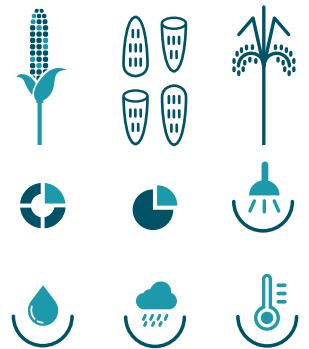




Food and Agriculture
Organization of the
United Nations

Digital agriculture in FAO projects in sub-Saharan Africa



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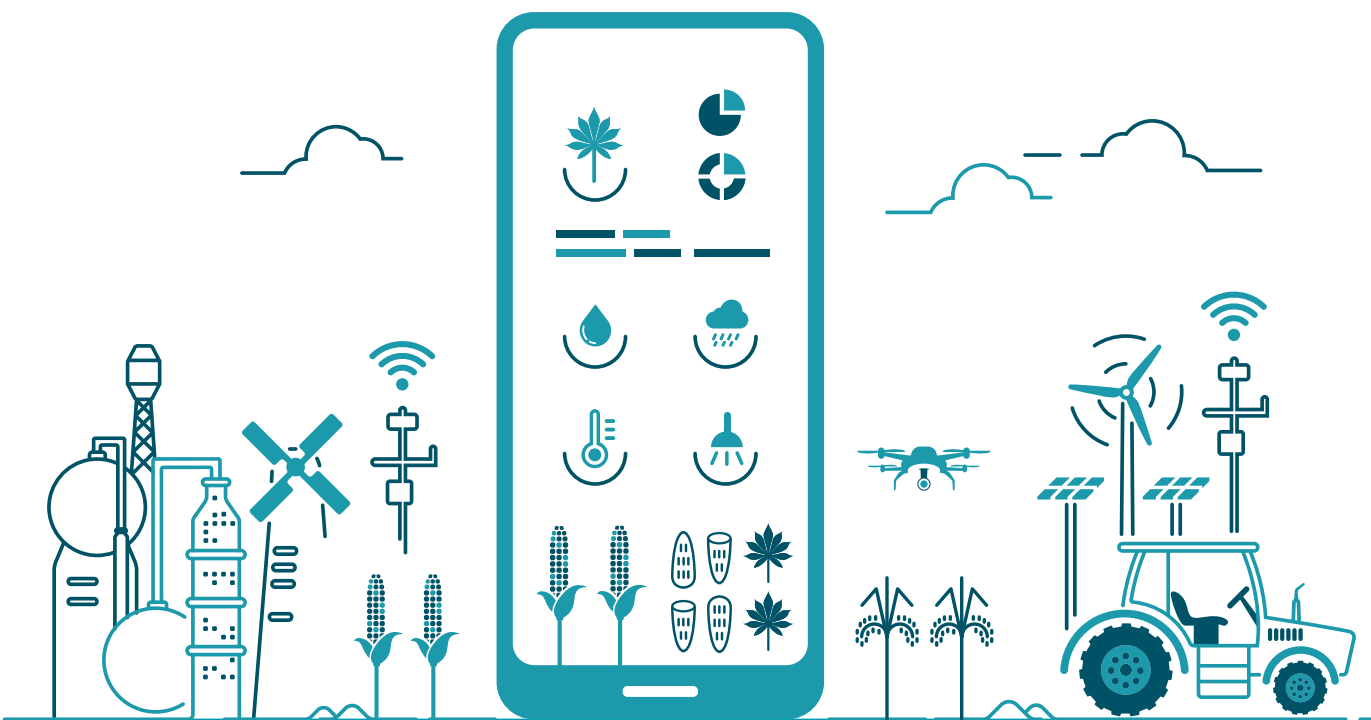
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Foreword

The Food and Agriculture Organization of the United Nations (FAO) has long acknowledged the transformative power of innovation and technology in agriculture. As outlined in the FAO Science and Innovation Strategy, we are committed to promoting the use of science and innovations to favour the advent of agrifood systems that are more efficient, inclusive, resilient and sustainable. This pledge aligns well with the Sustainable Development Goals (SDGs), and Agenda 2063 and the Malabo Declaration of the African Union. The rapid digitalization of agriculture offers a gateway to modernizing the sector across Africa, echoing FAO's ambition to foster an environment where technology serves as a catalyst to fight against hunger and poverty and for growth and prosperity.

This study is the result of a collaboration with Wageningen University and Research (WUR). It intends to facilitate the establishment of a more robust roadmap for mainstreaming digitalization in agriculture in FAO projects and programmes, for the benefit of our stakeholders. Its release demonstrates our attempts to draw lessons from our experiences using digitalization to transform the agrifood system sustainably, allowing the FAO Regional Office for Africa to improve support to countries.

With many examples, the study paints a positive image of FAO's work in digital agriculture throughout the African continent. But it also draws attention to the urgent need for further efforts, highlighting areas in which the organization and other partners may intensify their investments. This is crucial to ensure that the full spectrum of stakeholders, particularly smallholders, can effectively harness the power of digitalization to address emergencies, strengthen resilience to shocks, and for inclusive and sustainable development.

Despite the challenges, such as the persistent connectivity issues in rural areas and the affordability of digital services for farmers, there is a clear indication of strong digital engagement from governments and other national institutions. This calls for strengthening the mainstreaming of digital agriculture in FAO projects and programmes, and for enhancing public and private sector partnerships to foster digital transformation. Among others, the report rightly emphasizes the crucial importance of digital capacity-building particularly for smallholder farmers and the importance of data analytics to support effective agriculture policymaking. It also provides recommendations relating to the need to continue promoting pro-smallholder digital tools and services, while exploring the potential of newer innovations including generative artificial intelligence when needed and with specific stakeholders. The findings also underscore a need for further inclusion, particularly among youth and women who are essential to the sector's future yet are currently underrepresented in benefiting from digital advancements.

From the FAO perspective, as we look forward to the implementation of the recommendations laid out in this report, our focus remains steadfast on empowering farmers, supporting governments, and collaborating with our partners to build a food-secure Africa fostered by the power of digital agriculture.

Abebe Haile-Gabriel

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Abbreviations

AfDB	African Development Bank
AML	African Migratory Locust
API	Application Programming Interface
D4Ag	Digitalization for Agriculture
DPG	Digital PublicGood
DSP	Digital Services Portfolio
DVI	Digital Villages Initiative
FAMEWS	Fall Armyworm Monitoring and Early Warning System
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographic Information System
GSMA	Global System for Mobile Communications Association
IDEA	Identification, Delivery and Empowerment Application
ICT	Information and Communications Technologies
IVR	Interactive Voice Response
ITU	International Telecommunication Union
IoT	Internet of Things
MIPS	Multiple Internet Payment System
PARRSA	Projet d'Appui à la Réhabilitation et à la Relance du Secteur Agricole
PPA	Programme Priority Area
SDG	Sustainable Development Goal
WUR	Wageningen University and Research

Executive summary

The Science and Innovation Strategy of the Food and Agriculture Organization of the United Nations (FAO) has reaffirmed the objective of the Organization to build on innovations, including digitalization, “to realize context-specific and systemic solutions for more efficient, inclusive, resilient and sustainable agrifood systems”. This aligns with the ambition of governments in Africa to better use digitalization to transform agrifood systems, aiming for greater efficiency, inclusivity, resilience, growth, and for the achievement of the African Union’s Malabo Commitments, Agenda 2063, and the Sustainable Development Goals (SDGs).

