

# Digital Tech in African Agriculture: Livelihoods, climate change and food system transformation

## Workshop report

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## Context

The digital revolution in global agriculture has begun and this includes digital technology in African agriculture. We now see the use of a variety of digital tools on the continent, such as drones, precision farming machinery, digital decision-making support tools, digital labour management tools or online food and agricultural input marketplaces. Even though the digital revolution is still at an early stage in many countries in the global South, it is gathering pace as many actors in the international development community herald it as a solution to achieving food security, and environmentally sustainable and climate-resilient agriculture through climate-smart agriculture. Digitalisation is often presented as a silver bullet to solve the tension between productivity, profitability, and sustainability in food production. Donor agencies are following a 'digitalisation for development' approach, while the World Bank and the FAO promote digitalisation as a key tool for transforming small-holder agriculture in the global South.

## Not just farming; it's about the food system

Digitalisation, however, encompasses a wider transformation of the food system beyond agriculture. Digital technologies are currently being rolled out across the entire food commodity chain including applications to test credit worthiness of small-holder farmers, precision agriculture on the farm level, new digital tools for sorting, packaging, and processing, digital supply chain transparency and traceability tools, e-commerce and last mile delivery offered by supermarkets. We see a convergence of big food and big tech companies, as the latter are moving into the food system, and the former enhance their business models to incorporate more data-based approaches.

## Critical perspectives

Critiques of digital technologies emphasize the danger of an expansion of corporate power through digitalization and the loss of farmers' autonomy and knowledge. In many regions of the global South the digital revolution is gaining traction in a period of a deep restructuring of food systems due to the Covid-19 pandemic, the climate crisis, a renewed push for green revolution technologies such as the 'Green Revolution for Africa' strategy' and rising claims for a 'just transition in agriculture'.

Digitalisation also intersects with financialisation, the incorporation of agrarian production in the global South into global food commodity chains, the rising super marketisation of southern food systems as well as an expansion of commercial and plantation agriculture and thus farm labour in the context of the 'global land grab' from the late 2000s onwards.





## This research project

This research project investigates how digitalisation is transforming food systems in the global South, starting from the assumption that we are currently witnessing the emergence of new digital socio-technical systems that restructure how food is produced, distributed, and consumed.

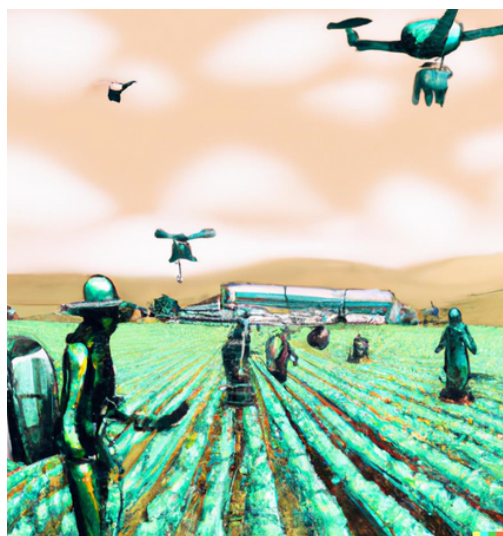
## A scoping study

The first phase has consisted of a three-month scoping study with three components.

- Three country studies: we conducted a review of the state of agricultural digitalisation in three African countries – South Africa, Zambia, and Kenya – which have significant horticultural sectors linked to global export markets.
- African regional: we reviewed continental initiatives for African agricultural development as advanced by intergovernmental and regional institutions, and the policy frameworks that promote commercialisation and technology uptake.
- Germany: we undertook research in Germany, which is where much of the tech development is underway and companies are headquartered.

## Consultation workshop

The Institute for Poverty, Land, and Agrarian Studies (PLAAS) at the University of the Western Cape, South Africa, in collaboration with the Collaborative Research Centre (CRC-TRR 228) programme at the University of Cologne, Germany, organised an exploratory online workshop from 25-26 September 2023. The workshop was the first phase of a process which includes designing of a multi-country and multi-year project on digital tech in African agriculture. Participants were invited from academic and policy sectors.



