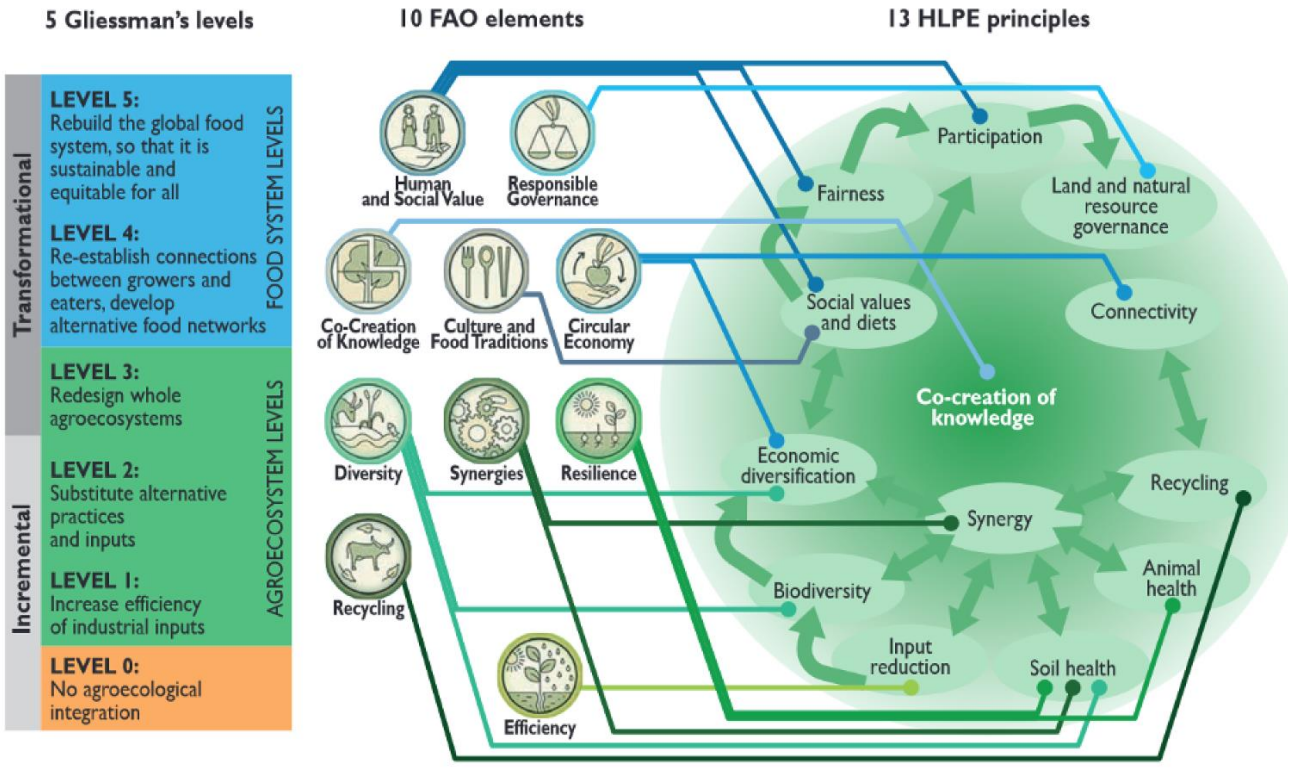
As a practice, agroecology seeks ways to improve agricultural systems by harnessing natural processes, creating beneficial interactions and synergies across the agroecosystem. Examples of on-farm agroecological practices are agroforestry, intercropping, integrated pest management and rotational grazing. With its origins in traditional and indigenous food systems across the globe, agroecology promotes a co-created, decentralised and interdisciplinary approach to knowledge generation, with farmers working alongside scientists to develop solutions.

As a social movement, agroecology was shaped by the grassroots peasant movement, which grew in response to the dramatic increase of rural poverty and inequality in the aftermath of the Green Revolution. The spread of industrial agriculture and increased globalisation of food systems have led to a growth in the counter-narrative and a vision of democratic, equitable and just food systems based on agroecological small-farm production. This involves supporting diverse forms of smallholder food production, farmers and rural communities, local knowledge, social justice, and indigenous rights for seeds and breeds.

