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

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(Original version submitted May 2021; final version accepted January 2022)

ABSTRACT This paper adopts a document analysis to describe the expected developmental effects of agricultural digitalization in Africa and the potential drivers to the narratives that echo such effects. Narratives show that digitalization is expected to bridge information and knowledge gaps in agriculture; promote food security; increase climate change/environmental sustainability; provide employment and empower the youth; promote gender and women empowerment; and enhance livelihood resilience in rural areas. With these findings, I argue that, though partly justifiable, private-sector led digitalization, with its optimistic technocratic narratives, follows, entrenches, and extends the ‘transformational rhetoric’ of the existing international development-driven African Green Revolution efforts to improve smallholder and rural lives through technological diffusion. However, without critical considerations of political-economic issues affecting its proliferation, as well as their implications on power structures and class restructuring, these narratives mask potential neoliberal incursions. Thus, issues of connectivity and the digital divide issues, the slow pace of technological adoption, scaling of digital solutions, and the weak enabling environments must be addressed to potentially make benefits inclusive. The initial suggested political-economic discussions of the narratives inject much needed critical perspectives into the early conversations by showing the potential drivers and motives of digitalization, as well as the tendencies to [among others] further concentrate power and restructure the dynamics of social classes in Africa.

KEYWORDS: Digital agriculture; development agencies; African development; smallholders; rural livelihoods

1. Introduction
Disruptive digital technologies are promoted by developmental organisations as tools that will lead to new development opportunities in Africa. But what effects are these technologies actually anticipated to have on smallholders and development in general? Since the contested successes of the ‘Green Revolution’ (Juma, 2015; Patel, 2013), mechanization, biotechnology, hybrid
seeds, irrigation, biotechnology, synthetic fertilizers, and recently Information and Communication Technologies (ICTs) promoted to transform livelihoods and reduce poverty in Africa. Under a pretext of a ‘New Green Revolution’ or ‘African Green Revolution’, these ‘transformational technologies’ have centred development practices and research on rural development, poverty reduction and economic development (see Dawson, Martin, & Sikor, 2016; Ejeta, 2010; Otsuka & Larson, 2016; Scoones & Thompson, 2011). ICT promotion in agriculture, as a complementary technology to the earlier Green Revolution innovations in Africa, continues unabated (Munyua, 2007).

For over a decade now, the ICTs agenda continue to expand into a digitalization of agriculture (digital agriculture) programming, where ICT in agriculture, e-agriculture, Mobile-Agri, and big data in agriculture are used to describe the application of ICTs in agri-food systems (see Ajani, 2014; Akullo & Mulumba, 2016; Alabi, 2016). Whatever terminology is used, digital agriculture is at the nexus of smart machines and data-driven agriculture, where digits [transmitted as 0s and 1s] direct agricultural activities and practices to optimize operations (Zhang, Wang, & Wang, 2002). Digital agriculture in Africa, therefore, includes mobile-enabled technologies that provide information to farmers to sophisticated automated systems where data-informed commands are given to self-controlled and intelligent devices to carry out activities (Technical Centre for Agricultural and Rural Cooperation [CTA], 2019; Emeana, Trenchard, & Dehnen-Schmutz, 2020; Olaniyi, 2018). Specifically, digital agriculture is the increasing application of digital tools such as mobile phones, robotics, drones, blockchains, cloud computing, and artificial intelligence to generate and manage data and the services and solutions (products that utilize digital tools and systems) for agricultural processes. Digitalization’s focus moves beyond the direct deployment of novel digital technologies to include creating services and solutions to overcome diverse agri-food challenges. Hence, development agencies increasingly drive attention towards African agricultural digitalization (Kim, Shah, Gaskell, Prasann, & Luthra, 2020). And while digitalization may be promising, the literature on the subject is still scanty, fragmented, and lacks cohesive narratives and critical engagements of potential impacts in the African context.

In this paper, I offer a birds-eye view on the narratives of development agencies on what might be the effect of DA in Africa while also exposing the anticipations to potential political-economic perspectives to explain why identified effects attained relevance. I show that digitalization is anticipated to provide wide-range benefits to transform smallholder practices, rural livelihoods, and stakeholders’ activities across the agricultural value chain; however, the connectivity/digital divide, adoption and scalability, and enabling environment must be ensured. To underline this argument, I use the results to present Seven anticipated effects of DA in Africa, while the discussions probe why the themes emerge. The discussion specifically describes digitalization as an emergent (uncritical) pillar of the African agricultural transformation and highlights who and what drives the digitalization and narratives while moving the discussion forward with two political economy issues to start critical conversations. Three Practical considerations for success of DA in Africa are then presented before a conclusion that reflects on the future of digitalization and areas for further research.

