Datafying African agriculture: from data governance to farmers' rights

Canfield, M.C.; Ntambirweki, B.

Datafying African Agriculture: From Data Governance to Farmers' Rights

Matthew Canfield[1] · Barbara Ntambirweki[2]

Abstract

This article explores the impact of digital agricultural technologies on African agricultural systems. As we describe, the datafication of African agricultural systems is poised to reshape agrarian power relations significantly. We examine the risks of datafication through a case study of Kenya, a hub for digitalization on the African continent. While Kenya leads in developing data governance policies, the current emphasis on personal privacy overlooks collective risks for smallholder farmers. We advocate for a paradigm shift towards a framework that prioritizes farmers' rights and fosters participatory data governance, placing farmers at the center of decision-making processes to address underlying power imbalances.

Keywords Digital Agriculture · Africa · Kenya · Farmers' Rights · Datafication

Disruptive digital technologies are increasingly being introduced in agricultural systems worldwide. Dubbed the 'fourth agricultural revolution' and celebrated as a 'game-changer for agricultural transformation' (Tsan et al. 2019), these technologies are emerging at a time when there is a growing consensus about the failures of industrial food systems in both feeding the world and addressing climate change and ecological degradation. Digital agriculture encompasses a range of 'high-tech solutions, including the internet of things, biotechnology innovations, cloud computing, precision agriculture, smart farming, drones, sensors, and robotics' (Jellason et al. 2021: 1). The promise of these technologies lies in their ability to gather data on nearly every aspect of the food system and deliver predictive analytics to optimize the decisions of farmers, governments, and the private sector. Advocates suggest that data-driven food systems can boost farmer productivity, bolster national food security, and aid in climate change mitigation and adaptation efforts (Lajoie-O'Malley et al. 2020; Montenegro de Wit and Canfield 2023).

✉ Matthew Canfield
m.c.canfield@law.leidenuniv.nl

1 Van Vollenhoven Institute for Law, Governance, and Society, Leiden Law School, Leiden, The Netherlands

2 Stanford Center on Philanthropy and Civil Society, Stanford University and ETC Group, Kampala, Uganda

While digital agricultural technologies were initially developed for large-scale agricultural producers in the Minority World, in recent years they have increasingly been adapted for small-scale farmers in the Majority World. In these contexts, digital technologies are endowed with even greater ambitions–enabling countries to 'leapfrog' development by overcoming the challenge of poor and under-invested infrastructure. This is largely done by providing the private sector and governments with greater access to information on the lives of small-scale food producers, who remain the primary food producers in much of the Majority World. These farmers have long been the target of previous agricultural revolutions, which have sought to 'modernize' peasant and Indigenous food systems and facilitate industrialization. Agrarian movements, however, have consistently resisted such interventions, which engender greater dependence on commercial inputs, expand rural inequalities, and erode agro-biodiversity. As the digital agricultural revolution reshapes power relations once again, movements of small-scale food producers, rural workers, and Indigenous peoples are beginning to formulate new claims for data justice.

In this brief article, we examine the implications of datafication and the power relations it generates in the context of African agricultural systems. According to recent research, over 940 million people rely on food systems for their livelihoods in sub-Saharan Africa (Davis et al. 2023). We begin by introducing how digital agriculture

is being promoted on the African continent and reviewing the research that has detailed the risks posed by the 'datafication' of agriculture. After, we turn to develop a brief case study of Kenya, a country that has become a key hub for digital agriculture on the African continent due to government and private sector support. Kenya is home to approximately one hundred digital agriculture 'solutions', which are estimated to be 25% of those identified on the African continent. As it has embraced technology, Kenya has also emerged at the forefront of efforts to develop data governance policies to address some of the risks we discuss. We argue, however, that by solely emphasizing personal privacy—a perspective largely shaped by data governance frameworks in Europe and the Minority World—existing forms of data governance overlook the collective risks inherent in datafication for smallholder farmers. This narrow approach fails to adequately address the broader challenges of digital transformation in African agricultural systems. Therefore, we advocate for a paradigm shift towards a more comprehensive framework centered on farmers' rights. Such a framework is essential to safeguard the agency and autonomy of smallholder food producers amidst the proliferation of digital technologies in African agricultural contexts.

Digital Agriculture in Africa

African agricultural systems have long been subject to significant interventions and so-called 'revolutions' orchestrated by external forces primarily hailing from the Minority World. Throughout the nineteenth and twentieth centuries, Africa bore witness to a 'cash crop revolution' engineered to restructure its agricultural landscape, prioritizing the cultivation of commodities like cotton and vegetable oils destined for processing within the factories of industrialized northern nations. This trend persisted into the 1960s and resurfaced notably in the 2000s, with northern states and philanthropic entities spearheading what is termed the 'Green Revolution'. Championed notably by influential bodies such as the Rockefeller Foundation and, later, the Bill & Melinda Gates Foundation, the Green Revolution has aggressively promoted the adoption of hybrid seeds, biotechnology, and agrochemicals, alongside efforts to integrate African farmers into global value chains. Today, the Green Revolution reflects a neoliberal paradigm in agricultural policy, aiming to supplant direct governmental support with the mechanisms of public-private partnerships (Moseley et al. 2015). Each of these revolutions has sought to reorganize agricultural production to facilitate extraction by powerful entities, including colonial powers, transnational corporations, and urban elites.