In 2018, following a 4-year consultative process, an FAO framework laying out the '10 elements of agroecology' was a milestone in bringing agroecology into mainstream policy debate and establishing a holistic version of it that included social justice components.

This conceptual maturity was consolidated the following year when the High-Level Panel of Experts (HLPE) of the United Nations Committee on World Food Security (CFS) translated these 10 elements into a set of 13 operational principles to guide agroecological food system transformation. These principles have been linked with Gliessman's 5 levels of food systems reform to provide a holistic framework for understanding agroecology as an approach for wholescale food system reform (see next page).

The broad and all-encompassing nature of agroecology is also its biggest weakness. The various practices and philosophies which sit within the agroecology movement, such as organic, biodynamic, food sovereignty etc, all have slightly different viewpoints and final goals. And as the concept gains in popularity and is used in a wider range of contexts, it is important that researchers and practitioners are explicit about their definition. Various authors have warned about the danger of co-optation and the loss of agroecology's more transformative elements.



Source: https://knowledge4policy.ec.europa.eu/node/49142_sv

In summary, agroecology offers an inclusive and comprehensive pathway toward food system transformation. It promotes greater understanding and wellbeing of natural living systems, connects social and environmental aspects of sustainability, addresses the whole food system, is attentive to power inequalities, and draws from a plurality of knowledges emphasizing the inclusion of marginalized voices. Agroecology is not just one tool in the toolbox – it is a different toolbox altogether.

Sources/further reading:

- For a more in-depth analysis of the history and evolution of agroecology: https://ipes-food.org/_img/upload/files/SmokeAndMirrors.pdf
- For an academic overview of the FAO's elements and HLPE's principles of agroecology: https://link.springer.com/article/10.1007/s13593-020-00646-z

What is Happening with Tech on Farms?

Technology is widely purported to be the solution to the environmental, social and economic problems in the food system. Farmers across the world being persuaded to adopt various technological 'solutions', from robotics to sensor-equipped drones, with the promise that they will improve productivity and efficiency. In addition, technologies such as Artificial Intelligence, Blockchain, genetic engineering and big data are being swiftly rolled out across all parts of the food system in the name of sustainability.

The UK government is promoting the tech agenda. In its recent Food Strategy, plans to "drive innovation and harness pioneering technology" were front and centre, with a planned investment of £270 million across farming innovation funding programmes.

High levels of investment in agritech are also seen in the private sector. Figures from Crunchbase shows that nearly $5 billion was invested in agritech startups, in 2021, far outstripping the $3.3 billion invested in 2020.

This table from the Tony Blair Institute demonstrates the wide spectrum of technologies envisaged across all parts of the food supply chain:

Three categories of food-tech innovation and individual innovations within each

A. Increase quality	B. Improve methods	C. Reduce waste
Precision • Robotics and automation • Farm-management software and sensing	New Foods • Plant-based food alternatives • Cultured and lab-grown food	Supply Chain • Food sensing and processing • Food preservation and smart packaging • Renewable cold-storage
Protection • Gene editing • Microbiome technologies for crops and soil • Biological-based crop protection	New Farms • Controlled environment agriculture and vertical farms	Marketplaces / mobile services • Digital marketplaces

Source: https://institute.global/policy/technology-feed-world

The speed of change leaves little room for debate as to which technologies will actually lead us to a more environmentally and socially sustainable future. There is an urgent need for such conversations to try to ensure that technology choices are democratic, rather than solely dictated by commercial interests.

Potential consequences of the tech agenda for agroecology

Technological developments through the ages have brought some positives to agriculture. Most (though undoubtedly not all) proponents of agroecology would agree that the tractor, when used well, has made their farming operations more economically viable, less back-breaking and freed labour up for more interesting work. Similarly, the new wave of high-tech innovations which are dominating agricultural discourse at the moment certainly has potential to help transition more of the food and farming system to agroecology.

