



# Strengthening digital agricultural extension and advisory services in smallholder farming



## INTRODUCTION

In 2022, 64 percent of urban dwellers in Africa use the Internet compared with 23 percent of people in rural areas (ITU, 2022). In the Asia-Pacific region, the corresponding percentages are 82 percent and 47 percent (ibid.). Although this evident urban-rural digital divide persists, over the last three years, worldwide the urban-rural ratio of internet use has decreased from 2.3 to 1.8, as rural areas gradually catch up (ibid.). Meanwhile, more and more governments in developing countries have integrated digital agriculture as a core strategy to improve agricultural production and promote public-private partnerships (PPPs). This, together with the availability of digital information resources, has driven the application of digital tools and solutions thus improving agricultural extension and advisory services (EAS) delivery during the past decade. Furthermore, the COVID-19 pandemic has triggered and broadened the use of digital tools for sharing information, delivering EAS to farmers, and to some extent receiving feedback from them. Digital technologies bring new opportunities for EAS delivery, including improved access to services in geographically remote areas, bridging the information gaps among different value chain actors, and contributing

to fair trade, market accessibility, social and financial inclusion and so on (FAO, 2021).

It is acknowledged that EAS provision through digital tools has the potential to transform the agrifood system and significantly improve smallholder farmers' livelihoods (Kansiime *et al.*, 2021). Emerging digital EAS initiatives, M-Omulimisa Innovative Agricultural Services in Uganda and Smart Farming on Cloud in China for instance (see the Examples for details), have started to provide a range of services, including agricultural advisory services, market linkages, financial access, supply-chain management, agricultural intelligence and other related bundled services.

Moreover, the availability, accessibility and affordability of digital EAS for smallholder farmers are critical to ensuring the inclusive development of agricultural digitalization while reducing the digital divide. However, ongoing EAS digitalization efforts tend to encounter several obstacles that prevent the effective utilization of digital solutions in the agricultural systems of developing countries. Common barriers include lack of infrastructure and reception coverage, high cost of digital devices and

management and maintenance of information and communications technology (ICT) facilities and products, weak regulatory framework, as well as poor institutional capacity and governance (Trendov *et al.*, 2019; Tsan *et al.*, 2019). Additionally, farmers' low-level e-literacy and digital skills and lack of ownership or management of digital devices exacerbate further the inequalities (Trendov *et al.*, 2019). This makes the potential of digital EAS to be underutilized and their benefits unequally distributed due to an evident, widening digital divide with regard to rural and urban areas, gender, and different social groups both within and among regions. In this regard, rural areas, especially remote ones, of emerging

economies risk being left behind in this agricultural digitalization process.

It is therefore critical to strengthen the spread and uptake of digital EAS among all players in the sector, especially smallholder farmers to promote a sound agricultural digitalization process that is both economically efficient and socially equitable. This requires the key actors within the digital EAS ecosystem to collaborate and take complementary measures to bridge the supply and demand side of the process and improve the provision and delivery of digital EAS to a variety of stakeholders, in particular smallholder farmers.



Using mobile phones to enter coordinates on eLocust3 app while tracing hopper bands of locust in a remote area (Kenya)

## KEY MESSAGES

Good practices of digital agricultural EAS often adopt similar innovative approaches or share common features that make them successful. They are prone to overcoming a series of constraints and challenges, such as (1) barriers to access, management and use of digital tools; (2) cultural and social limitations; (3) time and mobility constraints; and (4) literacy and digital skills. To overcome these constraints and challenges and thereby strengthen the uptake of digital EAS, especially by smallholder farmers, the following actions need to be taken:

- **Creating an enabling environment** in terms of policies, regulatory and legislative frameworks, human resources, infrastructure, and financial resources.
- **Building the capacities of public agricultural extension and advisory service agents and community champions** to deliver digital services, especially at the grassroots level.
- **Designing digital products and agricultural extension and advisory services with smallholder farmers**, rather than for smallholder farmers.
- **Enhancing smallholder farmers' digital literacy** through a variety of training or capacity-building activities to improve their uptake of digital agricultural extension and advisory services.
- **Strengthening scalability and sustainability** by better understanding the existing ecosystem, responding to different connectivity scenarios and changing needs, and bundling digital services together.
- **Highlighting the role of incubators, accelerators, and innovation hubs** in guaranteeing the availability, effectiveness and upgrading of digital tools and technologies in the long run.
- **Leveraging multistakeholder partnerships** to foster sustainable business models and provide a broader service portfolio, including input financing, crop insurance, weather updates, market information and so on.
- **Promoting digital ethics** by embedding principles such as transparency, accountability, data protection and inclusiveness into the creation of digital products, tools and services related to agricultural extension and advisory services.