The FAO Regional Office for Africa is intensifying its efforts to promote the adoption of digital agriculture against this backdrop. It has developed a guiding framework for better supporting sub-Saharan countries on digital agriculture. The present study, conducted in partnership with Wageningen University and Research (WUR), has contributed to that framework. Its aims were to:

- provide a situational analysis of key project interventions that addressed digital agriculture across all subsectors in sub-Saharan Africa;
- carry out a deep dive analysis on the contribution of digital solutions in some of these projects for increased crop production and protection, for risk reduction, as well as for making value chains more profitable and attractive for investment; and
- provide recommendations on how to better support the adoption of impactful digital solutions.

After an introductory chapter, another provides an up-to-date overview of key features of digital agriculture in Africa, building on the findings of some key studies and publications, with the objective of presenting the thematic framework of the study. These reports include the African Union’s digital transformation strategy, digital agriculture reports by the Global System for Mobile Communications Association (GSMA) and the Organisation for Economic Co-operation and Development (OECD). They emphasized the potential of digitalization for agriculture (D4Ag) in Africa and highlighted the need to accelerate support in that area and address obstacles, such as poor connectivity in rural areas, weak coordination among institutions and limited policy reforms. The FAO

programme priorities in the Africa region as well as its guiding framework for digital agriculture are also presented.

Chapter 3 introduces the methodology used for the research. This is mainly based on an online survey prepared by the FAO Regional Office for Africa, which targeted projects implemented in the region with a digital agriculture component. In all, 72 valid project entries were selected after quality control of the survey data. Not all FAO projects in Africa with a digital component were captured in the survey. A total of 40 countries out of 47 in sub-Saharan Africa responded. Some of the countries that have not responded claimed they do not have activities related to digital agriculture. Interviews were also conducted with key FAO personnel involved in some of the implemented projects. A framework was designed to analyse identified FAO projects and provide recommendations.

The survey outcomes were analysed in two steps. First, descriptive statistics helped to unveil findings related to all survey questions, with cross-tabulations carried out in some cases to apprehend links between key themes. The questions of the survey related to the agriculture subsectors covered, the geographic focus, the linkage with FAO programme priorities in Africa and cross-cutting themes, the beneficiaries, the digital technologies promoted, the use cases addressed, the types of digital activities carried out, the implementing and funding partners, the challenges met, key results, the contribution to project outcomes, and the respondents’ view on the adequacy of FAO response to stakeholders’ digital needs.

Second, two deep dives were conducted on how FAO projects have addressed the use of digital tools for crop production and protection, and value chain competitiveness in the region. Learnings from literature and other organizations on how digital solutions can be used to address these themes are also presented.

Key findings

The first aspect analysed was the importance of digital activities in the considered projects. Based on the classification adopted for the analysis, most of the projects identified (41.67 percent) were “mid-level” digital projects, with a couple of digital activities implemented in much

larger agrifood projects. Furthermore, 16.67 percent were “low-level” digital projects, with a primarily symbolic role for the digital component (for example, data collection using a tablet in a seed-production project). And 23.61 percent were “largely digital” projects while 18.05 percent were “predominantly digital”.

The most prominent agriculture subsector in which digital tools have been applied is crop production (57 projects), followed by livestock (38 projects), fisheries and aquaculture (28 projects) and forestry and natural resource management (20 projects). It is important to note here that several projects are connected to two or more subsectors. This distribution highlights the importance of crop production and livestock in the region as a whole.

Regarding subregional coverage, digital agriculture activities have been implemented the most across Eastern Africa, followed by Western Africa. Central Africa and Southern Africa are much less represented. This distribution corresponds largely to the intensity of digital agriculture at the regional level as observed in the literature.

Respondents were asked to select the most relevant FAO programme priorities in Africa and cross-cutting themes to which their projects are related. Several projects were related to many priorities. All programme priorities and cross-cutting themes were mentioned. Out of the 15 programme priorities adopted at regional level (which cover priorities at national levels), the 7 mostly mentioned were, in order: crop production and protection systems; trade and market opportunities for inclusive growth; “scaling up climate-smart agriculture; agribusiness, inclusive and resilient agrifood value chains; animal production systems and One Health platforms; fisheries and aquaculture systems; and livelihood resilience to natural and human-made disasters. While a programme priority such as decent employment in agrifood systems (the one that centrally hosts youth activities) and a cross-cutting theme such as gender equality and women’s economic empowerment have been less referenced, they are obviously important areas of digital activities in the region. These findings may illustrate important priorities in which FAO may focus its digital interventions, as well as where there are gaps in terms of digital activities.

The most represented group of beneficiaries is government agricultural institutions such as ministries, extension and agricultural research entities. Policymakers and subregional/regional intergovernmental organizations may be added to that group. This reflects the fact that FAO’s institutional mandate puts the relationship with

governments and public organizations in the foreground. Other well-represented beneficiaries include youth, farmers, farmers’ organizations and cooperatives, and women. The less represented beneficiaries are agrifood/business, stakeholders specialized in digital technologies and services (ICT stakeholders), displaced as well as indigenous populations.

Regarding women and youth, a deeper analysis carried out shows that, while women were cited as beneficiaries in 56 percent of the projects, only 16 percent of respondents acknowledged that their projects was related to the cross-cutting theme of gender equality. Similarly, while 61 percent of projects cited youth as beneficiary, only 8 percent of respondents linked their digital activities to the priority programme on decent employment in agrifood systems (largely focused on youth). These findings may illustrate that women and youth are actually not benefiting enough from digital activities implemented in projects.

Another finding relates to promoted digital technologies. The most represented ones are the relatively simpler ones such as mobile applications or SMS/USSD or interactive voice response (IVR) services, together with the use of computers. The weak digital literacy of farmers and the increasingly important penetration of mobile phone-based services in Africa may explain why these technologies seem to be preferred in FAO’s projects. While it may be understood that FAO projects do not often use more advanced technologies or services such as blockchain in the region, it would be useful for FAO to pay attention to the need for advanced solutions, considering the full spectrum of its stakeholders, as well as to the need of promoting innovative solutions that provide proven value.

Software-based solutions used in the projects have been developed either by FAO or by third parties. A couple of dozens of digital solutions developed by FAO, at headquarters or in country offices (generally with the support of the Information Technology Unit at corporate level), were used and promoted. Some of FAO mostly used solutions in many countries include the Fall Armyworm Monitoring and Early Warning System (FAMEWS), the Event Mobile Application (EMA-I) for livestock management, eLocust3m App to fight desert locust, the Digital Service Portfolio, the Identification, Delivery and Empowerment Application (IDEA). National successful digital platforms built by FAO that have been identified, which sometimes serve as models, include the Form Management Tool (FMT) or E-platform in Somalia, the Zambia Integrated Agriculture Management Information System (ZIAMIS) and the Kenya Integrated Agriculture

Management Information System (KIAMIS). Some of these platforms, built by FAO on governments' request, have been or are being handed over to governments. Some have also become digital public goods.

In terms of activities, training on the use of digital tools ranks first, followed by the development of digital platforms or social media platforms (to provide visibility to institutions or as e-commerce gateway), data collections, digital agriculture awareness creation and networking. Here too, very innovative activities or those building on advanced tools, such as the provision of index-based insurance, are less cited. It would also be good to consider very innovative activities in the future, even if they would need to target specific beneficiaries or to be implemented as pilots.

A macro categorisation (use case) analysis shows that most activities implemented are related to agrifood data analytics for agriculture policymaking, (data collection, analysis and monitoring to mainly support government), and digital advisory service provision. Next come market linkages services, followed by smart farming and access to finance activities. Many activities in these categories are related to climate or food resilience-building and emergency support. Supply chain management digital activities are less common.