Bellon-Maurel et al (2022) have identified a number of ways in which technology could be helpful for agroecology:

- **Knowledge creation** New modes of building knowledge are needed, and technology could help by, for example, modelling complex agroecological systems and aiding the participatory collection of data on growing methods.

- **Improving production** Agroecological farmers could benefit from precision agriculture or precision livestock farming on their farms, or the incorporation of economic data to help them at a strategy level. Agricultural equipment designed for complex systems could help make such systems more viable.

- **Improving farmers' integration with regional or economic ecosystems** Digital technologies could positively impact agricultural services such as advice or insurance, as well as reshape value chains, for example through online platforms allowing farmers to connect directly to consumers.

- **Sharing data, information and knowledge** Technology is helping knowledge exchange, for example through YouTube channels and peer support groups. This could potentially be scaled up.

However, the rapid growth of technologies in agriculture also poses many risks to agroecology, not the least of which is reducing the whole system approach of agroecology to an a la carte menu of approaches and technology choices. If this rapid rollout of new technologies continues unabated, it presents significant challenges to the increasing support that agroecology is enjoying in local, national and global discourse. To avoid being swept up in the vision of a high-tech agricultural future, it is vital that the movement considers these challenges and claims control of the narrative about which technologies are appropriate for the kind of future we want.

From an agroecological perspective, some of the major questions which need to be asked about technology in agriculture are:

Does it promote or support an industrial agriculture model?

Many of the corporate and financial interests behind food system technology development want to keep the agriculture industry as close to existing practices as possible. The technologies are designed to allow for more intensification, more yield per hectare and more productive plants and animals. Meanwhile, well-funded PR campaigns are promoting the narrative that food production can be 'greened' or made more sustainable through technology.

Powerful proponents of agritech are likely to use agroecology's weakness – its broad and poorly understood systemic nature – to choose only the bits which suit them and develop a story that their technologies can help scale up agroecology. For example, a plant genetically engineered to be disease resistant can be argued to help reduce inputs and promote an integrated pest management approach, as well as helping farmers. This may sound appealing, but it ignores the question of how the technology can promote a more just, equitable and democratic food system.

Without a wholescale assessment of specific technologies, as well as the power structures and systems that underpin them, agroecology risks being reduced to a simple set of environmental metrics. At the heart of agroecology is the relationship between the environmental and socio-economic factors, and centring food producers and their communities in decision-making on the governance of food systems is essential.

Who will benefit?

Who stands to benefit from a high-tech agricultural future? A recent study into the discourse surrounding Precision Agriculture found that the promotion of the technology is geared towards two audiences that have become important agri-food governance actors: the finance and tech industries. They discovered that "*the majority of websites [they] analyzed indicated the financial value of digital tech for farmers and investors alike before they described any environmental benefits, much less farmer justice concerns, or more fundamental reforms of food system reform*".

Does it focus on the symptoms of the problems, rather than the cause?

Agroecology is a systems approach, which means that it seeks to understand the entire network of food production and distribution methods and their relationships with the physical world in which they exist. It recognises that the myriad of environmental, social and economic problems in the food system are inextricably linked.

Many new technologies are not created from such a systems approach. Instead, developers normally boast of their ability to 'fix' a specific problem. To take a recent example, some are calling for gene editing of chickens for resistance to avian flu. However, evidence shows that new highly pathogenic strains of avian flu developed in industrial poultry units. The low genetic diversity and immune-compromised birds which have been heavily bred for fast growth and high meat yields all increase the risk for a virus outbreak. Tackling the bird flu outbreak with further breeding, this time in a laboratory, amounts to a failure to recognise the multitude of problems created by the industrial poultry system. It will simply kick the can down the road until another disease or major pollution outbreak.

The more tech 'fixes' which find their way into the food system, the more cracks are papered over, making it harder to see the scale of systemic challenge we face. Agroecology provides a vision for a transformative shift of the food system – scaling it up requires a widespread understanding of these systemic challenges and solutions.