*Milk procurement managers attending a training session on how to use a mobile phone application (Kazakhstan)*

### ***Creating an enabling environment in terms of policies, regulatory and legislative frameworks, human resources, infrastructure, and financial resources***

Support from key actors like governments and investors is critical to scale up and sustain digital EAS aimed at transforming the agrifood system. To better support the development of digital EAS, governments are expected to take the following measures to create an enabling environment:

- reviewing current agricultural EAS policies and digital EAS systems to identify existing systemic, technical and capacity gaps and thereby develop a policy framework for enhancing digital EAS. Governments need to play a crucial role in creating an enabling environment for the growth and sustainability of digital EAS increasing incentives to support small and medium-sized enterprises (SMEs) to invest in digital agriculture for sustainability (African Union, 2020). These incentives include regulating the sector to ensure a level playing field as well as exploring PPPs to support investments in technology infrastructure. Leading ministries also need to systematically invest in knowledge, innovation and the incubation ecosystem for digital, women and youth entrepreneurship (Kim *et al.*, 2020);
- developing a strategic approach to the digitalization of EAS, identifying entry points, priorities, key performance indicators (KPIs), enablers and barriers. Given that digitalization is a multisectoral process,

institutional entrepreneurs with a clear leadership should be identified and entrusted;

- mainstreaming digital EAS in an incremental, consistent way. EAS agencies and organizations should integrate digital EAS into their mandates as essential public-good services provided to meet smallholder farmers' practical needs;
- setting up public digital infrastructures and establishing interoperability standards for on-time interchange of big data at different levels and among a variety of digital providers to support EAS; and
- organizing campaigns to raise the awareness of farmers and farmer organizations of the importance of digital EAS. On this basis, farmers as well as their affiliated organizations need to be empowered to access and support digital EAS.

### ***Building the capacities of public agricultural extension and advisory service agents and community champions to deliver digital services, especially at the grassroots level***

Due to a lack of human resources specialized in digital EAS, public EAS agencies and agents tend to lack the capacity to deliver digital EAS, especially at the subregional level. This is exacerbated by a lack of training in digital capacity either at the pre-service or post-entry level. To improve the uptake of digital EAS, it is crucial to provide relevant training and thereby build a team of public EAS

agents capable of delivering digital EAS. Therefore, it is necessary to:

- adopt a training approach that favours inclusive digital EAS. Consider the need to address gender issues and the outreach to marginal or vulnerable groups through digital EAS in the overall design of training curricula;
- develop training guidelines and modules for EAS agencies and agents on digital EAS based on prior assessment of EAS clients' needs for digital EAS;
- highlight the role of training community champions and lead farmers. Train especially female, youth and lead farmers or community champions to train their peers can be an effective way of overcoming barriers;
- empower EAS providers through training of trainers (ToT) courses. Upgrade the training curricula regularly so as to keep pace with the fast changing realities; and
- promote the use of digital tools by EAS agents to monitor and evaluate their own performance in terms of responsiveness, efficiency, farmer satisfaction and so on.

### ***Designing digital products and agricultural extension and advisory services with smallholder farmers, rather than for smallholder farmers***

Digital EAS must be tailored to a large and widely dispersed farming population characterized by diversity in opportunities, constraints, farming objectives, and information needs. Designing with smallholders is a co-creation process that involves testing prototypes and incorporating user feedback into the development process before rollout and scale-up. This ensures that the digital tools used are both applicable and accessible to a specific user group and that the information delivered is actionable because they are relevant to specific needs and contexts, thereby resulting in desired changes. Therefore, it is necessary to:

- gain an in-depth understanding of the characteristics (e.g. age, literacy levels, agroecological zones, etc.), information needs (e.g. good agronomic practices, new technologies, weather, market, etc.) and problems of the targeted smallholder farmers. This is necessary as they often are a heterogeneous group with diverse characteristics and needs;
- determine the features of digital tools or which existing ones to use according to the digital literacy, local infrastructure, and the purpose of the EAS needed by farmers: (1) diagnosing problems that farmers face; (2) raising awareness (e.g. on improved practices); (3) teaching good practices; (4) persuading farmers to try new practices; (5) reminding farmers what they have learned; and (6) getting feedback from farmers regarding what they do not understand, additional information they need, etc. (Davis *et al.*, 2020). Accordingly, a variety of digital EAS forms such as radio and TV programmes, calls, short message services (SMS), interactive voice response (IVR), video clips and so on can be selected. Services are to be delivered alone or in combination through different digital tools (e.g. radio, feature phone, television and web-based/smartphone applications) to optimize

the effectiveness and relevance of digital EAS to complement conventional EAS;

- make sure that policies with a clear orientation of research and innovation towards accessible, affordable and easy-to-use digital services for smallholder farmers are in place;
- support local multiactor platforms that allow capturing real-world problems and opportunities of farmers and co-designing digital tools that are demand-driven;
- assess digital innovations, tools and services in a systematic way to gain a sound understanding of the real benefits gained by the farmers; and
- work with community facilitators and agents, especially in collaboration with existing farmer field schools if any, to allow for mediation in the delivery of EAS and gathering feedback to help make improvements.

### ***Enhancing smallholder farmers' digital literacy through a variety of training or capacity-building activities to improve their uptake of digital agricultural extension and advisory services***

Digital illiteracy, along with insufficient digital human capital development and infrastructure investments in rural areas, has become paramount barriers and constraints for them to access and harness the potential of digital EAS (Awadalla, 2019; Evans, 2019; Hudson *et al.*, 2017; Kansime *et al.*, 2021; Tsan *et al.*, 2019). Therefore, smallholder farmers need essential training to improve their digital literacy to enable them to access digital EAS and achieve sustainable economic, environmental and social gains. To this end, it is necessary to:

- promote participatory farmer education and training courses on digital literacy to build up their capacities and skills and increase their access to digital EAS through available digital devices and tools;
- provide farmer digital literacy education in an incremental, consistent way to scale up smallholder farmers' uptake of digital EAS while ensuring equity and inclusiveness;
- explore complementarities between digital and non-digital tools to increase the effectiveness of digital approaches and build the capacities of smallholder farmers; and
- create spaces for collective learning to encourage peer exchange and discussions to enable mutual learning and experience sharing. This is likely to overcome reluctance, increase the propensity to adopt digital EAS, and support the maintenance of innovative solutions.

### ***Strengthening scalability and sustainability by better understanding the existing ecosystem, responding to different connectivity scenarios and changing needs, and bundling digital services together***

It is paramount for developers of digital EAS to understand the existing ecosystem including external

factors that may contribute to or hinder the success of digital EAS. Such factors include affordability and availability of digital tools, policy environment and regulatory framework, economy, sociocultural factors or prerequisite technology infrastructure such as network coverage, etc. Besides, the following aspects need to be fully considered to enhance the scalability and sustainability of digital EAS:

- Existing digital EAS initiatives must be considered to avoid duplication of efforts as well as seize opportunities for learning from others' experiences. The existence of other initiatives also provides opportunities for forming partnerships capitalizing on the different expertise and ensuring efficient use of available resources.
- It is fundamental to gain a sound understanding of the frame conditions in terms of income level, social norms, gender, etc. of the recipient community of digital EAS.
- Small establishments can bundle their services together to achieve a wider reach and stronger viability. This is important for leveraging strengths and complementarities of different approaches and tools. Besides, they need to update their digital contents and service portfolio on a regular basis according to community needs and feedback.
- Sustainable business models for service delivery are critical for the sustainability of digital EAS. Most ICT projects and initiatives rely directly or indirectly on donor funding. This dependency together with a lack of appropriate business plans makes them prone to failure after the withdrawal of donor funding. Therefore, innovative financing strategies and appropriate business models are needed to scale up operations to enable sustainability.
- Although most developing countries have intermediate Internet penetration, digital accessibility in rural areas still remains low and varies according to age, gender and income. As such, reaching all farmers with disruptive agricultural technologies will require a range of tools that can operate in different connectivity scenarios (Kim *et al.*, 2020).

