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Introduction

Smallholder farmers in the Global South have typically struggled to access advanced technology to aid crop prediction, chemical usage, disease prevention, and financial services. Main barriers to access agrarian technologies are connection – through Wi-Fi or cellular networks – or access to technology itself – phones or computers. The prohibitive financial burden may also result in farmers unable to access technology. While smallholder farmers produce between 50 per cent and 75 per cent of calories consumed globally, they are excluded from essential innovations that can save labor and chemical costs, inform farmers about pest and disease, and utilize connections with scientists to gain insights on soil/plant health (Stone, 2022, p. 610).

Efforts to address the 'digital divide' or lack of access have been undertaken by a variety of actors, governments, NGOs and corporations (Rotz et al., 2019; Agyekumhene et al., 2020). However, the creation and dissemination of technology thus far has typically ignored rural agrarian contexts and informal systems; effectively creating technology that causes significant changes to agrarian contexts. Further, NGOs and companies driving the charge in connecting rural smallholder farmers act in their own interests, often pushing farmers to increase their chemical use or adopt a certain product (Waldmueller, 2015). Significant power imbalances become apparent given the lack of involvement of rural communities in a products development is a signifier of colonial mindset (Waldmueller, 2015). Companies and NGOs adopt colonial

mindsets by using, drawn from Western sources (stemming from colonial ways of knowledge production), are superior to the lived experience and traditional knowledge farmers have in the global South. As knowledge creation is concentrated in the global North, colonial mindsets dictate that they 'know best' when creating development plans for the global South (Waldmueller, 2015). Thus, creating a significant power imbalance between creator and consumer of agrarian technology.

Not only are farmers oftentimes convinced to use technologies that are not effective, or align with informal and traditional farming practices, they are subject to their data being collected without their knowledge (Stone, 2022). Further, many farmers experience job deskilling and loss of autonomy because of technology adoption. Deskilling results after farmers lose decision-making capabilities after their autonomy and skills are no longer necessary as technology makes decisions on behalf of the farmer. However, in this process, farmers lose traditional knowledge and connection to the land that is important in smallholder farming.

NGOs and companies frame technology making decisions on behalf of a farmer as a relief, however, it often results in farmers losing decision-making ability and becoming estranged from the land they work on (Stone, 2022). Smallholder farmers rely on informal knowledge passed down as well as community knowledge sharing, currently, agrarian technology stands to discount such information to serve their larger interests (Stone, 2022).

Further, companies are often acting in their own self-interest, as they leverage smallholder farmers frequent inability to understand data policies and the subsequent consequences of their data collection (Stone, 2022).

To counter such effects, scholars have begun to encourage the use of Responsible Research Innovation (RRI) to address such issues. RRI is defined as a "transparent, interactive

process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (to allow a proper embedding of scientific and technological advances in our society)" (Ludwig et al., 2021, p. 216). By using RRI, companies and NGOs include key stakeholders – smallholder farmers – to gain crucial insights and understanding of what farmers want and how a product can be achieved with minimal disruption of current practices.

At present, digital technologies rarely help farmers, instead introduce issues such as deskilling, increased chemical inputs, surveillance, and loss of autonomy; utilizing RRI in the creation of agrarian technology in the global South would help mitigate the significant power imbalances and allow farmers to participate in the development process.

Responsible Research Innovation (RRI)

Current innovation in the agrarian technology sector focuses on monocropping and large-scale industrial farming operations. Corporations developing technologies have been criticized for "fostering divisions" between farmers (Bronson, 2019, p. 1). The uneven adoption of technology has exacerbated inequalities between smallholder and industrial farmers in the global North and South (Bronson, 2022). Further, the unequal gathering and distribution of data from farmers to 'big data' perpetuates power imbalances between farmer and corporation. The promotion of large-scale farming perpetuated by agrarian technology pressures smallholder farmers to invest significant capital into technology (Bronson, 2019).

RRI has a central focus of where data collected goes, how it is used, and who benefits (Bronson, 2022). There are concerns over how data collected from a variety of technology is

reappropriated to “teach” new algorithms or for corporate gain – using farmer profiles to create specific advertisements for chemicals (Bronson, 2019). They question surveillance and the misuse of farmer data – challenges of which Zuboff and other scholars have posited regarding surveillance capitalism (Zuboff, 2019). Data is constantly being mined under the guise of providing consumers with more tailored products and curating their online and reality to align with them. However, Zuboff (2019, p.71) believes the contrary, “surveillance capitalism’s unusual products manage to be derived from our behavior while remaining indifferent to our behavior. Its products are about predicting us, without actually caring what we do or what is done to us.” While companies may justify the importance of data collection, it is important to question the intention of such statements.