Today, the digital revolution is often framed as a solution to urgent problems confronting agricultural systems including lower productivity rates, high rates of food insecurity, and the effects of climate change–all of which create the imperative for agricultural transformation. The African Development Bank Group (African Development Bank 2016), for example, identified the application of information and communication technologies (ICT) as a new way to drive modernization and integrate African agricultural producers into global value chains. More recently, Kudama et al. (2021: 292) describe how small-scale farmers in Africa may benefit from digital technologies that will enable 'access to real timely price, market, and farming information and safe financial transactions, alternative value chain linkages, multifaceted knowledge, better earning and yield, reduce costs, social well-being and risk minimization, women empowerment benefits'. Driven by this narrative, digital agricultural technologies are proliferating across Africa. Indeed, USAID suggests that 45% of all digital agricultural innovations developed for Low- and Middle-Income Countries have been developed for Africa, with at least 666 'solutions' active in 2022 (USAID 2023).

Despite the optimistic narrative surrounding the potential benefits of digital technologies for supporting their success is limited. Abate et al. (2023: 102,439) underscore this point, noting that 'systematic evidence of the favorable impact of these innovations remains scarce, and the few pieces of evidence available in the literature are mostly based on relatively small pilot projects'. For instance, mobile financial services, a cornerstone of digital agricultural initiatives, are utilized by only a fraction of smallholder farmers, estimated at around 1% (Parlasca et al. 2022). Furthermore, the struggles faced by digital agricultural platforms in developing sustainable revenue models indicate that smallholder farmers currently perceive limited value in these technologies.

Indeed, today, there is a growing concern that digital technologies will entrench the inequalities produced by earlier revolutions. Abdulai (2022: 1600) argues that, in Africa, the dominant narrative of digital agriculture 'uncritically entrenches and extends the pillars of the earlier Green Revolution efforts to transform and modernize smallholders without due considerations to potential power and class restructuring'. This is primarily because the revenue model of these technologies continues to hinge on the sale of agricultural inputs and financial products. For instance, the Kenyan platform DigiFarm, powered by the telecom Safaricom, integrates advisory services with input sales, loans, crop insurance, and market access, constituting one of Kenya's largest digital agricultural platforms. The company not only profits from fees associated with its mobile money platform MPESA but also from charges imposed on input companies such as agribusiness giants Yara and Syngenta (GATSBY

Africa 2022). Yet what differentiates and intensifies the power and control facilitated by digital technologies is their capacity to render their users newly legible to businesses and governments through the data they accumulate.

Data is thus a key resource that is being harvested from farmers. It is collected from sensors embedded in soils and agricultural machinery to provide information on soil carbon, moisture, and macronutrients; drones and remote sensing technologies on land tenure, use, and productivity; and mobile applications on farmer input use, productivity, and pest pressures. Combined, this data offers a 360-degree view of farmers for governments and the private sector to better target food producers with their desired interventions and maximize their profits (ETC Group 2024). As researchers, activists, and social movements evaluate the impact of digital technologies and the forms of control they enable, they have increasingly focused on the power of data.

Data Power in African Agriculture

Critical data scholars refer to 'datafication' to describe the mass quantification of life and rendered in formats that can be tabulated and analyzed (Mayer-Schönberger and Cukier 2013: 74). While datafication is a key process of the digital revolution, it is also seen as a key resource for development. Philanthropies, international institutions, and foreign aid agencies now all devote growing resources to datafication. This agenda, though it may sound neutral, is not uncontested. For example, Linnet Taylor and Dennis Broeders (2015) argue that 'data-driven development' makes populations in the Majority World more visible to the private sector and governments, but does not necessarily enhance their representation. Laura Mann (2018: 28) points out that data for development projects often claim to promote technocratic, data-driven solutions to data problems, but at the same time, 'create data of immense commercial value and provide prospects for new forms of bureaucratic control and economic restructuring'.

Concerns over collecting and extracting data from the Majority World reflect broader apprehensions over the ascent of informational capitalism in which data is a key commodity that propels unequal accumulation of wealth and power (Fuchs 2009). Critics of this process argue that it is engendering a new form of colonialism that extends and entrenches inequalities between the Majority and Minority Worlds (Couldry and Mejias 2019). Benyera (2021) argues that datafication enables the (re)colonization of Africa because it conceptualizes Africa and Africans as resources for data mining.

In the context of agriculture and food systems, researchers have raised specific concerns over processes of datafication

and their implications for sustainability, food security, and farmer livelihoods. While an exhaustive overview of these concerns is not possible here (Hackfort 2021), discussions surrounding the datafication of food systems largely focus on two key themes: the consolidation of political-economic power through data and its computational processing infrastructures and the epistemic power embedded within datafication.

