Policy Recommendations for Digitalization of Agriculture and Sustainability

Policy Brief

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A COMPANY PERSPECTIVE

Agriculture around the globe is facing a challenging future. Limited arable land, population growth, climate change, food waste/loss and a declining, aging farmer population all present problems to be overcome. Moreover, a healthy food system will be central to achieving the UN's 2030 Sustainable Development Goals (SDGs) to end poverty and hunger. While these challenges are massive, they are not insurmountable. Innovation will allow farmers to meet these growing economic, environmental, and societal challenges.

In this regard, digitalization – the collection, storage, analysis and sharing of data – has become one of agriculture's most promising evolutions. Digital farming combines a farmer's knowledge with cutting-edge technologies, such as artificial intelligence, proximal and remote sensing and variable application technologies, helping to make more informed and real-time decisions. It holds great promise to make the global food system more productive, resilient and environmentally sustainable. (McFadden et al., 2022)

Yet, digitalization is not only about new technologies. It will change the way of business for many of the value chain partners involved. Farmers, big and small, can improve farm management planning and de-risk their operations. With real-time data on weather patterns, soil moisture levels, and crop health, farmers can make informed decisions about planting and harvesting schedules, reducing the risk of crop failure due to weather events or disease outbreaks. Additionally, and importantly, smallholder farmers can have better access to information and trainings, and improved ability to utilize technologies and engage in additional markets. Digital solutions targeted to the needs and skills of smallholder farmers can support their inclusion and increase yield and profitability where it matters most.

In order to leverage the possibilities of digital agriculture, strong policy support is needed to make it happen. The following is a look at several ways the digitalization of our food system is advancing, solving global nutritional challenges, and alleviating environmental impacts, as well as our rationale and recommendations for policy making in this direction.

ON THE FARM – DIGITAL AND PRECISION FARMING

A field of crops may appear on the surface as uniform and homogenous; in reality, it is comprised of complex variables including soil composition, moisture levels, pest pressures and other agricultural conditions. Digital farming incorporates data to understand and use the variability within the field. It increasingly enables farmers to choose the most suitable seed variety, the best planting density and time, and to optimize the use of water and fertilizer. Then, precision machinery enables the execution of the agricultural plan and the timely, spatially fine-tuned application of inputs. The benefits of digitally managed and easily adjusted irrigation, fertilization and planting schedules promises to result in more efficient use of resources such as water and land (World Bank, 2019) and

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increased yields. Optimized spraying of pesticides avoids overuse and minimizes run-off. The benefits are positive environmental effects (World Bank, 2019), cost reductions and higher productivity.

»Digitalization makes the value chain more transparent.«

So, what do we know about the current benefits of digital and precision farming? A 2022 report concluded that "on-farm productivity, sustainability, and resilience benefits from digitalization have been well documented for commercial row crop farms" (McFadden et al., 2022). A universal understanding of impact will remain difficult as it depends on various factors such as field conditions, equipment and software quality. For example, reductions in herbicide use will be higher in a field with spatially limited weed occurrence versus a thoroughly infested field. However, companies and the scientific community are rushing to develop advanced solutions. Progress in sensor quality, advanced precision equipment, more reliable prediction models and a more complete portfolio of solutions will drive costs down and efficiencies up. Success also depends on sufficient data exchange among public and various private actors and the avoidance of data siloes.

Digital and precision farming uptake is highest among larger farms in high-income countries (World Bank, 2019). Policies should support the adoption by all, including smaller and diverse farms, organic or conventional, and farmers in developing countries. Smallholders in developing countries need precision application solutions which are affordable. Access to service providers and technology sharing platforms like TroTro Tractor[1] or Hello Tractor[2], which connect growers and service providers (Finger et al., 2019), is growing and providing initial helpful solutions.

EMPOWERED COLLABORATION

Digitalization makes the value chain more transparent, allowing for product traceability spanning from on-farm production to the end consumer (World Bank, 2019). Thus, a customer buying fruits may be able to identify the farm from which they originate (e.g., through the Global Gap Number).[3] Consumers find information about the production standards which may additionally be verified through a label. For the food systems, the value in such tracking and monitoring lies in the improved efficiency of supply and the avoidance of food losses (World Bank, 2019). The farmer knows what to produce and has the benefit of secured buyers. The local supermarkets, traders and food companies benefit as traceability reduces the risk of incompliant or sub-quality production. For example, they can track their production standards concerning regenerative agriculture or carbon emissions. Such partnerships have specific value in developing countries and the ability to integrate small scale farmers into markets. Implementation costs are a challenge but the contribution of such projects to the SDGs can be high.