Implementing partners of FAO-funded digitalization interventions are governments (66.67 percent of the studied projects; this mainly involves ministries in charge of agriculture). The Organization collaborates with them particularly in the framework of pluriannual agreements (Country Programming Frameworks) which aim at supporting agrifood interventions in general. Engaging directly private digital agriculture service providers which play a key role in terms of implementation on the ground of digital solutions seems difficult.

Apart from governments (which provide in many cases joint financial contributions), funding partners of digital activities are generally the well-known bilateral or multilateral institutions that support agriculture development (UN System, the African Development Bank (AfDB), the European Union, the Foreign, Commonwealth and Development Office [FCDO], the International Fund for Agricultural Development [IFAD], etc.). In most cases, their support was not directly targeting the digital activities, but rather the larger agrifood projects. However, the most cited funding partners, which may have more appetite for digital agriculture activities, are the European Union, the United States Agency for International Development (USAID) and AfDB.

Regarding FAO's corporate initiatives, the most centred on digital activities is the Digital Villages Initiative, currently launched in nine countries in Africa. Next comes the Hand-in-Hand Initiative through its geospatial platform.

Results achieved and recommendations

The objective of this study was not to fully assess the impacts of the targeted digital activities; this would have required substantive investigations, including on the ground. However, the survey and interviews have revealed that a key result achieved in many projects is related to improved data collection, analysis and sharing. As digital activities have been mostly implemented as part of larger agrifood projects, they help to increase production and productivity, to successfully build climate resilience, and to address climate hazards; they provide more opportunities for youth; they help improve market integration, transparency and reduction of transaction costs and financial inclusion.

FAO programme officers have estimated in majority that the Organization has so far been "somehow" effective in responding to countries' needs (41.66 percent of responses). However, 23.66 percent think that FAO has been "very adequate" in its response while 20 percent indicate that the response has been "adequate". While overall results look positive, the figures also indicate that FAO can improve its support.

Two sets of recommendations were made, based on response from the study participants, and are detailed in the last chapter of this report. The first centres around better leveraging digital technologies for food security and food system transformation in countries in Africa. Recommendations under this category are the following:

- Foster digital awareness, knowledge-sharing and capacity building on digital agriculture;
- Advocate for improved digital access, telecommunications and relevant infrastructure;
- Promote data-driven agriculture, data ethics and improved data interoperability;
- Support the scale-up of effective and sustainable digital agriculture solutions;
- Enhance digital policies and governance;
- Promote institutional coordination and partnerships; and
- Enhance digital agriculture inclusion.

The second set of recommendations specifically articulates

around how FAO can strengthen the integration of digitalization in its Africa programme priorities. They complement the first set and are the following:

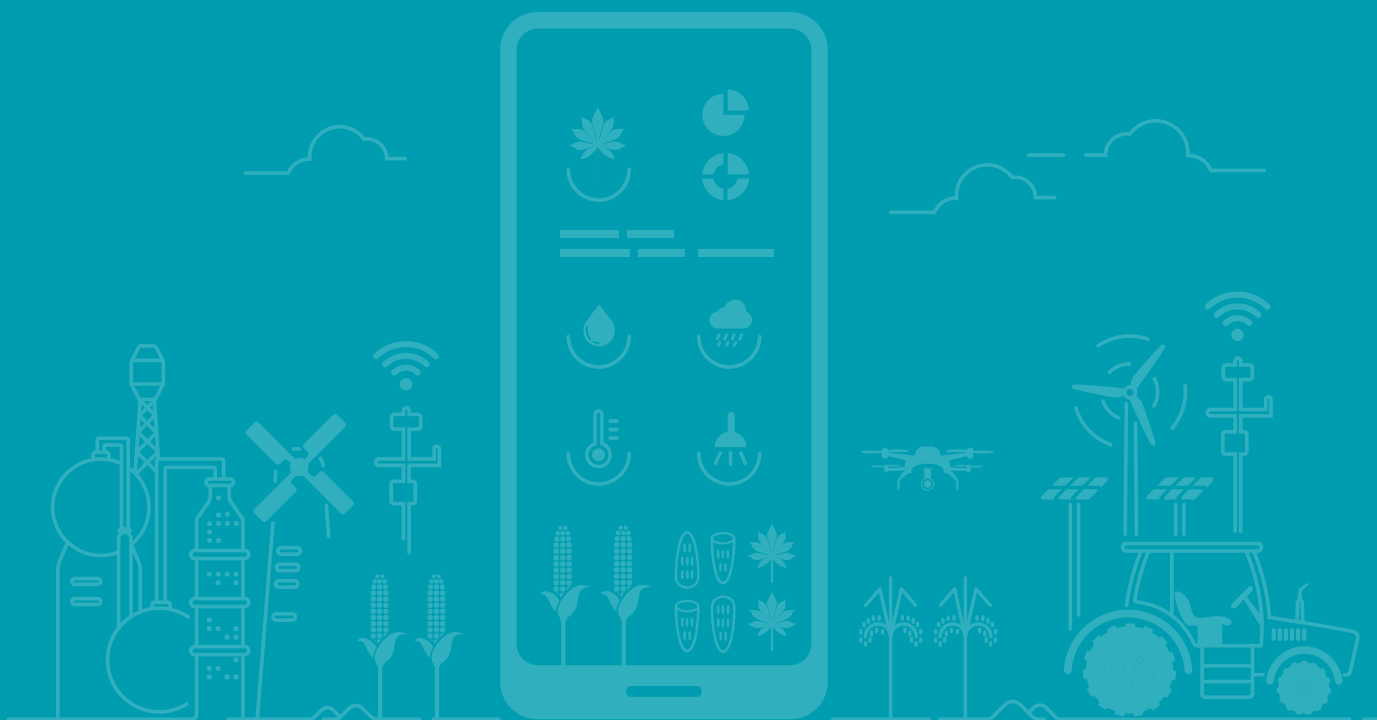
- Strengthen the integration of digital agriculture in FAO programme priorities in Africa;
- Develop practical guidelines for programme managers on digital agriculture project implementation;
- Promote internal knowledge-sharing and capacity building on digital agriculture;
- Empower focal points on digital agriculture at national, subregional and regional levels;

- Enhance the value of FAO's digital agriculture solutions; and
- Expand the scope of digital agriculture activities.

We hope that the findings will help improve the integration of digitalization into FAO projects and programmes in Africa, contribute to a better understanding of the impacts of digital agriculture projects in the region, thereby facilitating the successful adoption of digital technologies and solutions by key stakeholders, including smallholders, youth, women, and policymakers.

1

Introduction





Agriculture remains one of the most important economic sectors for the African continent, accounting in 2021 for 18.9 percent of total GDP, according to the World Bank (The Global Economy, 2023), and employing 54 percent of the continent's population, based on statistics by International Labour Organization (World Bank, 2023). According to African Union Commission (AUC) estimates, in 2014, Africa was home to 60 percent of the world's uncultivated arable land (AUC, 2015).

There are both challenges and opportunities to the transformation of African agriculture. Challenges include socioeconomic factors such as ineffective agriculture policies, lack of mechanization and adoption of innovations, weak access to finance, weakly managed urbanization and population growth. There are also physical factors related to land degradation and climate change and variability. Despite these challenges, positive trends such as agricultural productivity growth (Myeki *et al.*, 2022) and a reduction in poverty rates (Beegle and Christiaensen, 2019) are observed. However, regarding these trends, the continent shows significant geographical disparities, and in any case is overall heavily dependent on imported staple foods. Many changes are taking place, including gradually increasing access to markets for smallholder farmers as well as farmland ownership and farm-size distributions. Given this context, there is a consensus that agricultural transformation in Africa may not follow the same trajectories as in other parts of the world. Through the Malabo Declaration and Agenda 2063, African heads of State articulated their vision of what a transformed African agriculture should look like, that is, one based on the transformation of large numbers of family-oriented and subsistence producers and their structures through market integration and improved agrifood systems. Strategies supporting digital innovations in agriculture are instrumental in responding to such challenges.

