Agroecological TRANSITIONS Programme

POLICY BRIEF

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Critiques of digital tools in agriculture

Challenges & opportunities for using digital tools to scale agroecology by smallholders

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KEY MESSAGES

- Two themes manifest in the challenges outlined, unequal power relations and a disconnect from farmers' needs and input.
- Agricultural digitization should strive to follow ethical principles specific to the sector, agroecology offers an existing framework.
- Digital technical assistance that advances the interests of smallholders and is relevant to their farms can facilitate a shift towards agroecology through farmer-to-farmer networks and knowledge exchange.
- Recommendations include:
  - Govern for an inclusive digital ecosystem & economy
  - Leverage and expand food, data & social justice movements
  - Code ethics into digital development

Digitization of food systems is well underway. The digital ecosystem and its actors have increasing influence over how food is produced, what food people buy, and flows of information among supply chain actors and consumers. Efforts to transform food systems towards sustainability and resilience are increasingly reliant on digital resources, and alternative agriculture and agroecology is promoted as a solution.

Yet the top-down, often corporate-driven nature of digital tools can be at odds with the ethos of grassroots social movements, like agroecology, that value the sovereignty of local food systems and participants' self-determination. That is not to say that large-scale farms and corporations do not have a crucial role to play in feeding a rapidly growing population.

As these digital tools evolve, there is interest from progressive agriculture advocates to consult the voices of smallholders when developing and implementing digital resources, to ensure smallholders are not left behind, and to recommend practices that are supported by robust evidence.

However, unequal access to the digital ecosystem is excluding some segments of society from new ways of accessing information, finance, and markets. Smallholder farmers in low- and middle-income countries (LMICs) are particularly disadvantaged and are easy targets for exploitation by larger food system actors (Ingram et al., 2020; Ajena et al., 2020).

The most sophisticated tools are designed for larger scale farmers in wealthy countries or have associated fees smallholders can't afford (Birner et al., 2021; Streed et al., 2021). While many smallholders are gaining access to the digital ecosystem, large numbers lack the latest hardware, high speed internet access, digital literacy, or relevant tools and content.

Inclusive development of food systems is undoubtedly at risk. Through a lens of agroecological principles, digital development for agriculture and new practices can be developed and assessed for relevance, inclusivity, and scientific validity.

Critiques of digitizing food systems & farms

To guide digital development to align with social values for better food systems and to be socially inclusive, we summarize the major critiques of digitization in agriculture and food systems found in the literature and public narrative.

Two themes manifest in the challenges outlined below: **unequal power relations** and a **disconnect from farmers' needs and input**. In addition, there are hidden economic, social, and environmental costs of digital tools and concerns of a lack of data privacy in major tools promoted for farmers in LMICs.

We conclude with recommendations for addressing these points to build a more socially inclusive digital ecosystem for agroecological food systems of the future.

1. Lack of relevant information for advancing progressive agriculture

There are few sustainability aspects incorporated into available digital technical advisories for smallholders in LMICs, and major knowledge gaps are prevalent. Many tools don't include progressive agriculture content or practices and lack robust scientific evidence behind recommendations. A greater effort to include diverse and progressive practices for climate change adaptation and mitigation as well as agroecology is needed to strengthen the resilience of smallholders.

This knowledge gap is exacerbated by the difference in data organization between digital applications and agricultural research data, making it harder to process the data collected to help the farmers (Bellon-Maurel et al., 2022). Without similar methods of data organization, most data cannot be used to benefit the farmer within the growing season (Streed et al., 2021; Ingram et al., 2020).

2. Data privacy

The profit of many digital services lies in the data they collect. Ambiguous and extensive terms of service agreements hide what data is collected and what happens with it. A company could collect user data and sell it to third parties without users' full understanding of the implications or use personal data to improve behavior-predicting algorithms that prompt a user to buy specific products.

Data security is another concern, especially for users within multiple marginalized groups (e.g., smallholder women farmers). Data leaks and theft can put the most vulnerable populations at greater risk. This common occurrence can facilitate exploitation of smallholders, the elderly, or anyone that lacks enough digital literacy to understand the potential outcomes.

3. Asymmetric benefits

Marginalized groups are often the last to benefit from new technology (Table 1). Sometimes, the developer, researcher, or investor receives greater benefits from a tool than the user it is advertised to serve. A combination of new actors and social action can catalyze the development of digital agricultural technology, mitigate market concentration, and promote inclusive digital agriculture (Birner et al., 2021).