Regarding the former, datafication engenders various political-economic asymmetries. Foremost among these is corporate dominance. Since most of the data capture occurs through infrastructures developed by the private sector, such as sensors and mobile phone apps, datafication is facilitating the integration of agriculture into informational capitalism (ETC Group 2024). Agriculture and food systems are already facing unprecedented corporate concentration (Clapp 2021), and the competition to control data exacerbates this trend. While access to and control over data are imperative for the development of predictive analytics tools that provide value to farmers, scholars caution that when farmers contribute their data to these platforms without retaining access or ownership rights, they risk becoming 'locked in' to specific technology providers, thereby increasing dependence (Ryan 2020; Hackfort 2023).

Secondly, and closely intertwined with the first point, this dynamic may widen the disparities between the Majority and Minority worlds. While agribusiness corporations strive to amass as much data as possible to market their products, they are now being joined by major tech conglomerates like Microsoft and Amazon Web Services, which are vying to dominate the back-end infrastructures for data sharing. Consequently, a new cohort of corporate players from the Minority World has begun to capitalize on African agriculture (AGRA Watch 2023). These tech giants possess substantially greater computational power, a quality that is becoming increasingly vital as artificial intelligence becomes more deeply ingrained in the economy (Srnicek 2022). Furthermore, corporations benefit as datafication transforms land and other resources, such as soil carbon, into assets that can be more readily purchased and traded (Duncan et al. 2022).

Third, datafication may widen economic asymmetries between large- and small-scale farmers. Bronson and Knezevic (2019) emphasize that while the 'digital divide' is typically understood to widen disparities between the Majority and Minority Worlds, it also exists between farmers who may have differential access to technology. According to Mehrabi et al. (2021), less than 40% of farmers in sub-Saharan Africa have access to the internet, and women have even less access. Only 13% of small-scale farmers are, in fact, registered for smart farming services (Alliance for a Green Revolution in Africa 2023). Yet it is not only access to the

internet and smartphones that produces the maldistribution of benefits from digital agriculture but also the design of digital agricultural tools. Smallholder food producers often produce a polyculture of diverse crops to ensure against crop failure and ensure food security. However, digital technologies like remote sensors require simplified monoculture landscapes to effectively measure and estimate production and yield (Jellason et al. 2021).

In addition to the political-economic asymmetries that digital agriculture may widen, datafication also exacerbates epistemic inequalities and whose knowledge matters in food systems transformation. Data is widely understood as objective and neutral, rather than reflecting particular worldviews. Such western and positivist approaches to scientific knowledge have long marginalized alternative ways of knowing. Growing struggles over food system transformation have highlighted the politics of knowledge and what kinds of data are legitimate by dominant global actors (Global Alliance for the Future of Food 2021). The turn to 'data-driven' and 'data-informed' food systems thus privileges what can be reduced, isolated, and quantified and what powerful actors determine is worth measuring.

Epistemic inequalities may also be further entrenched through the effects of digital agriculture on small-scale food producers. Asymmetrical control over what data is collected and by whom can have important social and knowledge effects by tethering food producers to particular knowledge systems and forms of data. Concerns have been raised regarding technologies fostering 'algorithmic governmentality', where opaque algorithms influence producers' behaviors to favor technology providers (Stock and Gardezi 2022). Consequently, there is a growing apprehension that digital agriculture may erode local, traditional, and Indigenous knowledge systems, leading to the dispossession of small-scale food producers (Fraser 2022; Stone 2022; Malik 2022).

The appropriation of local and indigenous knowledge is particularly concerning in the context of plant genetic resources. As USAID notes, 'the greatest opportunity for increasing agricultural productivity globally is marrying plant science data with farming practices data' (USAID 2018: 18). Genomic information, a valuable form of plant science data, is increasingly digitized and utilized in engineering new organisms through genetic technologies and synthetic biology. This 'digital sequence information' has been highly contested because it has not been addressed by legal regimes such as the International Treaty on Plant Genetic Resources, which ensures access and benefits sharing. This situation raises concerns about a new era of seed enclosures (Ajates 2023).

Given these dynamics, what role can data governance play in mitigating inequalities? How can governments leverage digital tools without exacerbating political-economic and epistemic inequalities? In the next section, we briefly analyze digital agriculture and data governance in Kenya, a country at the forefront of digital agriculture on the African continent. We describe how Kenya has taken steps to address some of these concerns by developing novel data governance frameworks, but that current policies remain rooted in a framework of agricultural modernization and serves primarily to facilitate data sharing rather than protecting farmers' rights.