In the FAO Strategic Framework 2022-2031, the Food and Agriculture Organization of the United Nations (FAO) has pledged to reinforce its activities on innovation and digital agriculture for an enhanced response to country needs. A Science and Innovation Strategy has been adopted to provide guidance on how the organization wishes to support the agrifood transformational process and the achievement of the Sustainable Development

Goals (SDGs) through innovations and evidence-based interventions. The second pillar of that Strategy articulates how FAO builds on technologies, including digitalization. The Strategic Framework has identified four "accelerators" (technology, innovation, data and complements (involving human capital, governance and institutions)) that it will leverage and which strongly build on digitalization and big data. FAO has also established at global level Digital agriculture as one of the 20 Programme Priority Areas (PPAs) of the Strategic Framework, a work stream that guides activity implementation in this domain. This PPA supports the execution of activities that help increase access to digital technologies to enhance market opportunities, productivity and resilience, and facilitates their integration into agrifood systems policies and programmes. It encourages the development of new knowledge and the sharing of best practices.

Against this backdrop and in order to respond to its regional priorities, the FAO Regional Office for Africa, which covers sub-Saharan countries, is enhancing efforts towards Member Nations' increased adoption of digital agriculture. This renewed engagement aims to help achieve the ambition of the Organization to transform agrifood systems towards more efficient, inclusive, resilient and sustainable agrifood systems for better production, better nutrition, a better environment, and a better life, leaving no one behind.

To learn from its digital agriculture investments and improve them in the Africa region, FAO has partnered with the Dutch organization Wageningen University and Research (WUR)¹ to produce this study, among others. The research analyses ongoing or recently concluded digital agriculture interventions of FAO in sub-Saharan Africa. Seventy-two activities or projects implemented mainly between 2020 and 2022 that involved the use of digital tools and services were identified through a survey.² The identified activities do not represent all FAO digital agriculture undertakings, but key interventions in the period have been covered.

The specific objectives of the study were to:

- provide a situational analysis of key project interventions that addressed digital agriculture across all subsectors;

¹ Wageningen Environmental Research, Earth Observation and Environmental Informatics team.

² Of the total number of interventions, at the date of this study, 49 percent were ongoing (a few of them started before 2020), 11 percent were in a transition phase, and the remaining 40 percent have recently ended (in the last three years).

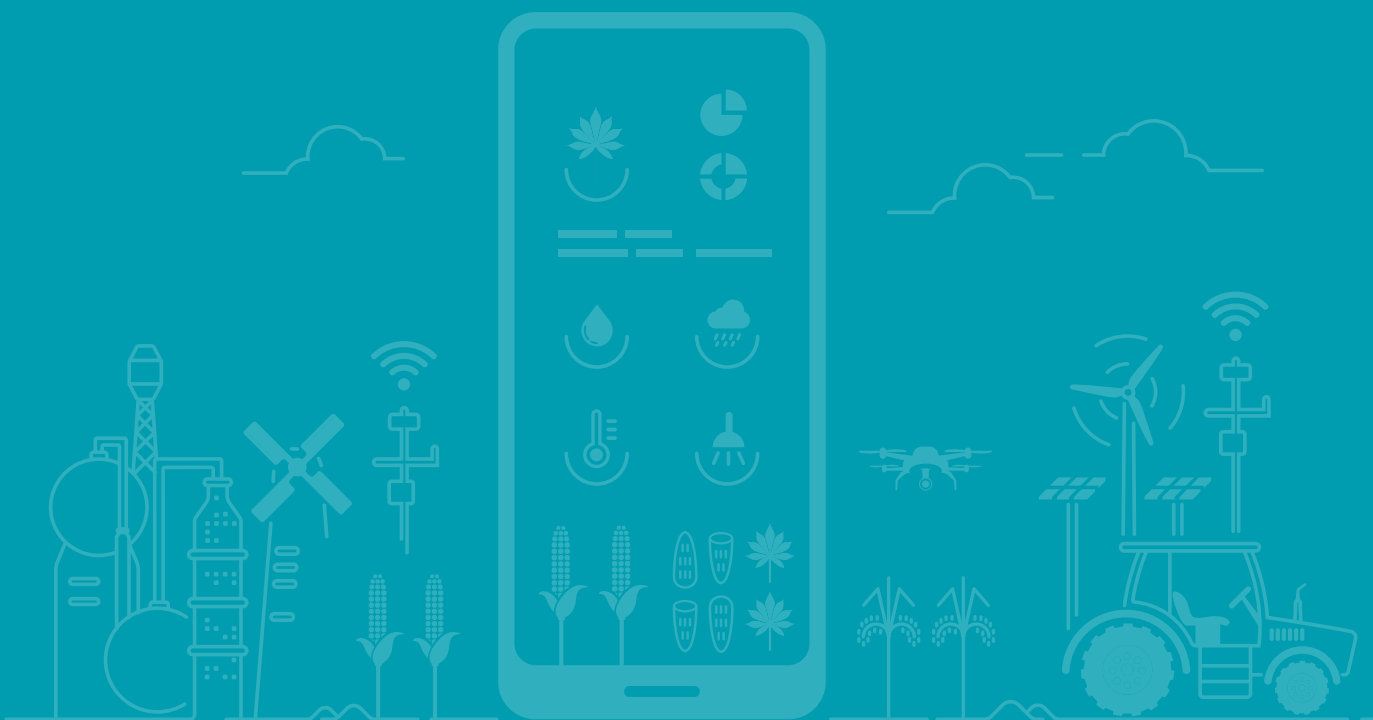
- carry out a deep-dive analysis on the contribution of digital solutions in some of these projects for increased crop production and production risk reduction, as well as for making value chains more profitable and attractive for investment;
- provide recommendations on how to better support the adoption of the most useful and impactful digital solutions; and
- facilitate stocktaking for the sharing of best practices and lessons learned.

The recommendations are notably intended to inform strategies for policy interventions in countries, better mainstreaming digitalization in FAO's programmes and eventually facilitate the effective adoption of digital technologies and solutions by FAO's key stakeholders (smallholders including youth and women, policymakers, etc.).

The following chapters describe the contextual elements on digital agriculture in Africa and the methodology used. Then, a diagnostic based on the analysis of the different research information sources (survey, interviews with FAO experts and stakeholders, project documents) is provided. Follows a deep dive into the use of digital tools for addressing issues related to improving crop production and fostering value chain competitiveness. Finally, key takeaways and recommendations are presented.

2

Setting the scene: context for digital agriculture in Africa





2.1 The need for enhancing agrifood system transformation in Africa

As mentioned in the introduction, digital agriculture is seen as having a critical role in enhancing agrifood systems transformation in Africa. On the one hand, digital agriculture contributes to structural changes in various food systems components, such as: increasing food production in a cost-effective and sustainable way; de-risking it through high quality and downscaled agrometeorological advisory; reducing post-harvest losses; making supply chains more efficient and transactions less costly; and increasing access to both input and output markets. Digital solutions also help reduce agricultural credit and insurance provision costs. On the other hand, digital agriculture helps to respond to crises of different nature. Digital solutions, for instance, have helped during the COVID 19 crisis to avoid the disruption of supply chains and provide money transfers to beneficiaries while ensuring social distancing. Similar advantages are obtained in areas of conflict and in response to natural hazards, for example, when it is not possible to send agents on the ground for technical assistance or cash disbursements.

Digitalization is considered one of the key solutions to address some of these challenges. In the next section, we will see how challenges are specifically addressed on the African continent, drawing on recent publications.