Table 1. Groups with low and high benefit from scenarios implementing a new digital tool

Scenario	Less benefits	More benefits	Explanation
Upgrading to new digital tool or practice (e.g., sensors, computers) and implementing new practices.	Smallholder farms	Large-scale farms	Investment in new practices and technology requires spare capital, which means wealthier farmers can upgrade their technology before smaller ones (Streed et al., 2021). This dynamic can be seen across levels and disparities.
A tool to assess farmer performance and collect farm data for research or practice development.	Farmers	Researcher & developer	Some research-developed tools extract huge amounts of data on farm management. It becomes exploitative if the farmer doesn't receive benefits from the analysis of the data or compensation for failed harvests, or if entry is a time burden.
Highly relevant application with tested practices but is text heavy and requires high connectivity.	Illiterate, rural farmers	Literate, connected farmers	Rural farming communities often lack access to digital infrastructure or have poor connectivity, and low digital literacy can restrict access to digital services and information. Tools with low connectivity requirements and those that incorporate audio, video, or iconography are generally accessible to a larger group.
Farm management application launched in a region with strict cultural gender roles.	Women farmers	Men farmers	Men have greater access to cell phones and say over farm management decisions. In some cases, it is unacceptable for women to own a phone, use it to manage tasks, or access finances or information.

4. A digital land grab: Data is the "new oil"

The monetary value of data increases as more is collected, aggregated, and processed. The more data sources you have, the greater share of the market you can influence and profit from. Agribusiness titans (e.g., Monsanto) are partnering with profitable data giants (e.g., Google) to produce a new generation of farm "inputs". Data is their "new oil".

> *"…it would be naïve to believe that small farmers and ethical co-ops can play in the new food data economy on a level playing field without being gamed, surveilled, extracted, abused and spat out by these data titans in the coming years" (Jim Thomas, ETC GROUP, 'The Biodigital Power Grab' in Agroecology & Digitalization, IFOAM Organics Europe)*

This is at odds with the agroecological principle of responsible governance, a solidarity economy, and human and social values. While new technology presents opportunities to increase productivity and decrease waste, it should not come at the cost of society's most marginalized groups. Digital justice and agroecology movements need to coordinate their efforts to confront large corporations monopolizing and prescribing practices in the food sector.

5. Hidden expense

There are many digital services that are advertised as "free". However, they often come with hidden costs, for example:

- A tool offers limited features and services in the free version, with premium features requiring payment.
- A free tool requires strict adherence to a practice list and input regimen, or the farmer risks losing access to advisory and financial services or discounted inputs.
- A farmer must buy fixed-price inputs, like a specific brand of fertilizer, through the tool to receive specialized advice or market access.
- Finance tools can be rigid in how they set interest rates or require farmers to pay back loans or follow prescribed practices.

Digital advice services should not be reliant on funding from agricultural input companies to provide a free resource to the most disadvantaged farmers.

There are also indirect societal costs. A digital tool could inadvertently replace a social interaction with a trusted extension agent, leaving the farmer without a trusted technical resource. However, when digital tools are used in tandem with site visits from an extension agent, a digital tool could free up both of their time and expand the number of farmers the agent can assist.

From an ecological perspective, farm data is energy intensive, and the life cycle of digital agriculture is another unsustainable consequence of specialized digital hardware. Farm technology, like single-use soil and air sensors, creates another source of toxic material that is expensive to properly recycle (Streed et al., 2021).

The environmental, health, energy, and social costs of input agriculture can't be externalized when creating new regulation and best practices (Ajena et al., 2020).

6. Disconnect between farmers, scientists, & developers

Rural farms in LMICs are complex production systems, often characterized by diverse crops and livestock on a small plot of land. It is hard to accurately model them, leading to mischaracterizations and incorrect assumptions by digital developers and scientists.

Yet, the rise of flashy technology has detracted from agroecological solutions that may be more cost-effective and ecologically sustainable (Ajena et al., 2020). Modern science and digital development often overlook local and traditional knowledge, a principle of agroecology, that may be key to understanding complex ecological, social, and cultural systems in which small farms operate.

These factors have contributed to a disconnect between digital developers' goals, scientists' priorities, and farmers' needs. This gap in understanding produces digital tools that are either irrelevant to farmers' situations or inaccessible (see Box 1).

What is needed are on-the-ground research and conversations with farmers on how tools can be more relevant and accessible to farmers and useful to researchers. Utilizing farmers' understanding of their land and community while promoting practices that align with local climate and social goals and needs can lead to large scale practice change (Wittman et al., 2020).

7. Exclusion of smallholder farmers

It can be very expensive to work with farmers in extreme rural areas like the Amazon or where there in poor infrastructure. It is hard to contend with poor internet and cellular connectivity, low digital and linguistic literacy, multiple local dialects, and distrust of strangers and new technology. Involving rural and smallholder farmers in digital development processes requires expensive and time-consuming trips to the field. These factors restrict the incentive to meet these farmers where they are, leaving them excluded from the process.

Box 1. Consequences of excluding farmers' needs and understanding:

- Loss of local and indigenous knowledge
- Greater farmer distrust of scientists, researchers, and technology
- Practices that are irrelevant to farmers and their production systems
- Digital tools that are hard for the user group to use
- Overlooked or undocumented socio-economic factors and barriers

Developing digital tools at the community level poses similar challenges and, while the end-product may be highly relevant to the community it was designed with, it may not be useful to other communities, limiting its scalability and profitability for the developer. Investment and customizable methodologies could make it easier to meet farmers where they are so their voices are included in the process.

