Task Force 05
INCLUSIVE DIGITAL TRANSFORMATION

Amplifying Digitalisation for Sustainable Agri-Food Systems

Maranatha Bernard Ferryal, Policy Adviser, Indonesia Fertilizer Research Institute (Indonesia)

Nora Ndege, Research Fellow, The University of Sussex (The United Kingdom)

Laras Wuri Dianningrum, Researcher, Indonesia Fertilizer Research Institute (Indonesia)

Tamalia Nur Fadillah, Researcher, Indonesia Fertilizer Research Institute (Indonesia)

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Abstract

Ensuring food security emerges as a critical global imperative, particularly in the present and future uncertain geopolitical and economic circumstances. The contemporary agri-food systems heavily depend on international trade, forging complex distribution networks for agricultural merchandise that significantly shape global food security. Notably, the value of global agricultural exports surged to approximately three times its 2005 figure in 2022.

Ironically, agriculture has contributed substantially to greenhouse gas emissions. The issue is worsened by the lack of sustainable agricultural practices and constrained access to technology, finance and markets. Given its inherently interconnected nature, agriculture serves as a commodity that binds the world across regions, economic groups, and wealth divides. Consequently, the agri-food trade carries a notably elevated carbon footprint.

Digitalisation has emerged as a critical catalyst in transforming more environmentally sustainable agri-food system pathways. Embracing digital technologies enables farmers to optimise resources through precision farming, fostering efficiency. These solutions also play a pivotal role in diminishing information asymmetry within the system and market. However, a significant challenge lies in amplifying the adoption of digitalisation across global agri-food systems, particularly in developing countries. The leadership of the G20 in the global economy is crucial to ensure that the benefits of digitalisation in agriculture and its trade are accessible to all, leaving no one behind in this transformative journey.

Keywords: Sustainable Agri-Food Systems, Digital Innovation, Climate-Smart Agriculture

Diagnosis of the Issue

Sustainable agriculture, food security and digital transformation

Environmental factors profoundly influence agricultural production. The effects of global warming have already begun to reshape current farming practices, with forecasts suggesting a potential decrease in global agricultural capacity by -15.9% by 2080 compared to 2003 levels (Cline 2007). Conversely, the growing global population, projected to exceed 10 billion by 2050, necessitates a substantial increase in food production. However, agriculture and food security face additional challenges, including escalating unforeseen disruptions, mainly stemming from geopolitical factors. For instance, conflicts and insecurity at sea disrupt the production and delivery of fertilisers, which account for over 50% of global food production (Erisman, et al. 2008).

In fact, agriculture emits about 45% of methane (CH_4) and 80% of nitrous oxide (N_2O) globally. Over-fertilisation of nitrogen-based fertilisers and wet rice cultivation are the main reasons for these significant emissions (McKinsey & Company 2020). The adoption of climate-smart agriculture practices remains challenging for farmers in developing nations due to various constraints. These include limited infrastructure and modern equipment access, insufficient financial investment, barriers to market entry, and a persistent reliance on traditional agricultural methods. Consequently, farmers are highly vulnerable to the impacts of climate change, leading to low productivity levels that jeopardise their livelihoods. Furthermore, the lack of access to relevant information worsens the knowledge gap, compounding the challenges these farmers face (GSMA 2020).

Digital agriculture is increasingly recognised as a pivotal tool for augmenting sustainable food production, a critical need for the expanding global population. Among its merits, digital technology enhances communication among stakeholders and land users, facilitating the exchange of vital information on the agri-food value chain (MacPherson, et al. 2022). However, successful implementation requires special attention to introducing, developing, and deploying digital technology. Farmers in rural areas often need more digital access and competencies[1]. There needs to be a focus on inclusive strategies to ensure equitable benefits for all. (GSMA 2020, Ndege, Marshall and Byrne 2024).

The G20 and global agri-food trade

G20 countries collectively dominated three-quarters of global agri-food trade, with exports totalling US$18.9 trillion in 2022—an increase of 36.86% from 2012. During the same period, G20 nations met their demand by importing agri-food worth US$305 billion annually, marking a growth rate of 4.66% per year (Figure 1). Their significant involvement in global agri-food trade translates into a substantial environmental impact, with G20 countries accounting for 62.62% of global agri-food system emissions, totalling 10.16 megatons of CO2eq. These figures underscore the pivotal role of G20 leadership in shaping the sustainability of the global agri-food sector (FAO 2024).