2.2 Importance and key features of digital agriculture in Africa

To get an overview of digitalization for agriculture (often also abbreviated as D4Ag) in Africa, we conducted a desk research on some of its specific issues and use cases³ (which are analysed in more detail in Chapter 4).

Through several reports, the Global System for Mobile Communications Association (GSMA) has analysed the status of ICTs in Africa, mostly from the perspective of mobile technologies. With more than 1.2 billion connections and over 650 million unique mobile users projected by the end of 2022 in Africa, mobile communications have the prospect of a greater reach in Africa than any other technology, making it an important

enabler of social and economic progress in the region. This is especially true when we consider the potential that digital agriculture can help unleash (GSMA, 2022a). Moreover, by the end of this decade, there will be more than 340 million 5G connections in Africa, equivalent to a fifth of total mobile connections (GSMA, 2022b), allowing in principle the creation of a set of advanced services to agriculture ranging from advisory to early warning to value chain tracing and access to market services. Mobile connectivity has the potential to accelerate Africa's digital transformation in agriculture, although realising this potential requires policy measures to support network investments and improve the affordability of digital services.

When considering **policies** and regulatory frameworks related to D4Ag, a first reference is the African Union's *Digital Transformation Strategy for Africa (2020–2030)*, published in 2020 (AU, 2020). It has been noted that D4Ag is gaining momentum in Africa due to a rapid increase in mobile phone access and internet penetration in rural areas. Africa has a large share of the world's remaining uncultivated arable land, enough, according to the African Development Bank, to feed 9 billion people by 2050 (AfDB, 2016). Onboarding the 200 million farming population currently without internet access would result in significant gains in GDP, economic productivity and gender equality. However, important obstacles need to be tackled for digitalization of agriculture to reach scale and create impact. First, there is a weak coordination among continental institutions pursuing the digitalization agenda of the continent. Second, low cohesion, cooperation, coordination and harmonization among regional and continental actors is the cause of limited policy and regulatory reforms. Last, to facilitate the interconnection of networks across borders, including national and commercial backbones, regulatory frameworks for data protection, storage, processing, and handling are needed.

Another key reference study is the *Status of Digital Agriculture in 47 sub-Saharan African countries* (FAO and ITU, 2022). The study assesses the status of the digital agriculture landscape in 47 sub-Saharan African countries.⁴ This is done through six key themes: infrastructure, digital penetration, policy and regulation, business environment, human capital, and agro-innovation. The study presents

³ The digital agriculture use cases are categorized based on the classifications developed on the one hand by CTA and Dalberg (Tsan *et al.*, 2019), and on the other hand by GSMA (2020), with some minor changes in the terminology. We will consider the following use cases for this report: advisory services, smart farming, financial services, market access, procurement and supply chain management and macro agri-intelligence, including data analytics for agricultural policymaking.

⁴ Countries are at varying levels of digital transformation, which makes it possible to share and learn from best practices and success stories.

both the status quo and the challenges faced in a digital transformation journey. Main takeaways from the study are:

- The region has a high potential for digital agriculture transformation. The potential is enabled by, among others, the continent's youthful population, mobile phone penetration, decreasing costs of mobile phone devices and the rise of digital platforms, e-commerce, and e-government services.
- Barriers still exist, hindering the digital transformation of agriculture, such as:
 - limited broadband access, especially for landlocked countries;
 - limited infrastructure in rural areas (access to electricity, reliable mobile broadband network coverage);
 - the fact that mobile broadband prices and internet-enabled mobile devices are out of reach for most people;
 - low digital skills in the population, especially among women, youth and rural populations;
 - a business environment that is not always favourable to attract investment in digital agriculture;
 - underinvestment in agro-innovation research and development, which should go hand-by-hand with digital innovation; and
 - lack of national digitalization policies and especially of strategies aligning them with agriculture policies (with a few exceptions such as Benin, the Niger, Nigeria and Rwanda).

The next paragraphs will address some key digital agriculture thematic issues in Africa.

In its report *Digital Agriculture Maps: 2020 State of the Sector in Low and Middle-Income Countries* (GSMA, 2020), GSMA observed that in sub-Saharan Africa, digital **financial services** have experienced considerable growth, driven by the prevalence of mobile money across many countries. Mobile money has made it viable to provide financial services via mobile phones and extend the reach of services to segments of the population like the small-scale producers, which financial service providers have traditionally considered too difficult and expensive to serve. However, this growth has been mainly concentrated in Eastern Africa, where mobile money adoption is more widespread. An example is the M-Pesa service by FAO in Kenya (Vodafone Group, 2023). Using satellite observation and geodata to provide social protection and financial services, the service reached 65 percent of

Kenyan households and, in later stages, provided early warning signs bundled services against pests and diseases.

Digitalization also impacts specific **issues** related to **climate change**, **agrifood policies**, and **inclusion** (referring notably to women and youth). Digital technologies and associated use cases have numerous opportunities for agrifood system transformation in the face of **climate change**. According to a report by Ferdinand *et al.* (2021) and sponsored by the Global Center on Adaptation, such services can increase global yields by 23 percent to 168 percent and incomes by 30 percent to 57 percent, with the highest increases occurring in case or bundled services. According to the "Global Matrix of Digital Readiness" referred to in the earlier-referenced publication, Ferdinand and his colleagues inform that most African countries have a high exposure to changing climate conditions and a low digital readiness to adapt. Small-scale producers, pastoralists and fishers often lack the resources to adapt and thus are most vulnerable to climate change.

According to a 2022 paper published by the Organisation for Economic Co-operation and Development (OECD) (McFadden, Casalini and Antón, 2022), beyond costs and relevance of D4Ag, trust in the use of digital technologies is an underlying fundamental condition for working with small-scale producers. Lack of digital literacy, social norms and resources create challenges such as data privacy, security, and confidence in data-sharing. National governments have a pivotal role in helping bridge these trust gaps, strengthening extension services for farmers' technological learning, facilitating data exchange between solution providers and farmers. Policy frameworks should also promote the standardization of evaluation and certification of digital agricultural technologies.

With regards to **gender inclusion** in D4Ag, a 2022 policy brief (FAO, 2021a) highlighted the digital gender gap in sub-Saharan Africa and its implications for FAO's response and its work. D4Ag can pave the way for improving the functioning and inclusiveness of food systems. For example, the FAO Country Office in Senegal partnered with a local startup, E-tolbi, to effectively work with gender-inclusive agripreneurs and extension agents. This resulted in a deeper penetration in the farming population (up to 60 percent of women) to provide agroadvisory and market linkage-based services.

Agriculture is the backbone of African economies, with 60 percent of its population employed directly in agriculture. But farming has an image problem in large parts of the continent. Many young Africans associate farming with

poverty, resulting in an ageing farming population that could threaten food security. Therefore, it is critical to understand the **gender and youth intersectionality** in D4Ag to efficiently work with rural men and women, not only to access D4Ag but also use and benefit from these new technologies that have an impact on food and nutrition security.

Finally, we refer to two publications by GSMA and FAO relating specifically to **some of the use cases** addressed by D4Ag.

In the GSMA report (GSMA, 2022c), the potential of smart farming is examined. These solutions, which go hand in hand with digital solutions, are defined as on-farm and remote sensors-enabled devices that generate and transmit data about a specific crop, animal, or practice. The report highlights that smart farming solutions can help smallholder farmers in lower middle-income country increase their productivity and resilience to disaster, optimize their inputs, labour and natural resources, and reduce crop and animal loss and waste. Smart farming tools have several benefits, including shorter production cycles, reduced farming operations costs through shared management and ownership of machinery, lower use of inputs, higher yields, and fewer losses from pests and diseases. However, such solutions face several challenges to achieving scale, namely, lack of mobile and internet of things (IoT) network coverage in rural areas, high cost of devices and connectivity, and the low digital and technical literacy among smallholders.