Digital Agriculture in Kenya

Kenya is a major hub for the development of digital agriculture in Kenya. Dubbed the 'Silicon Savannah', the country has a thriving tech sector. Multiple large multinational technology corporations are headquartered in Nairobi. The country is uniquely poised to adopt digital farming because of its existing infrastructure. Indeed, Kenya has the fastest and most reliable internet service on the African continent. The introduction of the mobile money platform, M-PESA, in 2007 by the telecom provider Safaricom is widely used throughout the country. Additionally, nearly half of Kenyans own smartphones, and around 98% of Kenyans own a mobile phone (Osiemo et al. 2021). This widespread connectivity has fostered the country's e-commerce expansion (Tabe-Ojong Jr et al. 2023). Kenya's status as the largest recipient of foreign direct investment in Africa further underscores its role as a key hub for technology development (McCampbell and Migisha 2022).

In addition to being the home to multinational technology companies, Kenya is also the headquarters to several continent-wide organizations that advocate for the adoption of new agricultural technologies. A network of organizations supported primarily by the Bill & Melinda Gates Foundation are headquartered in Nairobi. These include the Alliance for a Green Revolution in Africa (AGRA) and the African Agricultural Technology Foundation (AATF). In addition to promoting new crop technologies, these organizations also promote digitalization. AGRA has adopted a digital strategy in which it endeavors 'to be a leader, convener, partner, coordinator and catalyst in integrating digital excellence and accelerating improvement of farmer livelihoods.'

The concentration of corporate and philanthropic organizations in Kenya has significantly influenced the nation's approach to digital agriculture. Underpinning this approach is the Government of Kenya's ambitious agenda to digitize its agricultural sector, as outlined in its Agricultural Growth and Transformation Strategy. To this end, the Ministry of Agriculture and Livestock Development (MoALD) has

delineated seven priority digital use cases for implementation. These include: (1) Establishing an e-incentive programme and farmer registration system; (2) Delivering tailored e-extension services; (3) Developing a comprehensive food balance sheet; (4) Establishing an early warning system; (5) Optimizing land use and selecting value chains efficiently; (6) Implementing a monitoring and evaluation dashboard; and (7) Formulating standards and protocols for data governance to facilitate data sharing.

Both the government and the private sector have been actively developing digital tools for the agricultural sector. According to the most recent study, most of these products are digital agricultural advisory, followed by financial services and market linkages (FAO et al. 2021). However, few of these services have an active user base exceeding 50,000 farmers (GATSBY Africa 2022). According to the government, a key reason for this is a lack of data accuracy and usability. It notes that 'public goods like farmer registries' can help scale digital agricultural solutions by providing comprehensive data about the entire ecosystem. Therefore, the Government of Kenya has concentrated on developing an extensive data ecosystem. Supported by over US$5 million in aid from the Swedish Government, the national government collected over six million farmer profiles throughout the country in 2023. The data collected includes a wide range of information including land use, ownership details, cultivated crops, livestock inventories, production practices, and access to technology and financial services. These farmer profiles are to serve as digital identifiers, consolidating crucial data on individual farmers and their operations, thereby facilitating their recognition by the government and other stakeholders. Leveraging these profiles, the Government of Kenya aims to enhance the efficiency of its farmer subsidies through an innovative 'e-incentive' system, streamlining subsidy delivery and monitoring its utilization. Given the expansive information contained in these profiles, the private sector has a keen interest in accessing them.

As the government consolidates and analyzes this data, it now confronts critical questions about the necessity and methods of sharing it. Indeed, once gathered, this data's economic, political, and social significance has become evident, sparking fresh questions about how it will be governed.

Data Governance in Kenya

In recent years, Kenya has demonstrated leadership in developing data governance frameworks across East Africa. Like much of the world, Kenya has developed data protection legislation influenced by the EU's General Data Protection Regulation (GDPR). However, beyond this, it has also developed enabling regulations for this legislation within the Ministry of Agriculture. As described below, these frameworks remain rooted in a paradigm of individual privacy that do not address some of the most fundamental asymmetries of data power. With the increasing data collection, it is critical to establish robust governance frameworks to protect the interests of smallholder food producers.

Data Protection Act 2019

Kenya's Data Protection Act (2019) seeks to create an institutional framework and legal guidelines for processing personal data in Kenya. It generally adopts the framework of the GDPR but differs in some ways that reflect the institutional resources of the country as well as some protectionist measures (Mukiri-Smith and Leenes 2021). The DPA sets out procedures for data controllers to follow in the processing of personal data. Article 31 of Kenya's Constitution guarantees the right to privacy and data protection. These rights are reinforced in the Data Protection Act, which seeks to protect the privacy of data subjects by providing for their rights, regulating the processing of personal data, and ensuring that any processing of personal data is guided by the principles set out in Sect. 25. The DPA, however, is not sector-specific. Individual Ministries, such as the MoALD, have developed enabling frameworks to implement the DPA within specific sectors.

Data Governance Framework by MoALD

The MoALD developed a Data Governance Framework in 2022 with funding and support from the German Development Cooperation (GIZ). The framework does not cover all data collected and held by MoALD but rather focuses specifically on farmers' registration data in accordance with use case 1 of the Digitization and Coordination of Kenya's Agricultural Sector Data guidance document. Through the framework, MoALD has signaled a commitment to strengthen farmers' trust and give them the ability to make informed decisions about whether and how their data is collected and used. It emphasizes informed consent as a key principle to increase accountability and responsibility for data management procedures and to build trust between people and the organizations handling their data. However, the current framework not only poses key challenges in protecting the privacy of farmers but also in the security of agricultural data and in addressing the inequalities described above that datafication threatens to exacerbate.