### ***Highlighting the role of incubators, accelerators, and innovation hubs in guaranteeing the availability, effectiveness and upgrading of digital tools and technologies in the long run***

The availability and effectiveness of digital tools and technologies are often attributed to the presence of robust technology incubation and acceleration hubs and mobile money ecosystems (Kim *et al.*, 2020). Technology incubation and acceleration hubs can be fostered through the following actions:

- systematically investing in digital innovation ecosystem to underpin knowledge generation, technology transfer, and digital entrepreneurship, including that led by youth and women. It is equally commendable to provide tax incentives and an enabling policy environment;

- improving the level of value-added services of incubators, accelerators, and innovation hubs by (1) building a qualified entrepreneurship facilitator/mentor team; (2) promoting and normalizing the training of talents; (3) supporting them to continuously strengthen value-added services such as project packaging, diagnosis, entrepreneurship consulting, evaluation, marketing, product innovation, education and training, financial advisory, investment and financing, etc.; and (4) encouraging them to establish third-party service platforms or cooperate with third-party professional service institutions such as intellectual property, law, accounting, and consulting;
- highlighting regional cooperation to pave the way for a coordinated and differentiated development of incubators, accelerators, and innovation hubs, so as to promote the sharing of services, resources and talents; and
- underpinning youth involvement through a variety of empowerment activities such as boot camps, innovation challenges and so on. This paves the way for youth-led digital start-ups as important players in the digital EAS ecosystem.

### ***Leveraging multistakeholder partnerships to foster sustainable business models and provide a broader service portfolio, including input financing, crop insurance, weather updates, market information and so on***

From the perspective of the agricultural innovation system (AIS), multistakeholder partnerships facilitate knowledge exchange, learning and networking between different actors within the digital EAS ecosystem. Multistakeholder partnerships are also prone to helping develop sustainable business models with a "systems thinking" and form a centralized knowledge hub/comprehensive database. The latter can pull and analyse datasets from varied partners and sources to enable digital EAS to offer comprehensive and tailored quality contents. In addition, they can also help provide a wider service offering, such as advisory services, financial services, market linkages etc. and achieve greater impact while deriving mutual benefit to further specific organization goals. Multistakeholder partnerships are to be leveraged through the following actions:

- addressing the issue of fragmentation of initiatives and lack of synergies. Give priorities to initiatives that are aimed at integration and interoperability;
- identifying and reaching out to key stakeholders within the digital EAS ecosystem who will need to be involved to collaboratively build a positive outcome;
- strengthening the links between education, research, EAS and training. Engage different stakeholders, such as EAS providers, researchers, educators and trainers, entrepreneurs, inputs suppliers, NGOs, investors, financial service providers and farmer organizations, to jointly take coalitional actions to improve digital EAS provision;

- building a shared understanding of the barriers that impede and the enablers that promote the development of digital EAS, and the purpose of the collaboration; and
- developing an action plan through a participatory process to achieve the intended outcome, leveraging the particular capabilities and networks of each stakeholder.

**Promoting digital ethics by embedding principles such as transparency, accountability, data protection and inclusiveness into the creation of digital products, tools and services related to agricultural extension and advisory services**

Digital ethics are essential for promoting an agricultural digitalization that is inclusive, transparent, and

equitable. It should be considered as the cornerstone for building smallholder farmers' trust and confidence in digital EAS, the premise of their uptake. Therefore, it is necessary to:

- conduct the development of digital EAS in an inclusive manner, in compliance with ethical requirements, human rights, privacy protection and other relevant international standards;
- develop appropriate data stewardship strategies and take data privacy protection measures to regulate and manage digital EAS;
- highlight the ethical development and use of farmer databases. Such databases are crucial in the development and uptake of digital EAS. They often demand a heavy initial investment cost, especially for startups; and
- promote good digital EAS practices that have contributed to an ethical, equitable and adaptive agrifood system.