2. Political economy and technology promotion in agriculture in Africa

Scholars of African agriculture have long employed political economy to discuss how the differential composition of power in African society is shaped and how that, in turn, influence the wellbeing of different groups, including smallholders, rural people and marginalized groups (see Bates, 1987; Bates & Block, 2009). It probes how historical, structural, institutional, and power dynamics of economic activities and behaviours re-shape societal structures and processes (Bates, 1987; Boner, 2018; Friedmann, 1993). Specifically, the class (re)structuring processes and power dynamics within Africa’s agricultural development is of concern. Within such
discourse is how technology diffusion and interventions emerge and their consequential influence on diverse peasants and smallholders’ socio-economic conditions (Nyantakyi-Frimpong & Bezner Kerr, 2015; Shilomboleni, 2020). Central to the literature is the strong critiques of technology diffusion processes in the region, primarily through the attempts to propel a ‘Green Revolution for Africa’ by prescriptions of biotechnology, fertilizers, and high-yielding seeds. Critiques argue that agricultural technologies are promoted to serve the economic and political interest of neoliberal agendas without careful consideration of their potential adverse impacts (Braimah, Atuoye, Vercillo, Warring, & Luginaah, 2017; Schurman, 2017; Vercillo, Kuuire, Armah, & Luginaah, 2015). The literature on the political economy of agricultural technologies in Africa is enormous (see, for examples Berhanu & Poulton, 2014; Nyantakyi-Frimpong & Bezner Kerr, 2015; Scoones & Thompson, 2011); any attempt to fully engage such literature would amount to duplications without adding value to this paper. Hence, I choose to focus on why the approach is appropriate for discussing digitalization’s early narratives.

First, as already mentioned, political economy is extensively used in understanding agricultural dynamics in agrarian societies, including in Africa (Bates, 1987; Birner & Resnick, 2010). Hence, applying it to digitalization builds on an earlier analysis of agricultural change in the region. Secondly, because of its ability to critically engage processes, political economy offers a more in-depth analysis of why and how interests interact for certain things happen the way they do and their potential impacts on social structures (Boner, 2018). Thus, adopting a political economy lens will allow for the examination of the motives behind narratives identified while contemplating the potential consequences of such narratives and their supporting interventions. It will likewise allow for injecting much-needed critical perspectives into early discussions of agricultural digitalization in Africa.

2.1. Overview of digitalization in African agriculture

Digital agricultural tools, described as a part of disruptive Agri-technologies (Kim et al., 2020), are increasingly evident across agriculture in Africa. Though their spread have been uneven, Kenya, South Africa, Nigeria, and Ghana boast the region’s highest disruptive digital agricultural services (ibid). Digital agriculture in Africa is characterized, and largely driven by private actors, from small start-ups (e.g. Trotro Tractor in Ghana) to large multinational corporations (e.g., Microsoft’s Farmbeats, Alibaba) that provide multiple solutions within single platforms (Birner, Daum, & Pray, 2021).

According to the Technical Centre for Agricultural and Rural Cooperation (CTA) (2019), one of the leading development agencies for digital agriculture in Africa, there were more than 390 digital agricultural service providers in Africa in 2019, with over 70 per cent established in the last decades. By January 2020, the GSMA AgriTech programme tracked 437 digital agricultural services in Sub-Saharan Africa (GSM Association, 2020a). A World Bank scoping of the sector identified four key drivers that digitalization (among others) in Sub-Saharan Africa: (1) low-cost and pervasive means of connectivity, (2) adaptable and more affordable tools, (3) advances in data analytics and exchange, and (4) increasing demand for contextualized agricultural solutions (Kim et al., 2020, p. xiv). However, the increasing availability of mobile phones and internet services are the main drivers, especially in rural Africa. In Sub-Saharan Africa, despite the digital divide and inequalities within and among countries, mobile and internet penetration is growing steadily. According to the GSMA (2020b), in 2019, mobile subscriptions were about 477 million (accounting for 45% of the population), increasing from about 37 million in 2015. This penetration is expected to reach ‘reach half a billion subscribers in 2021 and 50% subscriber penetration by 2025’. Likewise, smartphone adoption is rising rapidly in the region, and will reach 50% of total connections in 2020—cheaper devices are expected to double penetration in the next five years as well (ibid). Hence, by 2019, the diverse digital services were estimated to have covered more than 33 million smallholders (Technical Centre for Agricultural &
Rural Cooperation, 2019). With the wide range of DA services, farmers receive advisory and information services, market linkages, supply chain management services, financial access, and macro agricultural intelligence solutions. The basic unit is leveraging big data to provide information and knowledge to solve some of the long-standing challenges in agriculture in Africa.

3. Methodology

This paper is based on document analysis that involved the careful consideration of a set of documents [printed and electronic] to apply their information to answer specific research questions. It involves reading and interpretation to gain meaning from documents (Bowen, 2009; Wood, Sebar, & Vecchio, 2020). I first defined the focus to explore and understand the current narratives on digital agriculture in Africa and focused this paper on the documents produced by development agencies due to the decisive role and the power of their discourses and activities in shaping the trajectory of the digital agricultural in Africa (Babcock, 2015; Technical Centre for Agricultural and Rural Cooperation [CTA], 2019; Emeana et al., 2020; Olaniyi 2018). The data was retrieved through a series steps (see Figure 1) from google, google scholar and other platforms (websites) using specific search terms (see Table 1).