To counter this, RRI promotes creating a transparent value system on data privacy and usage (Bronson, 2019). Farmers are encouraged to maintain ownership over their data and question what their data is being used for. Providing feedback to companies gives farmers more control over their data and allows them to become stakeholders in decision making processes (Bronson, 2019). RRI’s scope extends beyond farmers, advocating for government and scholars to recognize the social, ethical, economic, and political implications behind the mining of farmer data (Bronson, 2019). Encouraging the adoption of data regulations and including farmers in the development of technology as key stakeholders (Bronson, 2022).

By emphasizing the role of farmers in the securing of their own data, RRI pushes the onus onto farmers to educate themselves on data collection and usage, instead of holding companies and regulators accountable. While they do still advocate for government and companies to improve, the large portion of data accountability falls on the farmer. Many of whom may find it difficult to navigate large companies attempting to protect their data usage

patterns. In class, we have drawn similar conclusions when discussing feminist movement and placing the onus on women to drive development.

Agrarian technology in Africa

While much of the Western world has barred or restricted the global South's ability to develop in tandem due to lack of opportunity, machine learning gives the global South the opportunity to address such imbalances (Gwagwa et al., 2021; Agyekumhene et al., 2020). Applying AI and other technologies in smallholder farming would both improve sustainability and address food scarcity and insecurity (Gwagwa et al., 2021). Further, developments in the agricultural sector would likely yield significant results, as 54 per cent of all workers in sub-Saharan Africa work in the agricultural sector (Gwagwa et al., 2021, p. 2). Many African communities intertwine their agrarian lives with beyond "just a means of procuring food and livelihoods; it is intertwined with culture and underpins many key events in villagers' lives, such as births, marriages, funerals, and celebrations (Gwagwa et al., 2021, p. 6).

Taking a digital approach would better connect communities by communicating with consultants and neighbors to frequently inform farmers on variable conditions, pests, and disease treatment (Agyekumhene et al., 2020). Smallholder farms have typically been left out of the adoption of agrarian technology for several reasons, largely due to the lack of economic incentive (Gwagwa et al., 2021). While large intensive farms in the global North have higher wages, there is a higher incentive to save labor and input cost in a large farm, while farmers in sub-Saharan Africa make less wages. Further, the smaller size of farms reduces the efficacy and impact AI potentially has (Gwagwa et al., 2021).

However, agrarian technologies have still been implemented in the global South – potentially due to the benefit of little regulatory bodies on surveillance and data management (Stone et al., 2022). The smallholder farming sector in Ghana has seen the implementation of technologies to encourage connection though the use of "robots, drones, mobile phones, and AI" (Sarku and Ayamga, 2025, p. 2). While many technologies are viewed as emancipatory for smallholder farmers, releasing them from intensive labor and connecting them to global markets, many technologies create dependencies similar to colonial-era regimes (Sarku and Ayamga, 2025). By investigating

In Ghana, agrarian technology has proliferated across both the public and private sector, supported by several philanthropic organizations that forefront stakeholder interests over smallholder farmers. In parallel, the Government of Ghana recently introduced a "digitalization agenda" to implement "delivery drones for medications, a national digital address system, mobile money interoperability, and E-Agricultural platform, among other initiatives (Sarku and Ayamga, 2025, p.8). Key donors in philanthropic organizations typically are monopolizing agribusinesses' seeking economic gains by leveraging connectivity to smallholder farmers to push product consumption. Other donors may be seeking data extraction from unsuspecting smallholder farmers who have not been provided the tools to scrutinize and understand how their data is being used (Sarku and Ayamga, 2025). Consequently, creating dependencies on companies to provide necessary technologies they inevitably begin to rely upon, "leading to datafication, and surveillance capitalism though digital platform development (Sarku and Ayamga, 2025, p.3). Creating dependencies both deskills labor and forces indefinite reliance on technology to run smallholder farms. Once certain technologies are introduced, they enter the

technological treadmill, forcing them to keep adopting newer technologies to remain competitive in local and global markets (Stone, 2022).