**Desert Locust Surveillance activities using drones (Sudan)**

## EXAMPLES

### **M-Omulimisa innovative agricultural services**

M-Omulimisa (m-omulimisa.com) is an agriculture technology company that leverages ICT tools especially mobile phone technology to improve the livelihoods of smallholder farmers in Uganda. They support smallholders to improve their access to information and services needed to sustainably increase productivity and income. Services offered include:

**Disease/pest diagnostics and warning** are provided through mobile and a web-based platform, enabling farmers to interactively exchange information with extension agents in their local language. Farmers can ask agriculture-related questions and receive feedback from extension agents either by toll-free SMS or mobile app. The query is photo-enabled and farmers are able to send pictures, especially for disease/pest diagnostics. The messaging is integrated into the traditional extension service delivery model to improve efficiency and effectiveness. The app also enables farmers and extension agents to report disease and pest outbreaks using geo-tagged pictures.

**Agricultural insurance** (drought and excessive rainfall) is provided through a partnership with the Agriculture Insurance Consortium (AIC). AIC is a consortium of insurance companies providing subsidized (up to 50 percent) agriculture insurance under the Uganda Agricultural Insurance Scheme (UAIS), a PPP arrangement with the Uganda Insurers Association (UIA) and the government of Uganda. The service is commission-based and works through a network of agents. The loan products can be accessed via M-Omulimisa website, making it easy for smallholders anywhere in Uganda to access insurance when they want it. The service is integrated with mobile money, making it easy for farmers to pay for the insurance as well as receive compensation in case of loss.

**Group inputs loan facility** to provide access to critically needed agricultural services for smallholders (improved seed, fertilizer, post-harvest materials such as storage bags and tarpaulins, and insurance) provided as one product through affordable credit. The products are distributed through a network of commission-based village agents. The agents participate in farmer profiling to ensure they meet the basic criteria for a loan. The loan is an unsecured (no collateral needed) group loan that relies on the group's social capital.

#### **Key enablers:**

- Partnership with government and private sector.
- Mediation: It operates through an extended agent framework reaching the last mile, addressing context-specific questions including capacity building.
- Commission-based services where agents and operators earn a commission thus sustaining the services.
- Bundled services addressing risks associated with access to markets and credit. Better links between farmers and buyers help to overcome production and marketing obstacles.

- Inclusive business model offering incentives to all actors in the value chain: Demand is created for the input suppliers; farmers are willing to invest in improved technologies since they have access to affordable credit; microfinance institutions have access to a wide market of well-organized farmer groups that present a low risk due to agriculture insurance; and due to increased demand for agriculture products, village agents earn more commission.

### **Smart Farming on Cloud**

Smart Farming on Cloud, a smartphone app, is China's leading online education platform for agriculture. In 2016, the app was launched by China's Central Agricultural Radio and Television School (Science and Technology Education and Training Center for farmers of the Ministry of Agriculture and Rural Areas). The app has provincial subplatforms in Hunan, Jiangsu, Henan and Jilin provinces. Based on big data, cloud computing and mobile interconnection technology, this platform gathers various agricultural science and technology education resources, including information, lecture, community, Q&A, finance, etc. The platform provides farmers with a variety of services, including online learning, expert consultancy, agricultural information, agricultural technology promotion, marketing, rural finance and other comprehensive services. The platform has more than five million registered users, including 390 000 experts and agricultural technicians and 4.3 million farmers.

The app has the following advantages:

- (1) extended outreach:** By using the app, agricultural EAS agents, technicians and experts from different provinces can reach a wider range of farmers. The platform reduces the cost of travel, enabling agricultural EAS agents, technicians and experts to serve farmers more timely and solve their problems more efficiently.
- (2) strengthened and targeted interactions:** Farmers can visit a variety of virtual communities of practice with specific topics, such as "Smart Plant Protection", "Livestock and Poultry Breeding", "Village Market", "Leisure Agriculture", "Rice Technology", "Scientific Fertilization", etc. After entering a virtual community of practice, farmers can interact with other members, participate in discussions, watch self-learning videos, and pose questions. The app matches farmers' questions with relevant agricultural EAS agents, technicians and experts, improving their communication efficiency. The latter will respond to questions on agricultural production, operation, and extension and advisory services. Through these interactions, a benign feedback loop is generated through which agricultural EAS agents, technicians and experts, as the principal providers of digital self-learning materials, can better understand farmers' real and emerging needs. This is critical to adjust the digital self-learning materials, making them more responsive to farmers' real needs.
- (3) real-time and diversified services:** Farmers can use the app to participate in agricultural training at their own pace and access various agricultural technologies and market information at any time. The platform also provides them with more diversified channels to acquire agricultural knowledge. The channel "Smart Q&A Robot", among other channels, provides farmers with low-cost access to the needed knowledge and skills regardless of time and space.