One key challenge is the distinction between personal and non-personal data. Most data related to agriculture is not considered 'personal data'. According to the DPA, any information relating to a natural person who can be identified or who is otherwise identifiable is regarded as personal

data. On the other hand, non-personal data, such as weather and machine data, or agronomic data (such as yield, nutrient, and soil data), is not protected under the DPA. However, when these are shared in combination with each other (i.e., yield with location data), agricultural data may, in fact, provide personal information. Thus, the line between 'personal' and 'non-personal' data is blurry in the agricultural context. As a result, no public legal framework controls how these data are used, raising major concerns about public data sharing with the private sector.

The Data Governance Framework also does not address data collected by private parties. Such transactions are governed by contracts and license agreements, which provide smallholder farmers with very little negotiating leverage and are generally mistrusted due to complex provisions in the agreements (Jouanjean et al. 2020). Under the DPA, data processors and controllers are required to register with the Office of the Data Protection Commissioner. However, the regulatory requirements regarding processing only apply to 'personal' data. Generally, farmers remain concerned about sharing, use, and access to data collected by private actors. Data sharing raises fundamental concerns regarding how data should be governed and who should control and have access to it. Farmer consent is essential to ensure that their 'personal data' and 'non-personal data' is collected, used, and shared in a transparent, ethical, and legally compliant manner. However, what constitutes 'informed' consent remains undefined, especially whether consent is a one-time event or is ongoing process whenever data is shared.

The Data Governance Framework crucially incorporates a mechanism for farmer participation through the Data Governance Council. This Council, as outlined in the Framework, comprises senior management from the Ministry of Agriculture and Livestock Development (MoALD) alongside various stakeholders. The involvement of farmers' organizations and civil society is a cornerstone of inclusive data governance. However, the selection of 'stakeholders' in data governance presents an ongoing challenge, as it does in all forms of multi-stakeholder governance. In the realm of data governance, farmers' organizations often lack the necessary knowledge and understanding of data protection and the complexities of datafication, which impedes their effective engagement. Consequently, without substantial capacity-building initiatives, the only stakeholders who may effectively participate are those from the private sector.

International Pressures

In Kenya, agricultural data governance may also be shaped by international factors, particularly by supranational institutions and international agreements such as trade treaties. For example, member states of the African Union (AU) may be encouraged to harmonize their data governance regimes by the AU policy on data, enabling cross-border data flows and interoperability between various authorities. The AU policy aims to provide uniform privacy and data security guidelines, impacting member nations' national privacy laws and policies. If established, the US-Kenya Strategic Trade and Investment Partnership could also have implications for data governance in Kenya and other African countries. The partnership may encourage Kenya to align its data governance policies and regulations with those of the United States, especially in data and intellectual property rights areas. Increased trade and investment between the US and Kenya could lead to greater data sharing and collaboration between companies from both countries. Both the AU and bilateral trade treaties are likely to have an important impact on data governance, with little input from the farmers whom these policies will affect.

Towards Farmer's Rights in Data

Kenya is at the forefront of digital agriculture and data governance. Yet, as our review demonstrates, existing legal protections largely entrench a liberal approach to individual privacy that is inappropriate for the context of agriculture. Even beyond the agricultural sector, critical legal scholars have argued that individual privacy fails to address the collective risks and harms of datafication, including the vast power that it endows to both governments and corporations (Viljoen 2021; Waldman 2021). However, in the context of agriculture, the collective dimensions of data power are more obvious, as widespread data sharing is poised to further exacerbate inequalities and undermine farmer autonomy. Indeed, the reality is that data-driven agricultural technologies are intended to benefit large corporations, while smallholder farmers will not benefit economically from their own data. Smallholder farmer data will be extracted without fully informed consent and then sold to them for profit, further entrenching control of a few select companies wielding control over farmer data and food systems (Development Gateway 2023).

To address this risk, a robust concept of farmers' rights in the context of digital technologies must be developed. The concept of farmers' rights was developed to recognize farmers' contributions to genetic diversity and to counter the extension of breeders' rights to seed (Andersen 2005). Since then, farmers' rights have become a collective alternative to intellectual property rights and a framework for ensuring benefits sharing with food producers that have sustainably managed the world's biodiversity. Today, farmers' rights are enshrined in various national legislations, international agreements, and declarations. The International

Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was the first legally binding international agreement to formally recognize the contribution of local and indigenous communities and farmers to the conservation and development of plant genetic resources for food and agriculture. Article 9 provides for recognizing, realizing, and promoting farmers' rights regarding plant genetic resources for food and agriculture. It acknowledges farmers' contributions to the conservation and development of plant genetic resources and calls for protecting their rights to save, use, exchange, and sell farm-saved seeds. Farmers are key custodians and developers of crop diversity and play a pivotal role in providing food and nutrition to millions around the globe.