The 2023 edition of *The State of Food and Agriculture* (FAO, 2023c) and two background papers (Ceccarelli *et al.*, 2022 and McCampbell, 2022) highlight the importance of disembodied digital solutions⁵ for scaling digital agriculture in lower middle-income countries and Africa. Disembodied solutions offer vast opportunities for scaling digital information and supporting digitization, especially by addressing primarily the agroadvisory use case.

These various studies suggest that a gradient of more or less controlled forms of agriculture can be achieved with digital technologies and solutions, moving towards precision agriculture supported by environmental variables. As opposed to the difficulties encountered so far by the penetration of mechanization and especially fully automated solutions, disembodied solutions offer vast

opportunities for scaling digital information and supporting the digitization of agriculture, value chains and food systems in general.

2.3 Key themes in FAO's programme of work for Africa

2.3.1 Regional priorities and Programme Priority Areas

FAO provides support to Member Nations by responding to regional and country priorities that they have defined. FAO's interventions in sub-Saharan Africa aim to enable the implementation of the Malabo Commitments (focused on the agricultural sector) as well as the Agenda 2063, both adopted by the African Union. An important framework for defining more specifically FAO's regional priorities in Africa is the African Regional Conference. At its 32nd Session held in Malabo, Equatorial Guinea, in 2022, the Conference adopted four regional priorities:

- sustainable agrifood production systems;
- efficient and equitable food and nutrition systems;
- climate action and sustainable natural resource management; and
- building resilience, ending poverty.

These regional priorities are in line with the adopted Country Programming Frameworks (which are the programmatic instruments for the collaboration between FAO and each country in the region).

Since the adoption of the Organization's Strategic Framework 2022–31, the Africa region has defined 15 Programme Priority Areas out of the 20 established at global level. They support implementation of projects and programmes and the carrying out of the regional priorities and the Country Programming Frameworks.

The 15 regional PPAs, including their alignment with the regional priorities and the four betters (overarching intervention framework of FAO at corporate level) are illustrated in the Table 1. Apart from these 15 PPAs, cross-cutting themes have also been adopted. D4Ag is considered as one of those cross-cutting themes in the region.

⁵ This refers to software-based solutions that do not rely on the use of agricultural machinery but require limited hardware resources, generally in the form of a smartphone or a tablet, or software tools.

Table 1. Regional priorities, Programme Priority Areas and the four betters

African regional priorities adopted by FAO Member Nations	FAO's Programme Priority Areas in the Africa region	Four betters
Sustainable agrifood production systems	<ul style="list-style-type: none"> Animal production systems and One Health platforms and actions Crop production and protection systems Fisheries and aquaculture systems 	Better production
Efficient and equitable food and nutrition systems	<ul style="list-style-type: none"> Make nutritious foods safe, available and accessible Smart policies, institutions and investments for agrifood systems transformation Trade and market opportunities for inclusive growth Agribusiness, inclusive and resilient agrifood value chains 	Better nutrition
Climate action and sustainable natural resource management	<ul style="list-style-type: none"> Scaling up climate-smart agriculture Ecosystem restoration and sustainable land management Sustainable use of biodiversity, responsible governance of natural resources Water management for sustainable agriculture 	Better environment
Building resilience, ending poverty	<ul style="list-style-type: none"> Social protection for livelihoods and resilience Resilience of livelihoods and agrifood systems to natural and human-made shocks Decent employment in agrifood systems Resilient and sustainable food systems in African Small Island Developing States (SIDS) 	Better life

The cross-cutting themes of the Regional Office for Africa include: gender, youth and digital agriculture

Source: Authors' own elaboration

Digital agriculture activities at FAO support the achievement of the regional priorities and the PPAs. The analysis of D4Ag activities in this report will thus be made considering their interrelations with and contributions to the achievement of the regional priorities and the PPAs.

2.3.2 FAO's guiding framework for digital agriculture in Africa

The FAO Regional Office for Africa has recognized the strategic importance of digital agriculture for agrifood system transformation on the continent, and its effective potential for contributing to youth and women development, increasing inclusion, supporting poverty reduction and coping with shocks such as climate hazards and food security emergencies. The African Regional Conferences have, over the last years, consistently recommended a stronger collaboration with governments

and key stakeholders on that issue.

To respond to these requests, a guiding framework for digital agriculture interventions was developed in 2021. It contributes to the implementation of the corporate FAO Science and Innovation Strategy as well as the corporate Digital Agriculture Programme Priority Areas. It has defined three pillars under which activities are carried out:

- Pillar 1: Insight:** promote better informed development through insights from quality data, and encourage governments to use improved data and analysis as evidence for agricultural and food system development planning and SDG reporting.
- Pillar 2: Interact:** enhance the internal digital capacity and interventions of the FAO Regional Office for Africa for programming food systems transformation

and improving interactions with stakeholders.

- **Pillar 3: Impact:** develop local digital innovation ecosystems, enabling environments and capacity to deliver scalable inclusive solutions for SDG impacts.

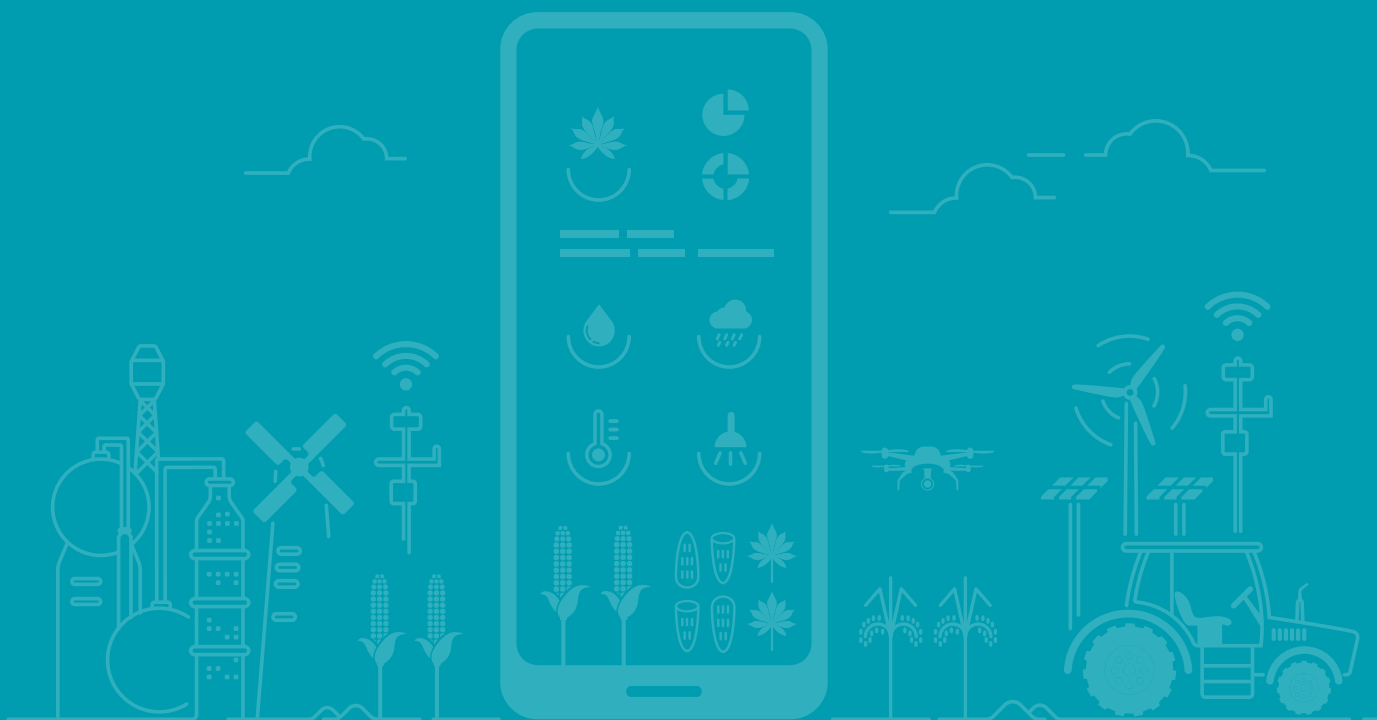
This guiding framework has recognized the need to leverage digitalization to more effectively enable capacity building for smallholder farmers, enhance opportunities for youth and women, reinforce digital inclusion, including by leveraging non-digital communication tools such as community radios when needed. It may support flagship

corporate programmes such as the Hand-In-Hand Initiative. It involves the execution of specific projects and initiatives such as the Digital Villages Initiative in Africa, which falls within its third pillar.