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[1] The digital disparity between rural and urban regions in the world's poorest nations remains entrenched, showing scant improvement in recent times. Notably, this gap is exacerbated in low-income countries, where fewer than one in five individuals (17%) residing in rural locales can access the internet. Moreover, the absence of comprehensive data on ICT skills, a pivotal facilitator, impedes the evaluation of progress towards achieving meaningful connectivity (ITU, 2023).
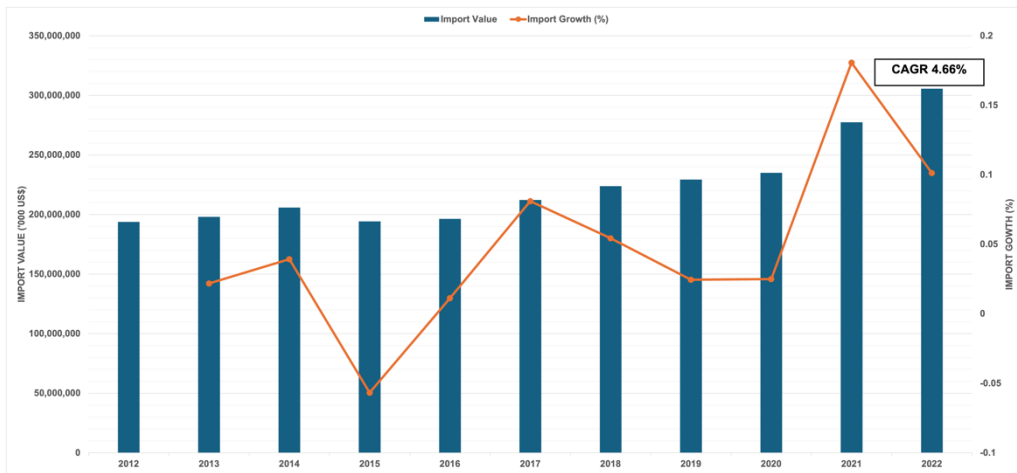
FIGURE 01 - G20 Import from the World (FAO 2024)

As Brazil assumes the G-20 presidency, it stands at a pivotal juncture to propel several pertinent issues for the Global South and bolster its international standing. It can spearhead efforts to enhance inclusivity and legitimacy in global governance. Brazil holds the potential to bridge G-7, G20, and BRICS issues by addressing pressing concerns such as inequality, sustainable development, and governance reforms. By fostering more robust connections between developed and developing nations, Brazil can play a pivotal role in advancing these shared objectives on the global stage (Garcia and Ramos 2024).

Confronted with the complex challenge of food security and sustainability nexus, the necessity for digital transformation in agriculture is undeniable. The G20 must lead in orchestrating actions to generate co-benefits for the global community. This policy brief recommends G20 to:

1. Introduce AGRI20 as an engagement group within the G20, dedicated to agri-food issues and serving as a specialised communication forum[2]. This group aims to amplify the voices of partners from developing and least developed economies and non-formal G20 actors. Emphasis will be placed on adopting digitalisation and climate-smart agriculture to address food security, sustainability, and trade.

Prolonged uncertainties from geopolitical and unprecedented challenges have been observed over the past five years (Figure 2). The scale of those uncertainties has pushed food prices around the globe. The COVID-19 pandemic threatened access to food in global and local food systems (UN 2020). The Russia-Ukraine War disturbed the trade access in the Black Sea, which eventually affected the scarcity of wheat and potassium for fertiliser (USDA 2022). Further, geopolitical uncertainty in the Red Sea has exacerbated the global food and phosphate-based fertiliser supply chain by delaying the voyaging time of shipping by 15 to 34 days (Glauber and Mamun 2024). The impact of El Nino from 2023 till the present has recently worried the rice markets and governments in Asia (Donnellon-May 2023).