The search process was targeted and only included documents published by international development organisation or produced through their support; 75 documents were retrieved for further consideration through title consideration of search returns. The process was supported by a targeted search for documents from websites of known development agencies and NGOs in Africa’s digital agricultural ecosystem, including Food and Agricultural Organisation

![Figure 1. The document review process.](image-url)
(FAO), CTA, African Green Revolution Forum (AGRF), Alliance for a Green Revolution in Africa (AGRA); World Bank; USAID, DFID, GIZ; and CGIAR. An additional 10 documents were added through this process. Of the 85 documents fully read for inclusion, 46 articles met the inclusion criteria of being (1) published from 2010; (2) in English; (3) addressed newer spectrums of digital agriculture conceptions rather than just older ICTs in agriculture rhetorics (4) and (5) directly addressed digital agriculture in Africa or speak to digital agriculture broadly with reference to Africa (see Supplementary Appendix 1). The documents were supplemented with information from websites from identified development agencies driving Africa’s digital agriculture ecosystem. All documents included in the review were available online. However, the limited availability of agency produced documents from Africa on the web could affect this review. Likewise, the biases of the researcher and the available documents online could favour certain type of digital technologies in this analysis. Also, since the researcher seeks to explicitly assess digital technologies broadly (emphasising the direct usage of newer terminologies of digital, smart, precision, etc), earlier ICTs interventions which implicitly refers to digital processes could be excluded. Likewise, using only online available documents could exclude certain narratives unavailable in web sources.

Retrieved documents were uploaded to Nvivo 12 for analysis, using content and thematic strategies. Each document was carefully scanned first to draw broader themes, as expected in content and thematic analysis (Vaismoradi & Snelgrove, 2019). A detailed reading followed this process to draw sections that speak to ‘what impact would digital technology in agriculture have on African development?’ . The nodes function in Nvivo 12 was used to code sections in documents. The coding provided the needed information to draw segments and quotes from the documents related to specific themes that echo particular discourses around digital agriculture. Each node was later reviewed and harmonize to remove duplications while combining nodes with similar issues. Two broad themes of anticipatory benefits and practical considerations with many sub-themes under each category emerged from the review of data. The approach allowed for emphasis on the contents of the documents and the presentation of what is implicitly or explicitly said about the digital transition (Assarroudi, Heshmati Nabavi, Armat, Ebadi, & Vaismoradi, 2018) in Africa. The thematic analysis allowed for drawing out key areas and topics evident in the literature (Nowell, Norris, White, & Moules, 2017; Vaismoradi & Snelgrove, 2019).

4. Results

The results presents the narratives of the expected effects of digitalization in Africa. The section outlining the seven key impacts of digital agriculture and their pathways to change (See Table 2 and supplementary Table 1 for details) on African development as revealed through the document analysis.

4.1. Key expected effects of digitalization in Africa

The seven fundamental thematic areas on how digital agriculture will affect development in Sub-Saharan is presented in Table 2.
4.1.1. **DA will bridge agricultural information and knowledge gaps.** One way digital agriculture is expected to affect development pathways and processes in Africa is through the provision of ‘….accurate, timely, and location-specific price, weather, and agronomic data and information ….’\(^{14}\), p. 7. Bridging the information gaps and increasing access to valuable agricultural knowledge is a crosscutting issue in the narratives, including the CTA and FAO documents. In essence, as digital agriculture produces and relies on quality data to gather information, it is anticipated it will improve decision making, enhance practices, enable innovative services and enrich communication amongst agriculture sector stakeholders. For instance, ‘mobile-based advisory services can provide much needed information on agricultural best

| Table 2. Anticipated benefits for digital agriculture transformations | Supporting quotes |
|---------------------------------------------------------------|-------------------|
| **I DA will bridge agricultural information and knowledge gaps** | ‘Key benefits of digitalization include greater access to information ….’\(^{3}\), p.1 |
| **II DA will lead to productivity gains and greater on-farm efficiencies** | ‘In fact, one of the greatest opportunities for increasing agricultural productivity globally is marrying plant science with improvement in farming practices through precision agriculture’\(^{4}\), p.1 |
| **III DA will lead to food and nutritional security in Africa** | ‘Increased access to and adoption of new technologies can address the challenges of food insecurity from multiple fronts, including increasing access of households to non-farm income and enabling households to better gauge the safety, quality, and nutritional value of their food’\(^{5}\), p.135 |
| **IV DA will facilitate Climate change/environmental sustainability and resilience** | ‘D4Ag has likely already helped reduce some effects of climate change by improving resource use (e.g., soil and water conservation due to advisory services), building resilience (e.g., via digitally-enabled agri-index insurance)’\(^{7}\), p.7 |
| **V DA will create employment opportunities and empower youth** | ‘The Internet offers concrete hopes for innovation and prosperity and when applied to agriculture may free the sector of its stigma - drudgery and poor income prospects - and make it more attractive for young people.’\(^{9}\) |
| **VI DA will facilitate gender and women empowerment in agriculture** | ‘Women play a core role in agriculture but underperform in terms of productivity largely because they lack access to resources such as finance, skills training, and information services. Mobile technology could bridge this gap, helping to: … Increase productivity and incomes of rural women and their households • Empower rural women in their households and communities and • Improve livelihoods overall for underserved communities’\(^{11}\), p.3. |
| **VII DA will ensure rural livelihood improvements and resilience** | ‘An increasing body of evidence highlights the potential of digital technologies to improve the lives of poor people’\(^{12}\), p.20 |

‘mobile-based advisory services can provide much needed information on agricultural best
practices, market prices and weather forecasts'\textsuperscript{15} p. 15. Specifically, mobile advisory services (e.g. Arifu, Farmline; Zowasei, Usomi, FARMSMALL, ESOKO, lima Links, etc.), which provide farmers with agronomic advice and other information, are central to enhancing practices and overcoming some structural barriers to agriculture in the region\textsuperscript{16}.