## Workshop objectives

The workshop explored research agendas and interests in the field of digital tech in African agro-food systems. The workshop discussed how digitalisation is transforming farming and food systems in the global South, starting from the assumption that we are currently witnessing the emergence of new digital socio-technical systems that restructure how food is produced, distributed and consumed. The aims of the workshop were:

- To get to know scientists, policy makers and practitioners in digitalization of agriculture in Africa.
- To share the findings of the scoping study with the aim of improving the work based on knowledge and experience of participants who are working on the subject.
- Get in-depth content feedback on the research idea, with particular focus on its relevance, additional focus areas, and complementarity to similar work.
- Establish an international collaborative network for sharing knowledge, ideas and experiences on the topic of digitalization of agriculture.
- Determining the outputs of the scoping study and identifying points of synergies with ongoing research agenda and work.

## Agenda

The first day had five sessions with the major focus on: 1) the presentations of the preliminary results from the scoping studies carried out in Kenya, Zambia, South Africa, Germany, and a policy review at the continental level. 2) A facilitated policy and academic engagement among the participants to identify scholarly priorities for and policy processes relevant to a future agenda, and gaps and focus for longer-term research. The second day focused on determining the research agenda and first steps towards establishing an engaged research network.

## Drivers of digital tech in agro-food systems

The wider context in which digitalisation in agriculture is developing includes growing commercialisation of agriculture through agribusinesses and agri-preneureship; the financialisation of farming where data is emerging as a new asset class; narratives of global food scarcity which animate international development discourses; the politics of climate responses, in the larger debates on climate-resilience; the politics of pandemic responses, which emphasise control over disrupted value-chains; and wider datafication within the food system, including in access to input and extension services; off-take, supply-chains, and traceability.

Demands for food traceability prompt moves towards data transparency in food systems, yet digital tech simultaneously invokes questions around proprietary data. Climate response is pushing more prudent use of resources, with precision farming being promoted as a way to reduce environmental pollution, manage soil and reduce water use. In a context of climate change, these rationales find their justification in public policy. Along with these technologies focused on production and market linkages is a process of 'land datafication', with the proliferation of technologies to map informal and customary land.

## African policy review

Three quarters of African countries have digital tech centres, and an estimated 13 per cent of small-holders use digital tools, and this is anticipated to increase to 200 million African farmers using digital technologies by 2030.

African intergovernmental policy frameworks have evolved over the past two decades, and yet while building blocks are in place, the issue of digital technology is not squarely addressed as yet. The phases can be identified as:

- Phase 1: Millennium Development Goals (MDGs) and the Comprehensive Africa Agricultural Policy Programme (CAADP) from early 2000s
- Phase 2: Global Economic Crisis (2007-2010), African Agribusiness and Agro Industrial Development Initiative (AAIDI), New Era Partnership for Africa's Development (NEPAD) to promote investment
- Phase 3: Sustainable Development Goals (SDGs), a Strategy for Agricultural Transformation, and a focus on the Fourth Industrial Revolution (4IR)
- Phase 4: Covid 19 Pandemic, AU Digital Transformation Strategy for Africa (2020-2030), Major ICT regional protocols, but not digitalisation of agriculture.

Digitalization of agriculture can be understood as an 'orphan' in Africa's regional protocols, frameworks, and laws. While widely invoked as a market and climate solution, there exists a policy and regulatory vacuum.



## South Africa

South Africa represents an extreme context in which inequality and 'agrarian dualism' presents an even more uneven terrain than other African countries for any new technology. The large-scale commercial and export-oriented horticultural sector is where digitalisation has taken root most substantially, and where innovations are moving rapidly – largely driven by global value-chain pressures. This dynamic is not evident among smallholder farmers. Just as the farming sector is divided, there is not one form of 'digitalisation' underway in South Africa.

Barriers to digitalization persist even among commercial farmers (lack of human resources and digital skills; high investment costs, lack of local spare parts and technicians; lack of trust between actors, lack of consensus about goals and use case). Digital production applications are supporting a shift towards more environmentally sustainable production practices, when economic and sustainability pressures act as a driver.

Digital technologies risk reproducing and exacerbating asymmetries between more and less powerful actors in the food system (e.g. producer cellars vs. smaller farms). And there are risks of job losses and intensified labour exploitation at general worker level, especially if no training is provided – though some key informants are of the view that, once the technology catches up with the labour requirements of the horticultural sector, retraining will not present any remedy to the disemployment effect.

South Africa exhibits a disconnect between public sector policy and private sector action and agents involved in the development and promotion of digital technologies. Given the context, digital tech is very likely aggravating inequalities of agrarian dualism with distinct dynamics in terms of growing inputs & services. For smallholders, there is very limited digital tech in production; rather, the battleground is over digital platforms for marketing. Small-scale farmers not being targeted by digitalisation solutions. Digitisation and data as an asset class are, for now, far more significant than changes in production.