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[2] Establishing engagement groups has proven instrumental in the G20's soliciting insights from non-formal institutions and enhancing the presidency's commitments in specific areas. Notable groups include STARTUP20, OCEAN20, YOUTH20, and LABOUR20. Given the evident vulnerability and complexity of agri-food systems, designating AGRI20 as an engagement group is paramount.
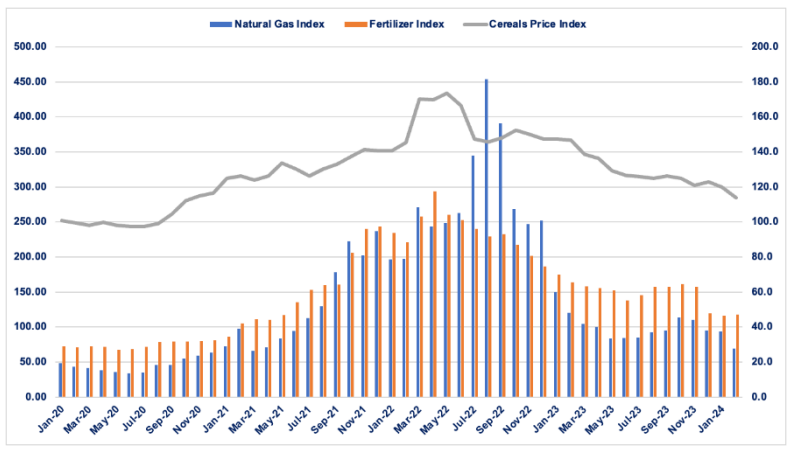
FIGURE 02 - Trend on Gas, Fertiliser and Crop Price Index (FAO 2024, World Bank 2024)

The G20 must ensure its leadership in the global economy is inclusive and promotes collective advancement, particularly in developing countries. Undoubtedly, global agri-food trade interconnects numerous countries worldwide. Oversights in formulating multinational policies could potentially precipitate a humanitarian crisis. AGRI20 has the potential to emulate the success of other engagement groups within the G20, effectively bridging the gap between developed and developing countries. This forum must include diverse actors, such as non-governmental actors, smallholder farmers, indigenous groups, women and youth farmers, traditional markets and other enablers in the agri-food systems.

2. Facilitate the adoption of a sustainable agri-food value chain beyond the G20, leveraging digital technology and market mechanisms by enhancing the AMIS & GEOGLAM platforms and leveraging blockchain technology. This strategy aims to enhance market access and encourage precision farming practices at the farm level. Digitalisation, both digitisation and IoT, has opened a new realm for the agri-food value chain (Figure 3). Improving water and fertiliser application management may reduce

GHG emissions by 833 million tons of CO_2eq with cost savings of around US\$ 12-97/ton CO_2eq (McKinsey & Company 2020).

The G20 should strengthen its AMIS and GEOGLAM by integrating generative artificial intelligence (AI) into a unified platform. The G20's commitment to agriculture must leverage advanced technology in its implementation (G20 2023). The integration of digital technology offers invaluable insights for both the G20 and nations worldwide[3]. This unified AI-powered platform can serve as a comprehensive tool for crop advisory, decision support, market analysis, and early warning systems, contributing to global food security.
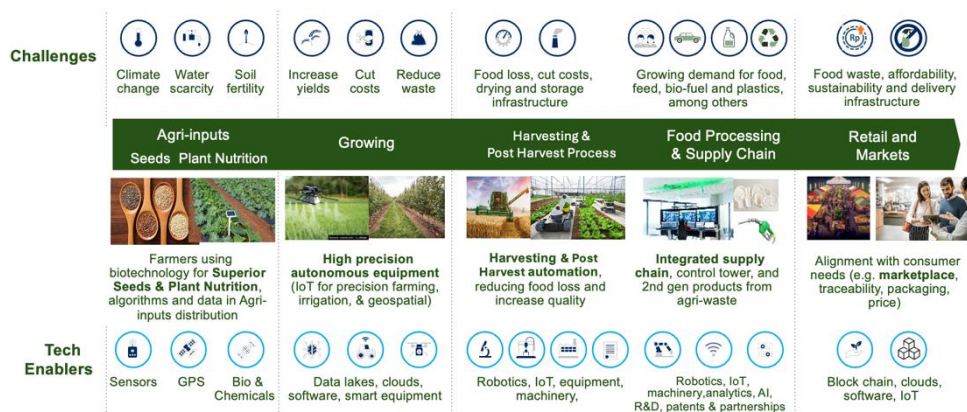