More recently, the United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP), adopted in 2018, acknowledges the contributions of peasants to food security, biodiversity conservation, and sustainable development. It recognizes peasants' rights to land, seeds, water, and other natural resources, as well as their cultural rights and collective rights to organize and participate in decision-making processes affecting their lives and livelihoods. Historically, peasants–including small-scale farmers, Indigenous peoples, and rural communities–continuously face marginalization and discrimination. UNDROP elaborates a robust concept of peasants' rights and supports the autonomy of small-scale food producers and their struggles for agroecology, local food systems, and community-based approaches to farming and food production.

International agreements such as the ITPGRFA and the UNDROP reflect growing recognition of the importance of protecting farmers' rights and promoting sustainable agriculture. Farmers' rights continue to evolve in response to the challenges presented by digital agriculture, particularly concerning seed sovereignty and peasant rights. The concepts of farmers' rights, seed sovereignty, and peasant rights have become interconnected and have evolved in response to the challenges faced by small-scale farmers and rural communities.

In the context of data governance, farmers' rights can provide a more robust framework to address the risks that digitalization poses. For example, farmers' rights could serve to address:

- **Ownership and Control of Data**: Farmers should have ownership and control over the data generated by their farming activities. This includes the right to decide how their data is collected, stored, processed, and shared and the ability to revoke consent or opt out of data collection activities.

- **Equitable Access to Technology**: Small-scale farmers, who often have limited resources and technical capabilities, should have equitable access to digital technologies and the necessary support to adopt and utilize these technologies effectively. This can help mitigate the digital divide and empower small-scale farmers to benefit from digitalization.

- **Protection of Traditional Knowledge**: Farmers' rights should include protection for traditional knowledge and practices that are integral to sustainable agriculture. Digital technologies should not undermine farmers' ability to preserve and transmit traditional farming knowledge, including seed saving, crop rotation, and agroecological practices.

- **Data Transparency and Accountability**: There should be transparency and accountability in the collection, use, and sharing of agricultural data. Farmers should have access to clear information about how their data is being used and the purposes for which it is being collected. Mechanisms should also be in place to hold data collectors and processors accountable for any misuse or breaches of farmers' data.

- **Policy and Regulatory Frameworks**: Governments and regulatory bodies should develop and implement policy and regulatory frameworks that protect farmers' rights in the digital age. This includes enacting legislation that safeguards farmers' data privacy, promotes data sovereignty, and ensures that digital technologies are used in ways that benefit farmers and contribute to sustainable agriculture and rural development.

Conclusions

This article emphasizes the need to shift underlying power dynamics by promoting participatory data governance with farmers at the center. The proliferation of data-driven-agricultural technologies risks exacerbating the structural inequities within the agriculture sector. It is essential that a holistic understanding of farmers' rights in the context of digital technologies be developed so that policymakers, technology developers, and farmers can work together to foster an inclusive and equitable digital agriculture ecosystem that upholds the rights and interests of small-scale farmers and rural communities. Indeed, farmers' rights-driven agricultural data governance should be viewed through the lens of power and participation. Key questions must be posed: who collects and translates farmer data into commercial value from farmers? How can farmers meaningfully participate in equitable, sustainable food systems? Meaningful involvement requires deliberate strategies to connect, understand,

and integrate farmer voices and communities to inform data governance frameworks. Fostering trust and building capacity can pave the way for more just and equitable food systems on the African continent.

References

Abate, Gashaw T., Kibrom A. Abay, Jordan Chamberlin, Yumna Kassim, David J. Spielman, and Martin Paul Jr Tabe-Ojong. 2023. Digital Tools and Agricultural Market Transformation in Africa: Why Are They Not at Scale Yet, and What Will It Take to Get There? *Food Policy* 116: 102439. April. https://doi.org/10.1016/j.foodpol.2023.102439.

Abdulai, Abdul-Rahim. 2022. A New Green Revolution (GR) or Neoliberal Entrenchment in Agri-Food Systems? Exploring Narratives Around Digital Agriculture (DA), Food Systems, and Development in Sub-Sahara Africa. *The Journal of Development Studies* 58(8): 1588–1604. https://doi.org/10.1080/00220388.2022.2032673.

African Development Bank. 2016. Feed Africa: Strategy for Agricultural Transformation in Africa 2016–2025. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/Feed_Africa-Strategy-En.pdf.

AGRA Watch. 2023. Corporate-Led Climate Change Adaptation: How the Gates Foundation, Microsoft, and AGRA Are Enabling the Digital Capture of African Food Systems. Seattle, WA.

Ajates, Raquel. 2023. From Land Enclosures to Lab Enclosures: Digital Sequence Information, Cultivated Biodiversity and the Movement for Open Source Seed Systems. *The Journal of Peasant Studies* 50(3): 1056–84. https://doi.org/10.1080/03066150.2022.2121648.

Alliance for a Green Revolution in Africa. 2023. Empowering Africa's Food Systems for the Future. Agriculture Status Report 2023. Nairobi, Kenya.