Proposed research priorities:

1. **Drivers:** financing for digital tech development
2. **Diversion:** Re-direction of tech away from low-income users/uses
3. **Dispersal:** Ethnography of on-farm tech and productionist narratives
4. **Datafication:** data ownership systems, public interest and the policy vacuum
5. **Land:** Links to land datafication and platformisation of customary and informal land rights

## Kenya

Digital tech is widely used in Kenya's agricultural sector, with diverse actors promoting technologies to serve distinct objectives:

- To enhance financial inclusion (eg. Apollo Agriculture)
- To increase net production through precision agriculture (eg. Astral aerial drones)
- To enable smallholders to access markets (Example, DigiFarm that is owned by Safaricom PLC, and backed by M-Pesa)
- To mitigate risk from weather and pests (eg. blockchain technology, like 'Drought Coins')

Kenya represents a ready environment for digitalisation and tech uptake due to several contextual factors: high mobile phone ownership and M-Pesa effect (mobile phone banking); many unemployed youth seeking opportunities in agribusiness; changes in development aid policies towards support for businesses (eg. from Netherlands).

Factors that impede the uptake of digitalized agriculture include high costs of digital tech

Low digital literacy, especially amongst small scale farmers; limited infrastructural access; a policy vacuum, especially to tackle cybercrime and to protect data. The laws are only recently developed.

Research priorities include an empirical study to determine scope and level of uptake of the technologies; the question of property rights of data; and questions of social sustainability, especially considering that loss of employment through digitization.

## Zambia

A variety of digital technologies are present in Zambian agriculture, spanning agricultural value chains and ranging from production, climate services, advisory, input access, market information, access to finance as well as access to index insurance. Current technologies include agri digital services, digital procurement, agri e-commerce and 'smart farming' technologies.

Zambia does not have well-articulated strategies on how to integrate digital technologies into agriculture. Zambia's agricultural digital ecosystem falls short of a holistic and multi-sector approach that address the existing siloes and small-scale initiatives. Although Zambia is still lagging in technology, the country is already having some good initiatives for digital adaptation.

Zambia has a GIZ-funded program, e-Pisca, to provide climate-related information services. Some commercial farmers are using drones hired from a Chinese company. Smallholders have not taken up these technologies due to cost barriers. However, over 90,000 smallholders have registered for the World Food Programme's 'Paygo' platform to sell their produce, though it's unclear how many use it. Also in use is the Field Area Measure App provided by the AKTC partnership between Zambia and Germany.



## Germany

German actors involved in the development, financing, infrastructure, operations and technical support for digital technologies in agriculture include:

1. Development organisations such as GIZ, BMZ, KFWnd (indeed, half of funding for digital tech in Africa done by donor agencies);
2. Large tech companies providing software and big data, such as SAP;
3. Non-agricultural hardware companies, such as Bosch, involved in manufacture of sensors, drones and other equipment for precision agriculture.
4. Start-up tech companies involved in tech development, including venture capitalists; and
5. Large agricultural input companies, branching out from agrichemicals and other inputs into digital products, such as Bayer.

These German institutional actors involved in digital tech in African agriculture are interrelated. For example, CLAAS cooperating with Bayer. Bayer Cares Foundation and SAIS Foundation are also linked. SAIS is financed by GIZ. The detail of the motives, influence and roles of each merit further research, but so too do the relations between them – as clients, funders, advisors, and more.