Further reading

- IFOAM Organics Europe Report (2020) – Agroecology and Digitalisation: Traps and Opportunities to Transform the Food System https://www.organicseurope.bio/content/uploads/2022/06/IFOAMEU_Agroecology_Digitalization_2020.pdf?dd

- Soil Association (2021) – AgroEcoTech: How Can Technology Accelerate a Transition to Agroecology? https://www.soilassociation.org/media/22821/agroecotech-soil-association-report.pdf
- Duncan et al, (2021) Who is benefitting? A Study into the Discourse around Precision Agriculture, Agriculture and Human Values, https://link.springer.com/article/10.1007/s10460-021-10244-8
- Michel Pimbert and Colin Anderson (2018) Technology vs Agroecological Innovation, The Conversation, https://theconversation.com/the-battle-for-the-future-of-farming-what-you-need-to-know-106805
- Colin R. Anderson and Chris Maughan (2021), The Innovation Imperative": The Struggle Over Agroecology in the International Food Policy Arena, Frontiers in Sustainable Food Systems, https://www.frontiersin.org/articles/10.3389/fsufs.2021.619185/full

What is agroecologically appropriate tech?

Although there is no agreed-upon set of principles for establishing which technologies are appropriate for agroecology, a number of academics have begun to tackle the question.

In the 2020 IFOAM report, Tisselli and Hilbeck drafted a set of principles for information and communication technologies (ICT) for Agroecology (ICT4AE). They used the FAO's 10 Elements of Agroecology as a starting point, considered the values that underpin agroecology and translated them to the design and development of ICT.

The result is a set of guidelines which is dramatically different from the industrial agriculture technology paradigm:

PRINCIPLE	ELEMENTS OF AGROECOLOGY (FAO 2018B)	PRINCIPLES FOR ICT4AE	CONVENTIONAL AGRICULTURE
Diversity	Integrating and increasing the biological diversity of ecosystems into agricultural systems.	Integrating appropriate and relevant ICT available in a specific context and favouring their interoperation	"One size fits all"
Co-creation and sharing of knowledge	Activating participatory processes where indigenous and scientific knowledge can lead to context-specific innovation.	Creating tools that combine top-down (scientist-to-farmer) with bottom-up (farmer-to-scientist) and peer-to-peer (farmer-to-farmer) modes of communication, aimed at the co-creation of situated agroecological knowledge.	Farmers are often regarded as clients of prepackaged information coming from unknown sources.
Synergies	Enabling the combination of diverse actors, activities and conditions to build biological, ecological, economical and social synergies in food systems.	Recognising ICT as a valuable element that supports larger sets of actors and processes.	ICT as drivers of agricultural transformation, often at the expense of other actors.

PRINCIPLE	ELEMENTS OF AGROECOLOGY (FAO 2018B)	PRINCIPLES FOR ICT4AE	CONVENTIONAL AGRICULTURE
Efficiency	Optimising food systems to produce more using less external inputs and resources.	Taking advantage of the full potential of the different ICT platforms available in a specific environment, regardless of their level of sophistication, to maximise their usefulness, as well as favouring energy-efficient technologies.	Privileging sophisticated (and often costly or largely untested) ICT for the sake of efficiency, while energy efficiency is not necessarily considered.
Recycling	Imitating and supporting biological processes to minimise waste of resources in food systems.	Reusing and repairing ICT to extend their lifespan and usefulness as much as possible.	Recycling is not always emphasised since business models are often based on replacing obsolete ICT.
Resilience	Increasing biological diversity and maintaining the functional balance of agricultural systems to enhance resistance and recovery in adverse conditions.	Designing sustainable ICT capable of withstanding adverse conditions, as well as minimising farmers' dependency on prepackaged information, monetised loops and external inputs.	Business models are often based on farmers' dependency on external inputs, including data, energy, devices and connectivity.
Human and social values	Protecting and improving rural livelihoods, equity and social well-being.	Respecting the integrity of farmers and their communities by placing them at the centre, avoiding disruptive practices such as surveillance or non-consensual extraction of data and supporting farmers' full ownership of ICT.	Farmers are often considered inefficient and unreliable, therefore replaceable by algorithms or machines and are also regarded as mere sources in data extraction and surveillance schemes.
Culture and food traditions	Supporting healthy, diversified and culturally appropriate diets.	Developing ICT initiatives that integrate local cultural values, including language, rules, regulations and religious considerations, into the core of their tools and methodologies.	Farmers must adapt to ICT, regardless of cultural constraints and conditions, since local culture and traditions are not necessarily considered.
PRINCIPLE	**ELEMENTS OF AGROECOLOGY (FAO 2018B)**	**PRINCIPLES FOR ICT4AE**	**CONVENTIONAL AGRICULTURE**
Responsible governance	Designing and implementing local, national and global political mechanisms that support sustainable agriculture and food production.	Complementing ICT platforms with corresponding governance provisions that ensure their appropriate usage by integrating a wide range of local actors, organisations and institutions.	ICT are often aimed at individual farmer-entrepreneurs or operators, while governance is often delegated to "smart" algorithms.
Circular and solidarity economy	Creating virtuous cycles that connect producers and consumers, prioritise local markets and support economic development, as well as optimising food systems by redesigning them according to the principles of the circular economy.	Embedding the principles of circular and solidarity economy into the design of ICT tools and methodologies, such as implementing locally relevant and solidary business models, orminimising and sustainably managing waste related to ICT usage.	Business models often follow the startup paradigm: "move fast and break things" and waste related to ICT usage is not necessarily considered.