## REFERENCES

- African Union.** 2020. *The digital transformation strategy for Africa (2020–2030)*. Accessed 8 May 2022 from <https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf>
- Awadalla, A.M.** 2019. Use smart phones as sources of farmers information. *Alexandria Journal of Agricultural Sciences*, 64: 277–289.
- Davis, K., Babu, S.C. & Ragasa, C.,** eds. 2020. *Agricultural extension: Global status and performance in selected countries*. Washington, D.C., IFPRI.
- Evans, O.** 2019. Repositioning for increased digital dividends: Internet usage and economic well-being in Sub-Saharan Africa. *Journal of Global Information Technology Management*, 22: 47–70.
- FAO.** 2021. *Empowering smallholder farmers to access digital agricultural extension and advisory services*. Rome, FAO. <https://www.fao.org/3/cb5944en/cb5944en.pdf>
- Hudson, H.E., Leclair, M., Pelletier, B. & Sullivan, B.** 2017. Using radio and interactive ICTs to improve food security among smallholder farmers in sub-Saharan Africa. *Telecommunications Policy*, 41: 670–684.
- International Telecommunication Union (ITU).** *Measuring digital development: Facts and figures*. Geneva, ITU. [https://www.itu.int/hub/publication/d-ind-ict\\_mdd-2022/](https://www.itu.int/hub/publication/d-ind-ict_mdd-2022/)
- Kansiime, M., Mugambi, I., Rware, H., Alokit, C., Aliamo, C., Zhang, F., Latzko, J., Yang, P., Karanja, D. & Romney, D.** 2021. Challenges and capacity gaps in smallholder access to digital extension and advisory services in Kenya and Uganda. *Frontiers of Agricultural Science and Engineering*, 1–13.
- Kim, J., Shah, P., Gaskell, J.C., Prasann, A. & Luthra, A.** 2020. *Scaling up disruptive agricultural technologies in Africa*. International Development in Focus. Washington, D.C., World Bank. DOI: 10.1596/978-1-4648-1522-5.
- Trendov, N.M., Varas, S. & Zeng, M.** 2019. *Digital technologies in agriculture and rural areas: Briefing paper*. Rome, FAO.
- Tsan, M., Totapally, S., Hailu, M. & Addom, B.K.** 2019. *The digitalisation of African agriculture report 2018–2019*. Wageningen, CTA. <https://www.cta.int/en/digitalisation/issue/the-digitalisation-of-african-agriculture-report-2018-2019-sid0d88610e2-d24e-4d6a-8257-455b43cf5ed6>

## ACKNOWLEDGEMENTS

This policy brief was developed by Puyun Yang, Yapeng Ou and Vuyo Innocent Maphango from the Office of Innovation of FAO based on the joint good practice studies conducted by FAO, the Regional Centre for Africa of the Centre for Agriculture and Biosciences International (CABI) and the Chinese Academy of Tropical Agricultural Sciences (CATAS). The authors would like to thank Dr Kui Liu, Dr Guixiu Huang, Ms Xue Zhang and Dr Yuanyuan Huang from CATAS, and Dr Monica Kansiime, Ms Rahab Njunge and Ms Abigael Mchana from the CABI Regional Centre for Africa for their contributions to the good practice studies and the co-funding from CABI Plantwise project. Thanks are also extended to Dr Gianluca Brunori (University of Pisa, Italy), Dr Simona Cristiano (Council for Agricultural Research and Economics, Italy) and Mr Andrianjafy Rasoanindrainy (African Forum for Agricultural Advisory Services), who reviewed the draft and provided valuable comments and suggestions. The authors are grateful for the rich inputs from colleagues Thembanani Malapela, Nikola Trendov, and Wei Liang. The support from colleagues Selvaraju Ramasamy and Nevena Alexandrova is also appreciated.

### Contact:

#### Office of Innovation

OIN-Director@fao.org

Food and Agriculture Organization of the United Nations

Rome, Italy