Andersen, Regine. 2005. The History of Farmers' Rights: A Guide to Central Documents and Literature. FNI Report 8/2005. The Fridtjof Nansen Institute.

Benyera, Everisto. 2021. *The Fourth Industrial Revolution and the Recolonisation of Africa: The Coloniality of Data*. Taylor & Francis. https://doi.org/10.4324/9781003157731.

Bronson, Kelly, and Irena Knezevic. 2019. The Digital Divide and How It Matters for Canadian Food System Equity. *Canadian Journal of Communication* 44(2): 63–68. https://doi.org/10.22230/cjc.2019v44n2a3489.

Lajoie-O'Malley, Alana, Kelly Bronson, Simone van der Burg, and Laurens Klerkx. 2020. The Future(s) of Digital Agriculture and Sustainable Food Systems: An Analysis of High-Level Policy Documents. *Ecosystem Services* 45: 101183 (October). https://doi.org/10.1016/j.ecoser.2020.101183.

Clapp, Jennifer. 2021. The Problem with Growing Corporate Concentration and Power in the Global Food System. *Nature Food* 2(6): 404–8. https://doi.org/10.1038/s43016-021-00297-7.

Couldry, Nick, and Ulises A. Mejias. 2019. *The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism*. Stanford University Press.

Davis, Benjamin, Erdgin Mane, Leman Yonca Gurbuzer, Giulia Caivano, Natalia Piedrahita, Kate Schneider, Nimra Azhar, et al. 2023. *Estimating Global and Country-Level Employment in Agrifood Systems*. Rome: Food and Agriculture Organization.

Montenegro de Wit, Maywa, and Matthew Canfield. 2023. 'Feeding the World, Byte by Byte': Emergent Imaginaries of Data Productivism. *The Journal of Peasant Studies* 0(0): 1–40. https://doi.org/10.1080/03066150.2023.2232997.

Development Gateway. 2023. Farmer-Centric Data Governance: Towards A New Paradigm. https://developmentgateway.org/wp-content/uploads/2023/02/Farmers_Report-Full_vFebFiNAL.pdf.

Duncan, Emily, Sarah Rotz, André Magnan, and Kelly Bronson. 2022. Disciplining Land through Data: The Role of Agricultural Technologies in Farmland Assetisation. *Sociologia Ruralis* 62(2): 231–49. https://doi.org/10.1111/soru.12369.

ETC Group. 2024. Trojan Horses on the Farm. https://www.etcgroup.org/content/trojan-horses-farm.

FAO, CIAT and World Bank. 2021. Digital Agriculture Profile Kenya. Rome, Italy. https://openknowledge.fao.org/items/fab01c51-9c1e-4497-8d4b-6f8477a177c2.

Fraser, Nancy. 2022. *Cannibal Capitalism: How Our System Is Devouring Democracy, Care, and the Planet and What We Can Do About It*. Verso Books.

Fuchs, Christian. 2009. A Contribution to the Critique of the Political Economy of Transnational Informational Capitalism. *Rethinking Marxism* 21(3): 387–402. https://doi.org/10.1080/08935690902955104.

GATSBY Africa. 2022. Digitally Enabled Agriculture: A Landscape Study of Digital Advisory Models for Smallholder Farmers in East Africa. https://www.gatsbyafrica.org.uk/app/uploads/2023/01/gatsbyafrica-digitally-enabled-agriculture-april-2022-003.pdf.

Global Alliance for the Future of Food. 2021. The Politics of Knowledge: Understanding the Evidence for Agroecology, Regenerative Approaches, and Indigenous Foodways. https://futureoffood.org/insights/the-politics-of-knowledge-compendium/.

Hackfort, Sarah. 2021. Patterns of Inequalities in Digital Agriculture: A Systematic Literature Review. *Sustainability* 13(22): 12345. https://doi.org/10.3390/su132212345.

Hackfort, Sarah. 2023. Unlocking Sustainability? The Power of Corporate Lock-Ins and How They Shape Digital Agriculture in Germany. *Journal of Rural Studies* 101: 103065, July. https://doi.org/10.1016/j.jrurstud.2023.103065.

Jellason, Nugun P., Elizabeth J. Z. Robinson, and Chukwuma C. Ogbaga. 2021. Agriculture 4.0: Is Sub-Saharan Africa Ready? *Applied Sciences* 11(12): 5750. https://doi.org/10.3390/app11125750.

Jouanjean, Marie-Agnes, Francesca Casalini, Leanne Wiseman, and Emily Gray. 2020. Issues around Data Governance in the Digital Transformation of Agriculture: The Farmers' Perspective. Paris: OECD. https://doi.org/10.1787/53ecf2ab-en.

Kudama, Gezahagn, Mabiratu Dangia, Hika Wana, and Bona Tadese. 2021. Will Digital Solution Transform Sub-Sahara African Agriculture? *Artificial Intelligence in Agriculture* 5(January): 292–300. https://doi.org/10.1016/j.aiia.2021.12.001.