FIGURE 03 - Digital Technologies in the Agri-Food Value Chain (IFRI 2024)

Furthermore, adopting distributed ledger technology, specifically blockchain, can enhance transparency throughout the value chain for G20 nations and their agri-food trade counterparts. This technology offers the potential alternative for sustainability certifications, which can be challenging for farmers due to complexities, lack of harmonisation among certification standards, and financial constraints (Everdin, et al.

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[3] Robust and impartial data must be available to address the challenges effectively. Moreover, there is a growing concern regarding the ethics of data sharing, primarily when utilised across international jurisdictions.

2022). The G20 is pivotal in driving research and field trials to leverage blockchain technology to accelerate the adoption of sustainable agricultural practices, especially among smallholder farmers in developing nations.

Projects and start-ups are emerging to leverage blockchain for supply chain management, quality assurance, and fair-trade practices in agriculture. While China showcases significant adoption facilitated by tech giants and government support, India faces barriers such as regulatory gaps, trust deficits, and technical complexities. Overcoming these hurdles requires proactive measures, including awareness campaigns and technical support, to foster widespread adoption and advance sustainability goals on a global scale (Yadav, et al. 2020).

3. **Mainstream climate funds to accelerate the adoption of agri-food digital technology.** Brazil has started its campaign as a G20 host to embrace developing countries in delivering climate funds, namely Green Climate Fund, Climate Investment Funds, Adaptation Fund, and Global Environment Facility (G20 2024). It is essential to ensure the effective utilisation of these funds; it is crucial to prioritise integrating financial support to adopt digital technology within agri-food systems. This initiative must encompass advancing digital applications and systems, prioritising human development, and bolstering public infrastructure. Concerningly, regions like the Asia Pacific, Middle East, North Africa, and Sub-Saharan Africa still have a significant portion—12-14%—of users reliant on 2G technology, with Sub-Saharan Africa exhibiting only a 55% smartphone adoption rate (GSMA 2024).
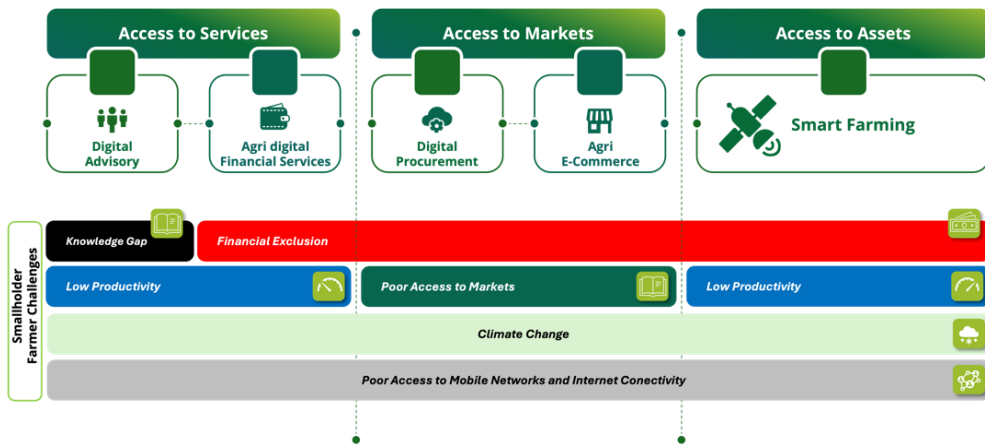
FIGURE 04 - Digital agriculture cases and challenges (GSMA 2020).

Addressing digital disparities is essential for fostering equitable and sustainable agricultural development (Figure 4). Studies show that for every 1% growth in the digital economy, agricultural development sees an increase of 0.033% (Jingyi, Lin and Zang 2024). This number underscores the significant impact of the digital economy on advancing agricultural progress and the urgency of bridging digital divides to ensure inclusive growth in the agricultural sector.