Case study – Esoko

While many international actors have attempted to infiltrate exploitable developing markets due to the lack of regulation surrounding agricultural technologies, a social enterprise in Ghana has attempted to create a product that aligns with RRI frameworks to create a platform that is locally and culturally relevant to Ghanaian farmers (Ludwig et al., 2021; *About Esoko*, 2025). Esoko's vision is to drive economic empowerment in the agrarian sector to provide digital services. They have since grown to reach farmers in 20 African countries to provide "information services on market conditions, weather, cropping calendar, nutrition information, and agronomic advice to nearly 3.7 million rural inhabitants" (Ludwig et al., 2021, p. 218). Esoko uses weather forecasts from the Ghana Meteorological Agencies and disseminates the information as climate-smart information for farmers and communities (Ludwig et al., 2021). Attached, they provide one-to-one services through a call center to manage "ambiguities, misconceptions, and misinterpretation of forecast information" (Ludwig et al., 2021, p. 221).

As Ghana did not have clear regulatory frameworks when Esoko was first created, they had to internally create regulatory ethical frameworks through a process of consultation with local farmers, communities, scholars, and people with moral and ethical stakes (Ludwig et al., 2021). Using RRI as a regulatory framework required Esoko to make forward thinking decisions to shape expected growth in agricultural technology use in Ghana. By considering multiple stakeholder views, they were able to successfully create value systems that prioritized indigenous and scientific knowledge (Ludwig et al., 2021). Engaging a multitude of stakeholders has a dual

process of building trust with skeptical farmers who may believe that Esoko is attempting to increase surveillance, and to educate farmers on the technical specifications of their information sharing process (Ludwig et al., 2021).

Many farmers remained wary of Esoko's intentions during their information gathering process due to their lack of knowledge and trust in actors attempting to alter their traditional farming methods. Esoko's pursuit of trust in Ghanaian rural populations dealt with the "strategic uncertainty about the willingness and capability of actors to be included in the technology design process (Ludwig et al., 2021, p. 219). Their solution was to utilize a reflexive process to understand informal farming practices and take different user geographies into account (Ludwig et al., 2021). Reflexivity challenges Esoko employees to consider their own biases and understand geographical contexts and ethics to create a program that is compatible for Ghanian farmers without disrupting their current informal practices.

As digital services proliferate rural agrarian areas, it is important to leverage RRI to address challenges and creating an innovative environment to pursue development. Fostering inclusiveness and responsiveness "involves embracing and drawing in multiple stakeholders through partnerships and different forms of collaboration in the innovation process" (Ludwig et al., 2021, p. 217). Essentially, Esoko achieves a product that improves productivity, chemical use, disease management, and the reduction of labor for farmers (Ludwig et al., 2021; *About Esoko*, 2025).

However, grassroots initiatives like Esoko are at risk of being shut down due to the Trump Administration's dismantling of the United States Agency for International Development (USAID) funding projects. Esoko currently receives funding from USAID-Agricultural Development and Value Chain Enhancement (ADVANCE) program (Sarku and Ayamga, 2025).

Losing funding leaves many smaller, grassroots projects unable to provide sustainable products. The lasting effects would likely result in RRI frameworks being forced outside of development spaces due to lack of funding. Thus, leaving larger philanthropic foundations to continue preying on undereducated farmers to pursue datafication and data testing. Companies and NGOs should prioritize integrating farmer feedback and requests into their product to create helpful, efficient solutions to share information. Further, promoters of RRI are facing significantly detrimental efforts in funding to share their messages and advocate for both government and farmers.

Conclusion

The integration of agrarian technology in the global South has largely been dominated by the interests of large corporations and philanthropic ventures, rather than foregrounding smallholder farmers. Farmers have repeatedly been excluded in the development process to create new technologies. A process that is crucial to gain understandings of local, social, cultural, and rural contexts that informs key features and needs a community has. The implementation of technologies has continually affected workers negatively, resulting in increased surveillance, deskilling, and dependency on external actors.

RRI presents a viable alternative to top-down development methods that have historically been damaging to people in the global South and perpetuate colonial roots (Stone, 2022). By promoting greater transparency, ethical data use, and the inclusion of farmers as key stakeholders in technological development, locally relevant technologies can be created. Grassroots initiatives like Esoko have shown the viability and importance of integrating RRI frameworks into company policies. However, the precarity of funding in the contemporary social climate leaves RRI principles vulnerable to being abandoned after funding cuts.

Moving forward, governments, scholars, and NGOs should advocate for stronger regulatory frameworks that seek best solutions for farmers, without profit-seeking and self-promoting by utilizing product placement. Development initiatives should empower smallholder farmers towards effective knowledge sharing. By adopting RRI principles, agrarian technology has the potential to become a tool for equitable development rather than a mechanism for further exploitation and control.

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