## Summary of presentations

1. **Starting point & aim:** We are currently witnessing the emergence of new digital socio-technical systems that restructure how food is produced, distributed and consumed. What we know and what we want to know about how digitalisation is transforming farming and food systems
2. **Scoping:** a small slice of vast terrain. Document analysis + interviews; limited fieldwork. Possibility of designing a multi-year study: how this would be focused and framed
3. **Research questions:** Which technologies, by whom, who's funding, what challenges do they aim to 'solve', who they target, what's the uptake, who's funding, who owns the data and what do they do with it - and influence of public policy and governance - public and private.
4. **Research design:** scoping logic: 3 countries + 1 + African policy review (policy vacuum at continental level; patchy and weak at national levels)
5. **Farm-level:** 'smart' farming and precision agriculture - diverse array from drone technology, GPS/satellite tracking, AI/ML, IoT - mostly in LSCF but also some in SSF. Exclusionary bias: inequalities among farmers; potential labour displacement (early stages for horticulture; different dynamics in arable farming).
6. **System-wide digital tech:** beyond production - input & services; off-take, supply-chains (traceability etc) - distinct from 1st generation ICT4D. This is where most presence in all 3 countries (vastly more for SSF in Kenya and Zambia than in SA, largely due to structural reasons).
7. **Country contrasts:** domestic tech environments vs largely foreign tech companies (heavy presence of donor financing in Kenya and Zambia). Relative absence of public policy and public programmes is a common thread.
8. **Germany:** 5 types of actors, and interconnections among these (multinational agricultural input companies; tech start-ups; non-agricultural hardware; development partners, NGOs and donors; multinational software & big-data companies)
9. **Digital tech geared to different scales:** bifurcation of tech; driving difference rather than blurring divides - therefore implications for inequality. Data governance: a paradox of transparency and proprietary data.
10. **Digital tech of different scales:** absorption of pro-SSF tech by big companies, redirection to larger-scale applications.



## Summary of responses

1. **Systemic change and causality:** interlocking dynamics of digital tech through agrofood system.
2. **Definitions:** what is meant by digitalisation? Differentiate and clarify typology.
3. **Mapping of actors and interventions** (eg. by tech type, institutional type, sector, country, source)
4. **Research design:** common research frame to allow for useful comparison across contexts (methodological) - combining global value-chain analysis within a political economy framework.
5. **Policy guidance:** what is an enabling environment? Clarification: we are not instrumental research to assist governments to promote uptake of digital technologies; rather to inform consideration of the significance of different forms and their implications (use-oriented basic research not policy consultancy).
6. **Labour displacement and labour-saving:** implications of tech for labour across different contexts (and how do workers respond?). Labour in a differentiated way.
7. **Livelihoods:** inequalities in uptake, use and outcomes, including between sectors and among smallholders (class, gender, generational) - distributional effects of digital tech & articulate with differentiation
8. **Food system restructuring:** shifting sites of accumulation and control due to digital tech - and implications for agrofood system concentration. Explicit political economy framing: who owns what, who does what, who gets what, what do they do with it?
9. **Data governance:** proprietary vs non-proprietary data systems: models / evolution. Socialising data in digital tech. [different from farmer-centric data governance?]
10. **Resistance and alternatives to (corporate) digital tech:** counter-narratives as to the role of technology in agrofood systems.

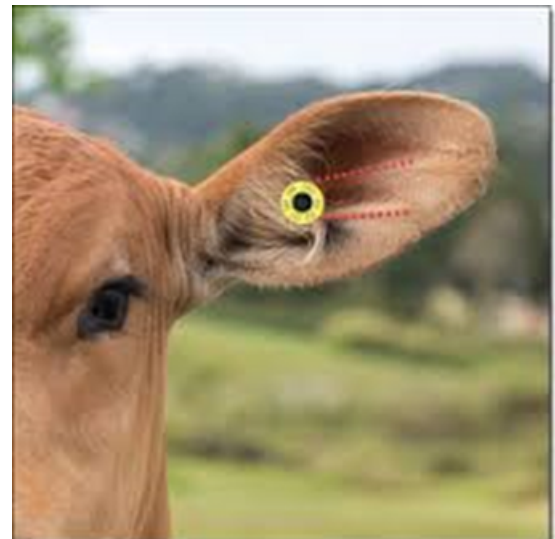
## Towards a research agenda

Discussions centred around three major identified themes:

- Livelihoods and structural inequalities
- Food systems and value chain restructuring
- Data governance and policy environment

Three overarching questions guided the discussions for each theme:

- Who is doing what? Who (else) is working on this? What is your/their focus?
- What do we want to know? What main research question(s) we should address?
- What's at stake theoretically? Which concepts/frameworks are useful - or need development?



## Theme 1: Livelihoods and structural inequalities

It was proposed that research should investigate the impacts on (different) farmers' linkages to markets and integration into supply chains at different scales, rather than looking at changes exclusively at farm level. At the same time, there should be an on-farm component, which also explores inequalities at household level, including gendered and generational differences in uptake and how this affects roles and control over decision-making and control of income at household level. For large-scale farmers, it will be useful to consider specific aspects of digital tech and labour in horticulture and compare these systematically across the three countries, and the selection of Kenya, South Africa and Zambia was endorsed as a suitable selection of cases.