However, the mere presence of services and information cannot guarantee access and usage among smallholders, as adoption is equally critical for any impact. Likewise, socio-cultural beliefs may undermine the value of digital information; because farmers are likely to be indifferent with new knowledge and practices emanating from digital tools. Smallholders are also likely hindered in their abilities to access digital information due to socio-economic and institutional conditions, for example, lack of access to mobile phones.

4.1.2. DA will lead to productivity gains and greater on-farm efficiencies. Stakeholders like CTA, FAO, AGRA and World Bank all consider digital tools, services and solutions as the levers to change farming and agriculture towards more productive practices. For instance, precision farming, a variant of digital agriculture that aims to use the right inputs at the right time, is presented as essential 'for smallholder farmers in West Africa to enhance crop productivity'.\textsuperscript{17} by minimizing decision errors. Specifically, all development actors are of the view that offering farmers tailored agronomic advice and connecting them to inputs through digital tools would propel efficiencies across different farming models.

However, the narratives, for instance, CTA, also contemplate the current shortcomings to achieving the needed productivity change. The inability to prove the benefits of digital tools to farmers, as yet, hinder their use and potential application of agronomic advice. Likewise, any discussions of productivity must include the ability of smallholders to utilise digital tools, as well as creating digital solutions that are sensitive to the specific needs of the diversity of farmers in Africa. The ability of digital tools to create such efficiency impacts also depends on providing smallholders the needed structural and capacity supports to fully appreciate and perform digital farming.

4.1.3. DA will lead to food and nutritional security in Africa. Digital agriculture is also presented as a pathway to ensuring food and nutritional security in Sub-Saharan Africa through the production of more food and increasing access of people to healthy foods. Sub-sahara has been the most food-insecure region globally in the last decade. One approach where organisations, example AGRA, find value in mitigating the situation in the region is through the deployment of digital technologies. The 2019 African Green Revolution Forum annual meeting was themed: ‘Grow digital: Leveraging digital transformation to drive sustainable food systems in Africa.’\textsuperscript{18} The theme and the conversations that ensued during the program underscore the anticipated role of digital technologies in promoting food security in Africa. Also, evident in this narrative is the impression that 'improved access to health and nutritional information through digital technologies would contribute to the reduction in the prevalence of hunger amongst the poor'\textsuperscript{19}, p. 135. For example, Nutrition programs—mobile-based delivery of food and nutrition information to households has been used in some parts Ghana and Tanzania to promote food and nutritional behavioural changes (see also, Barnett, Faith, Mitchell, & Sefa-Nyarko, 2019).

The ability of digitalisation to promote food security may have some merit, but such claims could undermine the different experiences of food insecurity in Africa. The causes of food insecurity on the continent is far and wide, including poverty, climate change, wars, and policy failures. Hence, claims of digitalization promoting food security, though partly true, appear reductionist and may obscure some of the true drivers of the phenomenon.

4.1.4. DA will facilitate Climate change/environmental sustainability and resilience. Climate change resilience and environmental sustainability is one of the anticipated effects of digitalization in African agriculture. As the World Bank’s ‘Scaling Up Disruptive Agricultural
Technologies in Africa report\textsuperscript{20}, p. 8 puts it; digitalization would ‘improve farmers’ decision-making through accurate, timely, and location-specific price, weather, and agronomic data and information that will become increasingly important in the context of climate change.’ Likewise, the ‘Data-driven solutions for Africa: Using smart tools to combat climate change’\textsuperscript{21} outlines the many ways digitalization will respond to climate change, including digital imaging tools delivering stress-tolerant maize, faster and for less,disease tracking and response, bringing the data revolution to smallholder farmers, and making use of digitized genetic diversity (p. 3). Precision-based technologies like drones, satellite systems, and AI, as well as mobile advisories, are at the centre of the climate and environment narrative.

However, limited coverage of current precision interventions limits any meaningful judgements of this claim. Also, while digital technologies could truly help smallholders and rural people adapt to changing climate, discussions must be situated on the local challenges driving unsustainable smallholder practices, such as declining soil fertility and traditional beliefs.

4.1.5. DA will create employment opportunities and empower youth. With about 40 per cent of Africa’s teeming youth engaged in agriculture (Sakho-Jimbira & Hathie, 2020), digitalization is expected to offer ‘an opportunity for Africa to leverage its youth bulge’\textsuperscript{22}, p. 5; because ‘D4Ag solutions bring clear benefits, some of which are particularly relevant to youth’\textsuperscript{23}, p. 114. The many youth-based projects, primarily supported by some development agencies, shows the anticipations intersecting youth, agriculture and ICTs in Africa. For instance, The African Green Revolution Forum and partner organizations established the Generation Africa to ‘strengthen the ecosystem that supports agripreneurship,’ particularly for youth\textsuperscript{24}, p. 31. Youth digital solution competitions like GoGettaz\textsuperscript{25} and Disruptive Agricultural Technology (DAT) Challenge and Conference\textsuperscript{26} are further testament to the anticipated youth employment and empowerment effects of digital transformation in Africa.

However, countries may still face challenges attracting the youth into primary agriculture without government support and engagements. Youth interest in agriculture may be rising, partly from application of technologies, but claims of development actors must not be detached from poor access to internet, telecommunication networks in much of rural Africa. Likewise, the low education due to decades of inactions in rural areas may also limit ability of rural youth to avail to the opportunities of digitalization.