The successful digital transformation of the agri-food value chain hinges on two crucial elements within its implementation mechanism. Firstly, a comprehensive inclusivity approach ensures that the technology deployed caters to the needs of farmers, aligns with available infrastructure and meets market demands. Secondly, the seamless integration of digitalisation into agri-food regulation and policy.

Inclusivity and participatory approach

The adoption of digital transformation in the agri-food value chain is not always synonymous with the immediate utilisation of sophisticated technology. Challenges persist, particularly in developing countries, where farmers' infrastructure and socioeconomic status vary widely, often lagging. Similar issues are also prevalent among certain G20 member nations. This phenomenon aligns with findings indicating that digital technology's impact on low-income countries remains limited, primarily due to insufficient infrastructure, low levels of digital literacy among the population, and challenges in digital governance (Jingyi, Lin and Zang 2024). Therefore, the utilisation of simpler yet transformative technology, as well as the digital knowledge of farmers, is essential.

Projects in various countries have demonstrated the effectiveness of inclusive and participatory approaches in unlocking the benefits of digitalisation in agriculture. Over time, KALRO in Kenya has refined its technology dissemination strategy by better understanding farmers' needs and perspectives. This evolution has transitioned from relying solely on the internet to employing specific channels such as apps, SMS, and interactive voice response (Ndege, Marshall and Byrne 2024). Furthermore, recent

developments include the introduction of the first bamboo internet tower in remote areas of Indonesia by the UK and Indonesia. This innovative yet straightforward technology serves approximately 400 people in a small village (VOINEWS 2024).

International knowledge exchange is necessary to unlock the potential of simple technologies and successful global projects. As technology infrastructure advances and farmers' knowledge expands, they become better equipped to embrace more sophisticated solutions. Implementing an appropriate business model that ensures sustainability, food security, and prosperity for farmers and nations alike is crucial. However, adopting radical innovation without careful consideration may result in failure and inefficient budget allocation.

Incorporating digitalisation into agri-food policies

Agricultural policies and regulations worldwide have yet to embrace digital technology comprehensively. This deficiency has left agriculture behind other sectors in harnessing the advantages of digital innovation. Integrating digitalisation into agri-food policy is not merely about substituting analogue methods with digital ones; instead, it holds immense potential in diminishing information asymmetry, lowering transaction costs associated with policy execution, and ultimately enhancing effectiveness and efficiency. Therefore, the G20 must furnish guidelines serving as a roadmap for nations seeking to capitalise on the benefits of digital technology in agriculture.

"Meta-governance" represents a dynamic and robust framework tailored to navigate the diverse stakeholders and the intricate hierarchy within the agri-food value chain. This approach encompasses i) diversity of participants, ii) complex structural interconnections and iii) a "Peer elders" concept, fostering effective collaboration among government entities, market players, and societal stakeholders to establish comprehensive guidelines

for agri-food regulation and policy. All these stakeholders and their interconnected networks play pivotal roles in generating, gathering, analysing, disseminating, and applying information flows, consequently influencing their impact (Qin, et al. 2022). G20 and its partners must also formulate policies to harmonise sustainable standards and certification. This strategic measure will expedite the adoption of digital technology in agriculture, facilitating enhanced connectivity between farmers and markets and fostering the implementation of climate-smart agricultural practices at the farm and farmer level.

Weighing the benefits

Navigating the accessibility gap for global farmers to embrace digital technology poses considerable challenges. However, the trajectory of agricultural digitalisation suggests a transformative impact, with projections indicating a potential unlocking of US$500 billion in global GDP by 2030 (McKinsey & Company 2020). This substantial value stands to be forfeited in the absence of investment in such technology. While the Asia Pacific region emerges as a focal point for growth within the digital agriculture revolution, Africa warrants particular attention. Forecasts indicate that only a quarter of this region will be digitally connected in the coming decade, underscoring the need for targeted interventions. Moreover, the global agricultural value chain is inherently susceptible to the uncertainties stemming from geopolitical shifts, economic fluctuations, and the impacts of climate change. Highlighting this vulnerability, the Global Report on Food Crisis revealed a stark reality: in 2023, nearly 282 million people across 59 countries faced acute hunger, representing a troubling increase of 24 million from the previous year.

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