Recommendations for agricultural digital development

As digital technology connects more of the global food system, using digital resources may be necessary to participate in the global and local economies. However, it is hard to pick and choose which technology is safe and useful and what is exploitative and unsecure.

Local food systems alone will not feed the world; so multiple approaches and strategies are needed, including some large-scale farming and big companies. Below are a few strategies to guide global digital development for inclusive and ecological agriculture.

Govern for an inclusive digital ecosystem & economy

Collective strategies to level the digital playing field are badly needed, but who has the right to collect the data? Who gets to store, use, and process it? There isn't an easy solution or a silver-bullet. Basic legislation to protect the rights and privacy of individuals and marginalized groups could include:

- Regulation to stop companies from taking the data in the first place
- Breaking up big tech companies into data collection companies, service providers, and developers can diversify digital ecosystem actors
- Making space for collective and community governance and ownership of data can increase relevance to local communities and facilitate knowledge sharing
    - Example: The UN Convention on Biological Diversity Nagoya Protocol ensures equitable access to genetic resources and sharing benefits from these resources with the UNCBD
- Retaining national and food sovereignty by developing international agreements to govern data flows, access, and ownership in the global digital ecosystem
- Creating incentives for developers to work with and design for marginalized segments of society

Digital movements: Food, data, & social justice

Alliances and coordination between food, data, and social justice groups are needed to bring human and digital rights to the heart of the agroecology movement, rather than have these rights be an afterthought (Anderson et al). This relies on social movements, the foundation of agroecology. The social and digital justice movement needs food systems data and sector expertise, and the agriculture scientists need insight into social and digital dynamics.

Digital and social justice movements and the agroecology community must work together to lobby for the needed legislation and regulation to create an inclusive digital ecosystem that preserves local and indigenous understanding and promotes co-creation of knowledge and practices with marginalized populations. Social and human capital are the foundations for this transformation.

Code ethics into digital design

Ethical principles should be integrated into the design of digital resources. However, they should be translated into specialized principles grounded in the values of the field of practice in which they are used (Ajena et al., 2020). This ensures the principles address individual realities in meaningful and locally relevant ways.

Digital tools designed for and with smallholders, under a set of agroecological digital design principles, may allow for more equitable capacity building, co-creation and co-design of tools and practices, cooperative learning, mentorship, and sharing of resources, knowledge, and practices. (See Box 2 and Ajena et al., 2020, Table 1, for an example of how agroecological principles can be translated for digital development.)

Box 2. Ugunduzi – Co-creating an application with smallholder farmers in Tanzania (Ajena et al., 2020)

Ugunduzi is a mobile application that encourages farmer-led research on farming practices. The development process included an iterative series of co-design participatory workshops with farmers in Tanzania who were transitioning to agroecological practices. This approach was used to understand farmers' perspectives and needs in order to address them in the function and design of the app.

Most participants did not own a smartphone, so devices were distributed during workshops. While smartphone usage and cellular networks are expanding and costs are decreasing in Tanzania, few smallholders have them and could not use this app.

However, the biggest challenge was finding balance between farmers' understanding of practical problem-solving and the systematic scientific method. The developers designed the app to allow farmers the choice between following a systematic approach like the scientific method or by drawing a map of unrelated plots and tracking their progress over time through record-keeping.

The co-design workshops differ from conventional top-down technology transfer in agriculture by including farmers in the design process. The participatory nature of this method means that the farmers have a greater sense of ownership of the app and the practices they develop through the record-keeping and self-led research functions.

Conclusions

Agricultural digitization should strive to follow agroecological principles and shift away from quantity-over-quality-focused technologies that reinforce inequalities and drive environmental degradation and exploitation of food system workers and farmers by large corporations, landholders, and governments (Ajena et al., 2020).

Digital technical assistance that advances the interests of smallholders and is relevant to their farms can facilitate a shift towards agroecology through farmer-to-farmer networks and knowledge exchange (Wittman et al., 2020). Agroecological certification and performance assessment tools can provide opportunities and mechanisms for farmers to assess their progress on economic and agroecological goals.

Digital tools for agroecology must not be one-size-fits-all solutions. They must integrate the diversity of the communities and farming systems they seek to serve.

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The Agroecological Transitions for Building Resilient, Inclusive, Agricultural and Food Systems (TRANSITIONS) Program aims to enable agroecological transitions through the development and adoption of holistic metrics for food and agricultural systems performance, inclusive digital tools, and transparent private sector engagement. The Inclusive Digital Tools (ATDT) project aims to support the use of digital resources and citizen science to empower farmers to co-create, adapt, and innovate practices for climate-resilient and low-emission agroecological outcomes at large scales.

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