The production of the current study forms part of actions identified to take stock of FAO's engagements in that area in Africa, to bolster ongoing initiatives and design more effective and new interventions. This will be achieved, considering lessons learned and best practices identified by FAO or other key organizations.

3

Methodology



3.1 Proposed analytical framework

To be able to analyse FAO projects in a coherent way and derive generally applicable recommendations, we designed an **analytical framework**,⁶ as shown in Figure 1.

On the left-hand side, project **inputs** are represented by digital technologies used by projects like drones, mobile applications, or digital data. Such technologies can be utilized, also bundled together, for different types of applications or use cases, like agro-advisory or financial services. When one or more technologies are used for a specific use case, we refer to them as **digital solutions**. Let's think, for example, of a specific digital solution developed, combining satellites and sensors to provide agro-advisory services.

Next to inputs we have **outputs**, which are the most direct effects of a project, or specific digital interventions such as the operational running of a digital solution for early warning pest control. At the centre of the framework, we have **outcomes**, which are intermediate effects of the project; this includes outreach (e.g. number of beneficiaries reached) and adoption (the protracted usage) of a specific digital solution.

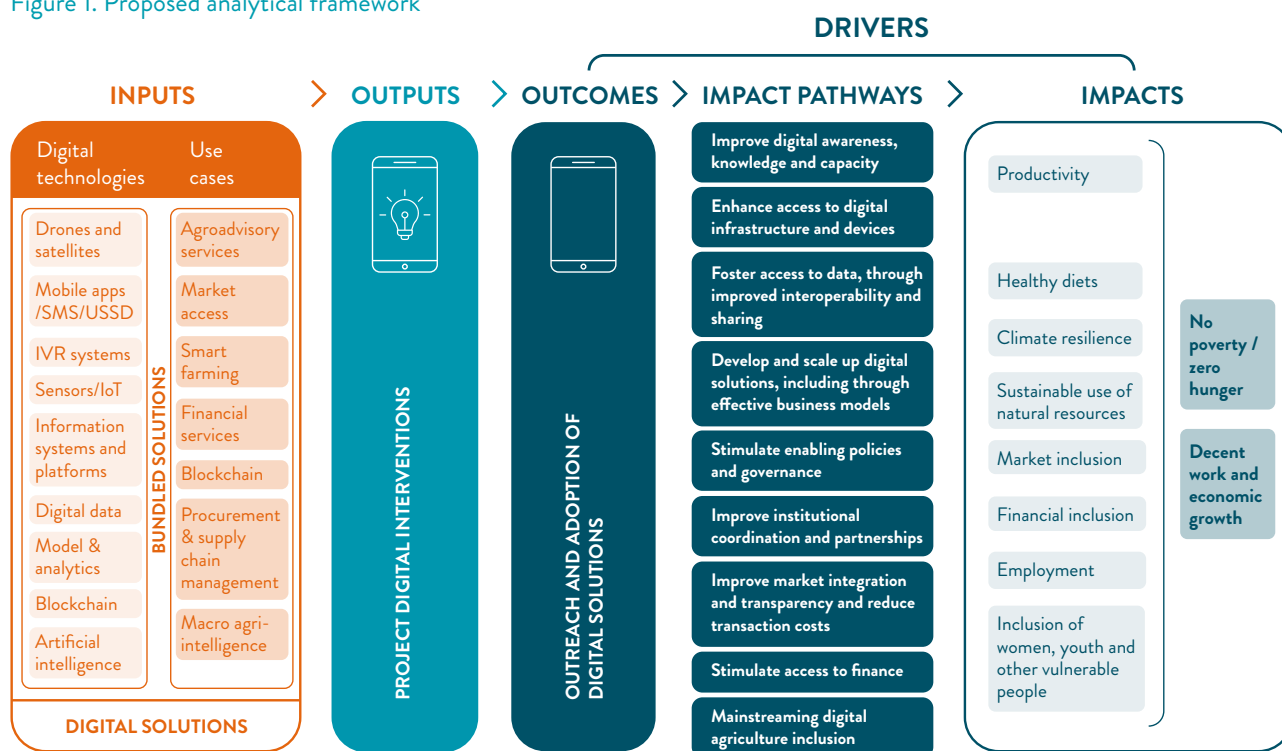
To the right of the framework, we have **impacts**, which are the indirect effects of a project (or higher-level developmental results). Impacts include farmers' productivity and profitability, healthy diets, climate resilience, sustainable use of natural resources, market and financial inclusion, employment, and finally inclusion of women, youth and other vulnerable groups. These are ultimately connected to key Sustainable Development Goals (SDGs) such as No Poverty (SDG 1), Zero Hunger (SDG 2), and to Decent Work and Economic Growth (SDG 8).

Impact pathways are the processes which ultimately lead to the project impacts. Considering the objectives of this study, attention is especially given to the role of digital interventions in that framework. Specific **drivers** and **barriers** act upon the achievement of projects' outcomes and impacts.

The pathways listed in the analytical framework are those derived from the literature and the results of this study.

Generally speaking, digital interventions have been analysed, considering their potential and contribution to

Figure 1. Proposed analytical framework



Source: Authors' own elaboration. See Footnote 6 for further details.

⁶ This framework was originally developed for the IFAD Rural Development Report 2021 and has been adapted to better fit the purpose of this report. More information can be found in Ceccarelli et al., 2022.

all result areas of FAO in the Africa region. However, due to the important number of FAO's programme priorities and considering the content of the projects identified, it has been decided to more substantively develop analyses targeting the following seven issues:

- crop production and protection and other production risks;
- value chain competitiveness;
- market access;
- access to finance;
- climate resilience;
- inclusion (particularly in terms of youth and women engagement); and
- agrifood policymaking.

In-depth (deep dive) analyses were carried-out for the first two of the issues mentioned: crop production and protection and other production risks on the one hand and value chain competitiveness on the other.

It is worth recalling that most of the projects analysed are not fully focused on digital interventions; most are agricultural development projects within which one or more interventions are related to digital technologies and solutions. More details on the nature of the digital interventions of the projects are included in Section 4.1.