Elsewhere in the literature, Clément (2020) has cited the need for the technology to be developed using transdisciplinary and participatory research methods, as well as ensuring they are financially accessible:

> *"Involving users in the design and training of digital agro-equipment, creating financial incentives for innovative equipment purchase, sharing costs among cooperatives and farming communities, or exchange platforms to facilitate producer eater relationships are pivotal aspects of adapting digital tools to agroecological innovation."*

In its AgroEcoTech report, the Soil Association considered the governance of tech for agroecology, including:

- Whether it enables and/or is created by participatory knowledge generation, with an interdisciplinary approach and farmers being involved in the design of the technology
- Whether it is accessible and equitable
- The accountability and transparency framework of the technology.

Despite some common themes emerging as to the types of questions which need to be asked about agroecologically appropriate technologies, there is little consensus in relation to the acceptance or otherwise of specific technologies.

To take the example of genetic engineering, multiple attempts have been made to consider it through an agroecological lens, with very different conclusions:

> *"genetic engineering and agroecology certainly have synergy in the context of agroecology as science, when applied to making crops less vulnerable to pests and diseases and when combined with cultivation using IPM" (Lotz et al, 2020)*
>
> *"Acceptance of certain forms of genetic engineering may give those promoting agroecological methods more scope to influence which strains are permitted, and how they can be used as transition technologies" (Soil Association's AgroEcoTech Report, 2021).*
>
> *"CRISPR/Cas shows high levels of incompatibility with agroecology, understood here as a primary benchmark for sustainability. While CRISPR/Cas crops and livestock can potentially be used within agroecological systems, uncertainties remain on their applicability, their opportunity-cost, and even the likelihood that they will be integrated into agroecological systems in the first place. This is not only due to the lack of interests and motivation expressed by practitioners of agroecology (see Co- creation & sharing of knowledge, Human & Social values in Table), but to the very logic in the design of CRISPR/Cas systems themselves." (Clement, 2021)*

This demonstrates the need for the wider agroecological movement to continue the discussions about agroecologically appropriate technologies, with the aim of moving closer to a consensus.

Technology is not values-neutral

One of the narratives surrounding technological innovation in the food system is that the technology itself is neither good nor bad, but neutral. Often this is expressed as a particular technology just being a "tool in the toolbox". An important starting position for our project, and something we intend

to explore in detail, is that this is not true, that technology is the product of human thinking and of ideology and these influence how we define problems and frame solutions.

The notion of the "tool in the toolbox" can lead to the kind of thinking that disconnects the 'problem' from the cause and also to framing agricultural challenges in a technological way. This, in turn, can lead to a disproportionate funnelling of funding into the development of high-tech solutions at the expense of other options.

Heinemann and Hiscox (2022) support the notion that when we frame problems as technological, the solutions we seek will always be technological in nature. But if we frame the issues facing farming and food production differently, they argue, different solutions become available.