4.1.6. DA will facilitate gender and women empowerment in agriculture. With women being central to agriculture in Africa, digital technologies are anticipated to empower women and help bridge gender gaps that characterize agriculture in Sub-Saharan Africa. In a recent piece by the Head of Gender and Inclusiveness at AGRA, she noted that ‘What had previously been a growing but limited shift towards the use of digital tools and technologies for food production and business has become a lifeline in the face of market restrictions, food insecurity and lockdowns. And among the biggest winners have been women’\textsuperscript{27} She added that the pandemic had driven the number of African women using digital services, including social media, to about 90%. Therefore, digital agriculture has the potential to ‘level the playing field for women in Africa’ with opportunity for empowerment and inclusively. The sentiment in the piece is evident in the development community, with AGRA and GSMA highly optimistic about the prospects to help overcome some of the gender barriers that limit women access to productive resources like markets, finance, mechanization, and land.

Nonetheless, the ability of digital tools to empower women will depend on the specific local context in Africa. For most parts, gender gaps are culturally driven, and access to digital services would likely be influenced by similar factors. Hence, the empowerment potential of digital tools must be rooted in cultural conversations, rather than treating digital tools as given. Women access to mobile phones and education (ability to use phones) would be critical in any such discussion.
4.1.7. DA will ensure rural livelihood improvements and resilience. Digitalization could provide an impetus for rural livelihood transformation, the narratives have argued. The increasing access to digital tools, and information, for the rural poor is viewed as a step towards opening more livelihood opportunities, including improvements to rural finance schemes through mobile payment systems. Likewise, targeted information could help rural people make effective decisions to cope with economic and environmental changes that affect their livelihoods while also allowing for diversification of rural economic activities. By opening opportunities with new services and access to information, digitalization may become a pathway to raise rural incomes and reduce poverty. Early examples of digital farmer advisory services documented by the ‘Digital Agriculture in Africa Report’ are already making inroads to this regard. However, such effects may vary across regions and classes in rural Africa. The impact of digitalization on rural poverty could be uneven; hence, discussions need to be situated on how such effects will affect different groups, such as women, peasants, illiterates, youth, and other marginalized classes.

5. Discussion

5.1. Digitalization as an (uncritical) emergent extension of the African Green Revolution?

In agriculture, investments in digitalization could be a game changer in boosting productivity, profitability, employment, resilience to climate change and more recently COVID specific responses. A digitally-enabled agricultural transformation could help achieve meaningful livelihood improvements for Africa’s smallholder farmers and pastoralists. It could drive greater engagement in agriculture from women and youth and create employment opportunities along the value chain. All this is driven by the fact that digitalization for agriculture has the potential to enhance efficiency, inclusiveness, and risk reduction in a combined way.

The extract above encapsulates the anticipated impacts of digitalization revealed in the results. Development stakeholders, irrespective of their area, focus on how digitalization could solve some of the challenges in their areas of interest, such as ‘the agricultural knowledge gap, lack of access to finance, lack of access to markets and climate change.’ (GSM Association, 2020a, p. 14), food insecurity, and empowerment of women. Due to the change and impact focus of these agencies, the documents reviewed shows largely commonalities in outlook, rather than conversations around diverse effects or local political-economic considerations. Thus, development agencies are convinced that ‘Nowhere is the potential of disruptive technologies [including digitalization] in agriculture more promising than in Sub-Saharan Africa … ‘ (Kim et al., 2020). In fact, ‘digital, data-driven and tech-enabled solutions’ is thought to have the ability to ‘trigger a new green revolution for Africa’.

Thus, the potential effects of digitalization, as presented in the narratives, extends and entrench the pro-poor Green Revolution rhetoric of ‘technology saviourism’ in Sub-Sahara, which has earlier resulted in mechanization, biotechnology, hybrid seeds, synthetic fertilizers, and later ICTs promoted to overcome these longstanding challenges under the pretext of a ‘new Green Revolution for Africa’ (Dawson et al., 2016; Mosley, 2002; Nin-Pratt & McBride, 2014; Vercillo et al., 2015). This technocratic outlook by agencies are also evident in the extended literature on ICTs and emerging scholarship on digitalization in Africa. Hence, digitilization in Africa continues the path of the Green Revolution for Africa, at least in rhetoric. However, the potential for digitilization to entrench green revolution outcomes is still debated in the literature. Weersink, Fraser, Pannell, Duncan, and Rotz (2018) suggests that DA is fundamentally different than Green Revolution in that DA at some point will allows for management of individual plants/animals in near real time. Hence, Weersink argues that DA and GR are fundamentally different types of technology in that one scales up and out (GR) while the other (DA) scales down and in. Clapp and Ruder (2020) by contrast, argue that power, money and politics
mean that the same dynamics will play out with the DA revolution as did the Green Revolution. In the absence of a totally different policy regime, they think that the negatives of the GR are bound to repeat themselves. Understanding the narratives of digitalization could help extend these debates.