Malik, S. Ali. 2022. Linking Climate-Smart Agriculture to Farming as a Service: Mapping an Emergent Paradigm of Datafied Dispossession in India. *The Journal of Peasant Studies* 0(0): 1–23. https://doi.org/10.1080/03066150.2022.2138751.

Mann, Laura. 2018. Left to Other Peoples' Devices? A Political Economy Perspective on the Big Data Revolution in Development. *Development and Change* 49(1): 3–36. https://doi.org/10.1111/dech.12347.

Mayer-Schönberger, Viktor, and Kenneth Cukier. 2013. *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. Houghton Mifflin Harcourt.

McCampbell, Mariette, and Claude K. Migisha. 2022. Digital Ecosystems for Smallholder Farmers in Low- and Middle-Income Countries: A Rapid Assessment of Digital Agriculture Ecosystems in Zambia and Kenya. Netherlands Food Partnership. https://www.nlfoodpartnership.com/documents/399/Report_-_Digital_ecosystems_for_smallholder_farmers_in_LMICs.pdf.

Mehrabi, Zia, Mollie J. McDowell, Vincent Ricciardi, Christian Levers, Juan Diego Martinez, Natascha Mehrabi, Hannah Wittman, Navin Ramankutty, and Andy Jarvis. 2021. The Global Divide in Data-Driven Farming. *Nature Sustainability* 4(2): 154–60. https://doi.org/10.1038/s41893-020-00631-0.

Moseley, William, Matthew Schnurr, and Rachel Bezner Kerr. 2015. Interrogating the Technocratic (Neoliberal) Agenda for Agricultural Development and Hunger Alleviation in Africa. *African Geographical Review* 34(1): 1–7. https://doi.org/10.1080/19376812.2014.1003308.

Mukiri-Smith, Hellen, and Ronald Leenes. 2021. Beyond the 'Brussels Effect'? Kenya's Data Protection Act (DPA) 2019 and the European Union's General Data Protection Regulation (GDPR) 2018. *European Data Protection Law Review (EDPL)* 7: 502.

Osiemo, Jamleck, Evan Hartunian Girvetz, Eva Hasiner, Kateryna Schroeder, David Treguer, Armine Juergenliemk, Alexandra Horst, Andy Jarvis, and Wietske Kropff. 2021. Digital Agriculture Profile: Kenya, April. https://hdl.handle.net/10568/113517.

Parlasca, Martin C., Constantin Johnen, and Matin Qaim. 2022. Use of Mobile Financial Services among Farmers in Africa: Insights from Kenya. *Global Food Security* 32: 100590, March. https://doi.org/10.1016/j.gfs.2021.100590.

Ryan, Mark. 2020. Agricultural Big Data Analytics and the Ethics of Power. *Journal of Agricultural and Environmental Ethics* 33(1): 49–69. https://doi.org/10.1007/s10806-019-09812-0.

Srnicek, Nick. 2022. *Data, Compute, Labor*, June. https://doi.org/10.7551/mitpress/13835.003.0019.

Stock, Ryan, and Maaz Gardezi. 2022. Arrays and Algorithms: Emerging Regimes of Dispossession at the Frontiers of Agrarian Technological Governance. *Earth System Governance* 12: 100137, April. https://doi.org/10.1016/j.esg.2022.100137.

Stone, Glenn Davis. 2022. Surveillance Agriculture and Peasant Autonomy. *Journal of Agrarian Change* 22(3): 608–31. https://doi.org/10.1111/joac.12470.

Tabe-Ojong Jr, Martin Paul, Gashaw Tadesse Abate, Kibrom A. Abay, and David J. Spielman. 2023. Digital Innovations and Agricultural Transformation in Africa: Lessons from Kenya. https://cgspace.cgiar.org/items/7e4ede83-7059-47e3-b916-2e802057cffa.

Taylor, Linnet, and Dennis Broeders. 2015. In the Name of Development: Power, Profit and the Datafication of the Global South. *Geoforum* 64: 229–37, August. https://doi.org/10.1016/j.geoforum.2015.07.002.

Tsan, Michael, Swetha Totapally, Michael Hailu, and Benjamin K. Addom. 2019. The Digitalisation of African Agriculture Report 2018–2019, June. https://hdl.handle.net/10568/101498.

USAID. 2018. DIGITAL FARMER PROFILES: Reimagining Smallholder Agriculture. https://www.usaid.gov/sites/default/files/2022-05/Data_Driven_Agriculture_Farmer_Profile.pdf.

USAID. 2023. State of the Digital Agriculture Sector: Harnessing the Potential of Digital for Impact Across Agricultural Value Chains in Low- and Middle-Income Countries. https://www.beanstalkagtech.com/d4aglmic.

Viljoen, Salome. 2021. A Relational Theory of Data Governance. *Yale Law Journal* 131: 573.

Waldman, Ari Ezra. 2021. *Industry Unbound: The Inside Story of Privacy, Data, and Corporate Power*. Cambridge University Press.