The idea of values-neutral technology can also lead to the belief among proponents of sustainable agriculture that as long as the proposed technologies benefit the environment and are profitable, sustainability will eventually be achieved and all people will benefit. But this argument fails to consider factors such as the power imbalances in the production and distribution of technology, the issue of economies of scale (i.e., whether it encourages large scale, standardised production), and social issues such as whether it increases farmer dependence on the private sector.

It is important to recognise that no technology exists in a vacuum. All new technologies are developed for a reason and under a value system, be that financial profit, higher yields, labour reduction or water use efficiency. The societal choices about which technologies to adopt and which to reject, where such choices are actively made, are also dictated by a value system of the kind of world we want to live in. To take an example from another sector, the values underlying the decision to rollout electric cars (e.g., personal autonomy, ownership) are very different from those underpinning an alternative decision to prioritise public transport investment (e.g., communal living, equality).

Recognising the values behind the technologies themselves as well as the choices of farmers and policymakers about technology in the food and farming system is, we believe, an important first step to analysing whether those choices are aligned with an agroecological future.

What are the opportunities of this project?

This project aims to bring together farmers from all strands of agroecology - including organic permaculture, biodynamic, 'nature friendly farmers' and pasture for life – for a series of discussions about the issues and questions raised in this briefing. The aim is to understand the points of agreement and disagreement, and hopefully work towards developing a set of principles to help guide the assessment of agroecologically appropriate technology which are accepted by all under the agroecological umbrella.

Participatory and co-created knowledge creation are important principles of agroecology and the project represents a unique opportunity for farmer voices to be front and centre of these conversations.

With the well-funded tech agenda in full force, it is vital that the agroecological movement grapples with the challenges and opportunities this presents. This project is an important part of the efforts to empower the movement to create its own narrative about what is required for the transformational change which agroecology can provide

What participants can expect

We are currently seeking 10 groups of 10 farmers from across the agroecological spectrum to participate in a series of workshops designed to understand your thoughts and feelings about a range of new proposed agricultural technologies and the practical and philosophical underpinnings of the technology choices you are making.

We anticipate there will be 2-3 workshops between January and July 2023. These will be a mixture of in-person and online, with some funding available to help cover travel costs to the in-person events. We are also looking to develop a few case studies and these may involve separate interviews.

We recognise that farmers are often very busy and so we will be using a range of tools to keep the discussion going including surveys and polls and virtual white boards. We will open a Google email group (or similar) as the project grows, so that participants can remain more informally in touch. We will also supply a range of materials for participants to read and consider at each stage

We anticipate these workshops will help identify overlaps and differences between different agroecological farming approaches and how these affect technology assessment and choices. In so doing, it will provide a much clearer picture of shared, separate and mutually supportive criteria across a range of farming disciplines. With each meeting we hope to clarify and refine the perspectives of each group.

In the final workshop, we hope to bring all the participants together to consider our analysis of the views we have had from the various strands, where they agree and where they diverge and, based on this, produce some suggested criteria for agroecologically-compatible technological choices. Our findings will be summarised in a final report.

About A Bigger Conversation

A Bigger Conversation is an initiative of Beyond GM in the UK. Through a series of meetings, panel discussions, roundtables and world cafes, as well as reports and analyses, this initiative has sought to raise the level of the debate around the use of GMOs in farming and food. Our goal is to involve more than the usual narrow range of stakeholders in the discussion including farmers, breeders, scientists, academics and grassroots leaders – representing many sides of the issue and offering multiple perspectives and diverse expertise.

The discussion around genetic engineering in agriculture, perhaps inevitably, leads to a more complex discussion around technology choice in general. It is our view that disagreements about how best to approach a sustainable food system in the future, and what role technology has in such systems, are ultimately less rooted in science than they are in values and worldviews. For this reason, we focus on the evidence rather than just 'the science'. We support those who aspire to have a more nuanced and deliberative discourse and therefore strive to include a wide variety of approaches to and ways of thinking about food system dilemmas.

Find out more: https://abiggerconversation.org | **Contact:** Pat Thomas pat@abiggerconversation.org