5.2. Who and what drives agricultural digitalization and narratives?

The neoliberal incursions into the food system and political-economic perspectives offer a starting point to unpack the drivers of the technocratic optimism effects surrounding digitalization. The narratives’ technological saviorism exhibits neo-liberalization traits that have engulfed agri-food systems in the last three decades (Busch, 2010; Carolan, 2018; Moseley, Schnurr, & Bezner Kerr, 2015). Four emerging features direct to this conclusion: (1) The limited engagement of governments in African digital agriculture space (2) allows for enthusiastic interest from multinational corporations, donors, and philanthropies who take lead roles, financially and technically, to (3) support plethora of private technology services providers and new actors to emerge in the agri-food system. Thereby (4) integrating smallholders into neoliberal market structures through digital platforms and services.

As the World Bank noted, ‘the key institutional investors in Sub-Saharan Africa are a mix of venture capital and development partners and include the international Finance corporation (IFC), the Melwater Foundation, Ahl venture partners, the Global System for Mobile communications Association (GSMA), and the US Agency for International Development’ (Kim et al., 2020, p. 23). Thus, digital technologies are predominately dominated by private and corporate actors, agribusinesses, supported by international development entities (see Birner et al., 2021 for extensive discussion on this). For example, in 2019, Google established the first AI lab in Ghana, with agriculture analytics a central piece of their work. Microsoft cooperation has also entered into the space with Microsoft’s Farmbeats in Kenya. Likewise, Chinese e-commerce giant Alibaba is noted as one of the big players to look out for in Africa’s digital agriculture ecosystem, so is IBM and John Deere International (Technical Centre for Agricultural and Rural Cooperation [CTA], 2019). These entities extensively shape the said narratives and entrench the set of ‘self-evident truths’ of their neoliberal values that promises transformations and efficiencies to smallholders and rural people. Hence, the emergence of these positive-spin themes are no surprising because development agencies and agribusinesses have worked in these areas (e.g. food security, women empowerment, livelihood resilience, etc.) with support from donors for decades, carrying same rhetorics of transformations and continually are likely to appropriate innovations in ways that further their interests and activities around the issue areas. More importantly, these issue areas offer strong appeal to aid and donors in African development and poverty reduction space. Thus, as with the older GR rhetoric, the romanticized framing of digitalization as pro-poor allows it to gain legitimacy in the development circles (Ignatova, 2017). And with legitimacy comes entrenchment of the activities and interests of influential international and local proponent organizations that drive such activities in Africa.

Also, digitalisation of agriculture sits well within older donor-driven (e.g. World Bank) national digital economy interventions in Africa (see African Union Commission & OECD, 2021; Azu, Jelivov, Aras, & Isik, 2021; Korovkin, 2019). For most parts, these initiatives, such as the World Bank supported African Digital Economy Iniative, moved to digitally enable people to ensure access to services (World Bank, 2021), but also to allow governments to generate revenues. Digitalization of agriculture sits within such initiatives, showing more similarities than differences to such efforts. For instance Bill Gates, a lead sponsor of the African Digital Thinking Iniative, expressed that, like other sectors, digitalization ‘might also bridge the gap between the formal systems of commercial agriculture and urban food markets, and the informal systems surrounding smallholders and rural trade’ 29, p. 90. Just as earlier digital interventions in
finance, agricultural digitalization follows plans to formalize smallholders. The creation of
digital identities for smallholder, which is mostly the first step to digitalization, could be viewed
as an avenue to bring out of reach smallholders into formal systems; thereby increasing their
access to services or governments and private sectors' access to the farmers. Such identities are
presented as pathways to bringing support to smallholders, but they could also be leveraged
-may be in future- as revenue engines. However, the private drive of agricultural digitalization-
thus far- also makes this new strand of digital economy different from the older efforts, because
the goal of such entities is mostly to make profit through competitive service provision rather
than purely taxation purposes. Nonetheless, putting private actors at the centre of digitalization
furthers the declining rural agricultural finance and government disinvestment shaped by shifting
interest of key actors (Odusola, 2021). Such disinvestments put smallholders at the mercies
of agribusinesses, which has resulted in African states playing declining roles in provision of
public goods.

5.3. Two Political-economy areas to start critical conversations?

While the transformations, optimism and saviorism in the narratives are valid, to some extent,
as Scoones and Thompson (2011, p. 14) argues, such technological interventions are unsustain-
able ‘without addressing the politics of innovation – and with it, the interests, values and choices
that drive agricultural technology research and development.’ Elsewhere, such optimistic yet tilted
narratives surrounding digitalization of agriculture has birthed a young but growing body of
scholarship on the potential social implications of digital technologies—but mostly focused on
the global north (see Carolan, 2018, 2020; Fraser, 2018; Rotz et al., 2019). This body of work
emphasizes the urgency to explore the larger political, economic, ecological and material moti-
vations and interests that shape technological interventions, including digital agriculture.
Hence, I draw on this scholarship to open discussions in two areas for potential political-
economy considerations of digitalization in African agriculture.

First, it is important to question the power dynamics that may emanate from digitalization in
agriculture. As already mentioned, agricultural digitalization in Africa is driven by private enti-
ties (see Birner et al., 2021), with support from external actors. While the narratives position
these neoliberal incursions in a positive light—as opportunities for investments—critical ques-
tions on their impacts on smallholders and rural economies’ survival must be asked. As copro-
rare entities take lead in app creation and knowledge generation, the digital space may impose
external knowledge which potentially could threaten local knowledge structures, as well as the
power they engender. As earlier technologies (seeds, agro-chemicals) have shown, a lack of crit-
ical examination could entrench corporations’ power and expose smallholders to the rigours
of the neoliberal market system (Amanor, 2009; Moseley et al., 2015). Hence, market-oriented
digitalization, as evident now, could deepen the neoliberal markets induced agrarian crises in
Africa as farmers’ dependencies on external actors for knowledge and resources expand. Hence,
it’s is critical to ask questions on how digitalization of agriculture will re-shape knowledge-
defined power structures in rural smallholder systems.