Digitally enhanced platforms go beyond the value chain and create an ecosystem of actors to co-create value (Hein et al., 2020). Platform solutions exist in many forms and with different purposes. An interesting example is a digitally enhanced platform for regenerative agriculture (ForFarmers by Bayer)[4]. A farmer considering low-till approaches or the use of cover crops may use this marketplace to receive and share information, to access agronomic support and complementary offers of various companies. This platform also enables access to rewards (company incentives/discounts/carbon credits) for carbon sequestration or reduction practices. For companies, the benefit of participating is the access to a progressive group of customers. E-platforms typically reduce the search costs for matching with partners (World Bank, 2019).

DIGITALIZATION DRIVES NEW BUSINESS MODELS

Digitalization impacts business models. Traditionally, and still today, agricultural input companies conduct business by selling inputs. With progressing digital transformation, this model leads to the increasingly integrated offering of products, digital services and agricultural practices. As digital agriculture develops, it creates more reliable prediction models and enables precision applications, thereby allowing the value creation and capture to shift to an agricultural outcome. For example, a farmer may pay for yield increases achieved through optimal planting density in combination with a certain seed variety. Such business models decouple productivity growth from input use and set the right incentive for environmental sustainability.

Farmers who seek financial rewards for the implementation of climate smart

»Digitalization impacts business models.«

agriculture need various forms of support. They need to *measure* the amount of GHG avoided, and to *report* this to a third party which can then *verify* the results (World Bank, 2022). Such measurement, reporting, and verification (MRV) activities are needed to prove that an agricultural practice like the use of cover crops has avoided or removed GHG emissions. Current systems often rely on manual labor, are costly and error-prone (Autenrieth, 2020). MRV benefits significantly from digital tools which automatically record activities, replace manual labor and increase the reliability of recording. Efficient MRV is the foundation for "unlocking climate finance" (World Bank, 2022) and thereby covering pertinent costs and rewarding producers financially. The objective is to make carbon farming a relevant income stream for producers.

BARRIERS

While the benefits are real, the barriers to adoption of digital agriculture are also real. Insufficient, low quality and expensive connectivity is an issue in many regions, but particularly severe in rural areas in developing countries. A lack of digital skills for farmers, extensionists, administrators, etc. is also a concern in both developed and developing countries (Trendov et al. 2019). Upfront costs limit the uptake of digital software and hardware, as does a lack of user-friendliness, limited use

cases, high operator skill requirements, mistrust of algorithms, and technological risk (McFadden et al., 2022). Particularly worrisome is the digital divide between developed countries and emerging economies with the severe risk of leaving vulnerable groups behind. Furthermore, the internet gender gap is an issue, as women often have reduced access to the internet compared to men, especially in South Asia and Africa (Sibthorpe, 2023).

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POLICY IMPLICATIONS

We recommend a national strategy to assess the strengths and weaknesses of existing digital systems and develop a coherent policy approach. Elements of such a strategy should include:

1. A well-developed digital infrastructure in rural communities as a precondition for digital farming. Governments must work to enable reliable and affordable connectivity to support the broad adoption of digital farming tools especially in developing countries and with special investments and targeted offerings for vulnerable groups.
2. Governments should strengthen digital capacity in administration, the university curricula, and extension services to provide education to farm decision-makers, particularly on digital and entrepreneurial skills.
3. Public funding and incentives should be allocated to enable farmers to innovate their operations through sustainable digital technologies (i.e., financial and non-financial programs, tax credits, lower interest rates, reducing trade barriers, etc.).
4. Governments and intergovernmental organizations should support research and development in digital technologies for agriculture. This can include funding for public-private partnerships to develop new technologies and promote innovation in the agricultural sector.
5. Legislative and regulatory frameworks which define farming practices (i.e., sustainable use legislations) should encompass and drive the uptake of digital farming tools, for instance, tailored recommendations, digital as a component of Integrated Pest Management decision making, precision application technologies and digital record keeping.

CONCLUSION

Digitalization is a game changer for a more sustainable agriculture. It is pushing the envelope in big ways, enabling access, precision management, and climate-smart farming all over the world. However, it is important to remember that while digitalization is a critical enabler, it is not the solution on its own.

We believe that the convergence we are seeing today between science, data and digital technologies will be key to unlocking critically needed, sustainable solutions that address the most urgent challenges facing our food systems. It can and must have a decisive impact.

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