Research questions could include:

- What is the value of digital tech especially in rural areas?
- What are the constraints to adoption?
- What are the gender-based differences, education-based differences and how are the inequalities with regards to secondary effects?
- Which problems are these intended to solve and what problems at farm level are considered important for resolution?
- What are the effects of digitalization on power structure in rural households?
- What is driving the development of the technologies and what is the profitability of these?

Research Design

The research should be based on the household and types of technologies used.

## Theme 2: Food system and value chain restructuring

It was proposed that the research should distinguish between tech that has been developed and is available versus tech that is taken up and deployed – as there is some evidence of a high fall-off rate and attrition among tech companies and users. The research should focus on how digital tech is articulating with existing transformations and trust issues within food systems, and specifically focus on the drivers of funding, including for precision farming, within the food system.

Research questions could include:

- What is the level of digital integration vs digital divide? Depending on different settings, markets, policy frameworks?
- Are there grand strategies and power players that shape the digital environment? Or a 'chaos'? What are the outcomes of different food systems?
- Is there a 'tech value chain' as well as the 'food value chain'?

Theoretical considerations:

- Transition and transformation studies
- Food regimes and food system analysis
- Socio-technological regimes
- Global value-chain analysis

## Theme 3: Data governance and policy environments

It was proposed that the research could focus on the governance, ownership, regulation and access to data. A farmer centric approach would recenter data governance to focus on farmers. Data justice is a priority issue: how is data ownership located, and how is this legally constructed? What options are there for data as a common property? Socio-technical imaginaries: how do people think different about data? How is data understood culturally?

Research questions could include:

- What are the practical implications of digitalisation on the management of data?
- What does the governance of a digital space look like?
- How can indigenous groups get a seat at the table and being included?
- How are technologies regulated by law and also by technologies themselves?

Research design

- The study should consider applying Action Research.

## Next questions for research

Are similar actors 'behind' the digital technologies operate in different countries? (Examples of companies operating in both Kenya and Zambia were given e.g. Apollo Agriculture).

Is there resistance to Ag Tech in the countries where scoping was done? (In Kenya, tea farm labourers have resisted use of drones on the basis that these technologies render workers redundant and jobless).

Other suggestions to be considered included:

- Structure of agrarian production relations
- Structure of tech ownership
- Structure of food system
- Need to consider 'digital agroecology'

## A multi-scalar study

A specific proposal was to adopt a structured comparative frame, to investigate different scales of farming in the three countries, and across each to investigate the different types of digital technologies that are available, are being used, and to map the extent of uptake, the profile of users, and use qualitative methods to investigate the drivers and implications of the technology. Within countries, where possible, we should aim to address cases at different scales:

- Large-scale commercial farms
- Medium-scale farmers
- Smallholders involved in contract farming
- Independent smallholders

## Networking and communication

We discussed the open invitation to other researchers engaged in similar fields of inquiry to join forces and share information about our respective studies with one another. While not establishing anything formal, we propose a mechanism for sharing information with one another – eg. via emails, and with perhaps one event or gathering a year. Added to this could be the goal of exchanging information, and presenting work-in-progress to one another for instance at an online meeting once a year. Over time, should there be opportunity to do more substantial research in this area, we will also invite advisors to provide some input to our work. And we further propose also joint panels for international conferences, and contributions to special issues of journals.

## Workshop participants

Martin Parlasca (University of Bonn, Germany), Alan de Brauw (IFPRI, USA), Stephanie Barrientos, Aarti Krishnan and Matthew Alford (University of Manchester), Peter Narh and Kojo Amanor (University of Ghana), Javier Revilla Diez (University of Hannover), Gladys Mosomtai, African Land Policy Centre, UNECA, Christina Hansen, Copenhagen, PhD on IT, Laurens Klerkx (University of Talca/Wageningen), Matthew Canfield (Leiden Law School), Lamine Doumbia and Cornelius Heimstaedt (Humboldt University), Diana Dieckjuergen, Gabriel Sison, Anja Dannewitz and Melusine Nehling (GIZ), Olanike Deji (Nigeria), Josh Woodard (USAID), Enoch Sakala (University of Zambia), Nkanyiso Gumede, Ayanda Madlala, Andries du Toit, Boaventura Monjane (PLAAS),

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