Secondly, digitalization may also raise concerns on the potential for class (re)structuring
associated with technology diffusion. As Bernstein (2010) has noted of class formation, the
introduction of any new resources (e.g. inputs) into agrarian systems is largely influenced by
the power of access, in terms of rights of ownership, distribution, utilization and control.
Hence, as with earlier GR technological diffusion, uneven impacts of DA on farming models,
rural/urban areas, cropping systems and genders groups would potentially create new layers/
classes of ‘haves’ and ‘have nots’. The adoption, scaling, and sustainability of services in the
region is still limited by many barriers, including resistance to change (see Duncombe, 2018;
Emeana et al., 2020; Hidrobo, Palloni, Aker, Gilligan, & Ledlie, 2020). Part of the problem
emanates from socio-economic, political, institutional, and cultural barriers that limit certain
groups’ ability to benefit from technologies (Juma, 2015). For instance, the GSMA (2019) estimates that Sub-Sahara African women are 15% less likely to use mobile phones than men and 41% less access to and use of mobile internet. With mobile phones and the internet at the centre of the digital transformation in Africa, inequalities in access (e.g. across geographies and genders) would undermine the anticipated impacts. Without sensitivities to class differences in rural Africa in the design and implementation of digitalization, benefits risk being exclusionary, a concern already manifesting in this innovation space. For example, although women make up nearly 50% of agricultural producers in Sub-Sahara Africa, early statistics show they constitute only about 25% of the user base of digital solutions in Africa (Technical Centre for Agricultural and Rural Cooperation [CTA], 2019). With high cost and uneven access, digitalization could entrench older classes and add newer classes as people with access enjoy certain exclusionary benefits. The uneven access to technologies, services and connectivity necessary for inclusive future of digitalization in Africa may also create unfair disadvantages for certain groups and open class differentiation spaces for some farmer groups.

6. Three key practical considerations for success of DA in Africa

Despite the strong emphasis on prospects and anticipated benefits, the narratives also clarify that some practical considerations are needed to facilitate the digitalization process. These considerations, when carefully enacted, could help address the political economic challenges of early digitalization.

First, the digital divide or inequitable access to digitalization must be bridged for digitalization in Sub-Sahara Africa to thrive. The ‘African Agriculture Progress Report’ 2019 emphasized connectivity and the digital divide as one of the three constraints to the continent’s digital agriculture future. The document’s rhetoric is shared by many organizations working in the digital agriculture ecosystem, including The Digitalisation in African Agriculture Report, 2018–2019. For example, of the 25 worst-connected nations globally, 20 are in Africa, where only about 22 per cent of households in these regions have access to the internet—with scarcity partly accounting for high prices. With such barriers to access, digitalization could disproportionally affect different classes, with the rural population, women, landless poor likely to be excluded. Hence, efforts to increase access to different groups would be needed to ensure equity of impacts. Bridging the digital divide could make the anticipated impacts inclusive to disadvantaged classes. It must however be noted that some progress is being made in this regard: ‘…Today, more than 1.2 million kilometres of Internet cables run across the oceans’ floors, but just 20 years ago, Africa was completely disconnected’, p. 130. There is a huge potential to leverage the growing internet and the ubiquity of mobile phone penetration mentioned earlier to develop digital solutions to reduce the digital divide and ensure digitalization does not create undesirable class re-structuring.

Secondly, the adoption, scalability and sustainability of digital solutions is critical to the success of agricultural digitalization in Africa, as well as making impacts inclusive. In this case, scalable describes the ability of solutions to expand their reach and serve a broader clientele, while sustainability is how services can maintain operations on a long-term basis. Despite the high penetration of digital agriculture in the last decades, the sector is still primarily driven by isolated donor-supported solutions that become hard to sustain after project funds run out. Part of the issue is attributable to challenges in obtaining farmers’ willingness to adopt and pay for digital solutions—after donor-support subsidizations run out. As the CTA reports that, ‘while D4Ag’s reach figures are impressive given the relative nascence of the space, use remains low’. Local political-economic factors are at the centre of the adoption and scalability challenge. For example, among other things, poor network, limited phone usage, illiteracy, poverty, coupled with skepticism of new innovations continue to undermine adoption and use of digital tools among many rural smallholders (Etwire et al., 2017; Kim et al., 2020). Hence, tackling this consideration would require addressing local political-economic factors that undermine sufficient proliferation.
Specifically, governments and private actors must work together to provide rural education, as well as create opportunities to improve livelihood activities to enhance abilities to pay. Such efforts would go a long way to create classes of people ready to take advantage of digitalization.

Thirdly, and more importantly, an enabling environment that provides the foundation on which digital agriculture will thrive in Africa must be consciously pursued by all stakeholders. The CTA’s Digitalization in Africa report comprehensively describes the essence of this practical consideration:

‘The speed and effectiveness at which an agricultural system transforms to become more data- and technology-driven is largely dependent on an enabling institutional environment that allows and encourages data and information to be managed, used, shared and exchanged effectively, equitably and fairly. This environment spans governments, farmers’ associations, financial and research institutions, and training centers, policies, regulatory frameworks as well as information and communications-related infrastructure. Crucially, enabling policies are required that allow, and in fact, catalyze investment in the backbone infrastructure that will permit rural populations to overcome their geographic, social and economic isolation’39, p. 25.

The extract alludes that the enabling environment is needed to cushion the digitalization agenda across scales, while maximising the impacts on rural classes. Identifying the current constraints to enabling digital solutions, policy regulations necessary for digitalization, and structural changes needed for successful digital agricultural solutions is crucial for targeting. Yet, without an enabling environment in policies, infrastructure, capabilities, and business culture, digital solutions and services may find it difficult to sustain operations, while farmers also struggle to avail to services.

The three practical considerations highlighted from the narratives show that the anticipation of crosscutting benefits—which the narratives are heavy on—are not given. Achieving the full potentials of digitalization and minimising the political-economic challenges would require further measures to overcome barriers currently evident in the region.

7. Conclusions and ways forward

While digital technologies may transform agricultural and rural development in Africa, introducing these novel innovations entails challenges, limitations and risk (Duncan, Abdulai, & Fraser, 2021). Hence, I argue, through political-economic perspectives, that though the narratives are justifiably optimistic, they uncritically entrench and extends the pillars of the earlier Green Revolution efforts to transform and modernize smallholders without due considerations to potential power and class re-structuring. Yet, digitalization’s full potential would be unattainable without careful consideration of the political-economic implications. Digital agriculture in Africa is at a nascent stage, but it opens a research space in desperate need of critical engagements that explore the dynamics between these novel digital tools and African societal elements, such as smallholder systems, farming life, rural structures, livelihoods, power relations, and economic conditions. Likewise, further research is needed on the dynamics of digitalization among rural smallholders, including how farmers engage with tools and services in diverse contexts, what and why different groups participate or otherwise, and the determinants of engagement in digital agriculture. It is only through such considerations are we able to unequivocally understand the true nature and effects of digitalization in the region.

Also, creating an inclusive enabling environment is critical to reaping digitalization benefits while minimizing the potential risk and inequality concerns. While governments are just beginning to realize the potential for digital agriculture and following that with efforts, their role in the digital transition is almost non-existent at the moment (Kim et al., 2020). Without the needed policy and regulations, connectivity infrastructure, and supporting infrastructure like transportation, the potential unequal consequences on underserved groups, such as women, youth, rural smallholders, cannot be minimized. Such enabling environment would also help
the private sector fully take advantage of the emerging opportunities inclusively. Likewise, it could reduce the current fragmentation and limited scalability, sustainability in the industry characterized by infant start-ups whose desperation to survive makes them susceptible to corporate control and half-baked solutions insensitive to user needs. Smallholders, who form most farmers in Africa, must be actively centred on creating the enabling environment and the solutions and services across the scale.

Notes

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4. Ibid.
5. The hidden middle: a quiet revolution in the private sector driving agricultural transformation: https://agra.org/wp-content/uploads/2019/09/AASR2019-The-Hidden-Middleweb.pdf
6. E-agriculture Strategy Guide. A summary: http://www.fao.org/3/a-i6909e.pdf
7. See note 2 above.
8. E-agriculture in action: Drones for agriculture: http://www.fao.org/documents/card/en/c/18494
9. Unleashing the potential of Africa’s youth through digital innovations: http://www.fao.org/rural-employment/resources/detail/en/c/1151913/
10. See note 2 above.
11. THE GSMA MWOMEN GLOBAL DEVELOPMENT ALLIANCE IS A PROGRAMME: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/06/Women_in_Agriculture-a_Toolkit_for_Mobile_Services_Practitioners.pdf
12. See note 6 above.
13. See note 2 above.
14. See note 1 above.
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17. Highlights From The West African Forum On Precision Agriculture: https://www.apni.net/2020/06/29/highlights-from-the-west-african-forum-on-precision-agriculture/
18. LEVERAGING DIGITAL TRANSFORMATION TO DRIVE SUSTAINABLE FOOD SYSTEMS IN AFRICA: 2019 Summit report
19. GoGettaz is an agrientrepreneurship program that allow Africa’s brightest youth to present agribusiness ideas that combine ‘technology, innovation and passion’ to food--https://vc4a.com/gogettaz/2020/
20. See note 1 above.
21. Data driven solutions for Africa Using smart tools to combat climate change: https://repository.cimmyt.org/bitstream/handle/10883/20205/60822.pdf?sequence=1&isAllowed=y
22. See note 3 above.
23. See note 2 above.
24. AGRF 2019-Report_Compressed.pdf: https://agrf.org/docs/AGRF%202019-Report%20_Compressed.pdf
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30. See note 27 above.
31. https://snv.org/assets/explore/download/Overview%20of%20D4Ag%20Sector.pdf
32. https://www.afdb.org/fr/news-and-events/press-releases/africas-agriculture-value-chains-must-go-digital-transform-production-webinar-36461
33. https://www.cnn.com/2019/04/14/africa/google-ai-center-accra-intl/index.html
34. See notes 1 and 2 above.
36. See note 2 above.
Disclosure statement

No potential conflict of interest was reported by the author(s).

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