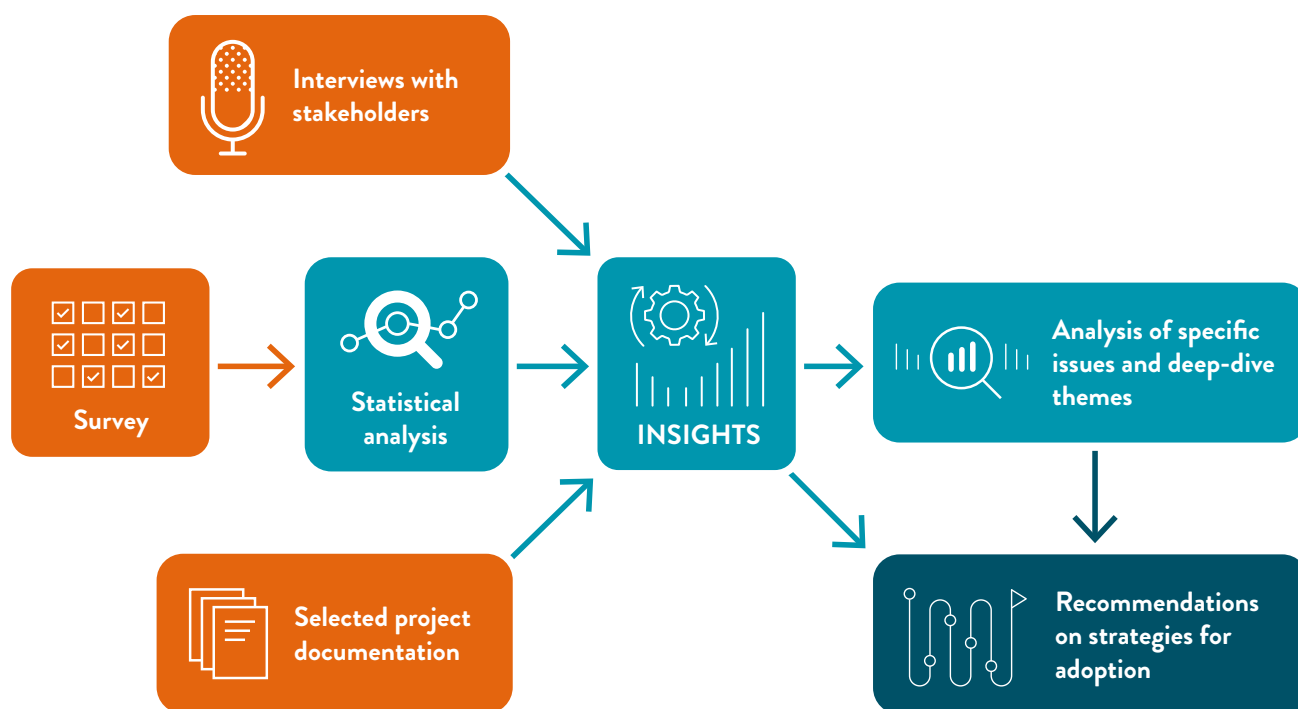
It is also important to further specify that the objective of this study was not to formally assess if the digital interventions have achieved the expected impact. Among other reasons, many projects were not at the stage when these could be evaluated. It was possible, however, in some cases to provide some insights into the impacts achieved.

3.2 Research method

In this section we give an overview of the methodological approach we have followed in this study, which is also schematized in Figure 2.

This study builds on the survey carried out by the FAO Regional Office for Africa and performed through an online questionnaire. The survey was intended to reach as many as possible FAO projects (ongoing or recently concluded i.e. in the last three years) which has or had a digital agriculture component. It was not possible to obtain a complete coverage of all projects with these characteristics. After performing a quality control of the data generated by the survey, there are a total of 72 valid FAO project entries; these are listed in Annex I. An exploratory analysis of the survey outcomes was carried out in two steps. First, the following key themes were characterized through univariate descriptive statistics,

Figure 2. Steps in the research methodology



Source: Authors' own elaboration.

which can be analysed directly from closed-ended questions or indirectly eliciting information through open-ended questions:

- agriculture subsectors (crop production, livestock, etc.);
- FAO programme priorities;
- countries of implementation;
- regions of implementation;
- beneficiaries;
- digital technologies used;

- use cases (digital farm advisory, markets, etc.);
- types of activity;
- partners;
- key corporate initiatives;
- implementation state of the project;
- challenges encountered;
- appreciation of FAO's digital response; and
- recommendations.

Then, some cross-tabulations of these themes were made.

Table 2. Projects selected for further analysis of documentation and interviews

Country	Name of project/programme
1 Benin	Stratégie nationale pour l'e-agriculture au Bénin (National strategy for e-agriculture in Benin)
2 Burkina Faso	Projet d'appui à la mise en œuvre du Plan de réponse et de soutien aux acteurs de l'élevage affectés par la crise de la covid 19 (Project to support the implementation of the response and support plan for livestock stakeholders affected by the Covid-19 crisis)
3 Cabo Verde	Building Adaptive Capacity and Resilience of the Forestry Sector in Cabo Verde
4 Congo	Système permanent intégré des statistiques agricoles (Permanent integrated system of agricultural statistics)
5 Ethiopia	A Global Network of Digital Agriculture Innovation Hubs Ethiopia
6 Ghana	Enhancing e-agriculture structures and mechanisms for extension, surveillance and early warnings
7 Malawi	Strengthening Community Resilience to Climate Change in Blantyre, Zomba, Neno and Phalombe Districts
8 Mozambique	PROMOVE Agribiz
9 Namibia	African migratory locust response to mitigate impacts on food security and livelihoods
10 Rwanda	Support to Agricultural Services and Digital Inclusion in Rwanda
11 Senegal	Digital Villages Initiative (DVI)
12 Somalia	Improving and sustaining food security in rural Somalia
13 South Sudan	Strengthening the Livelihoods Resilience of Pastoral and Agropastoral Communities in South Sudan cross-border areas with Sudan, Ethiopia, Kenya and Uganda
14 United Republic of Tanzania	Building capacity for resilient food security
15 Uganda	Blockchain and related digital technologies for sustainable agrifood value chain development in Uganda
16 Zimbabwe	Livestock Information Management System
17 Regional Office for Africa (Kenya, United Republic of Tanzania and Uganda)	Geographic Information System (GIS) based-approach for aquaculture in the Lake Victoria region

Source: Authors' own elaboration.

As specified in the previous section, seven specific issues were analysed in more details, based on both close and open-ended questions. In general, this exploratory analysis helped highlighting information gaps to be complemented through project documentation and interviews to support the diagnostic part of the study.

Out of the 72 projects that were part of the survey, 17 have been selected (Table 2) for analysis of their available project documentation (such as concept notes, project description/overviews, progress and termination and impact assessment reports in some cases, etc.). The selection was aimed at covering different PPAs and a balanced geographic spread was also considered.

Further to this, we carried out interviews with officers involved in the management of nine of these projects (Burkina Faso, Ethiopia, Ghana, Mozambique, Namibia,

Senegal, United Republic of Tanzania, Uganda and Regional Office for Africa as shown in Table 3). Some FAO managers at the regional offices, experts, as well as FAO project partners were also interviewed. In order to guide and report on the interviews, we used the analysis framework described earlier. Interviews also helped elicit information useful for deriving lessons learned and recommendations. Learning from these 17 projects helped to better articulate analyses and recommendations. Many of them have also been highlighted in boxes throughout the report.

A limited number of country offices (7 out of the 47) have not registered any digital agriculture for the survey. Some of these countries claimed they do not have activities related to digital agriculture. We interviewed officers of one of these countries to understand their rationale and views on digital agriculture.





Diagnostic



In this chapter, we distill the most meaningful outcomes from the exploratory statistical analysis done through univariate statistics and selected cross-tabulations. This is supported by figures, graphs and text boxes.

4.1 Importance of the digital activities

As not all projects were focused on digitalization, a first aspect that we have analysed is the actual importance of digital activities in the interventions considered. We have created a score expressing this importance and defined 4 classes that represent a decreasing degree of importance:

- **“Predominantly digital” projects:** There are 13 projects in this category (18.05 percent). In this case we consider projects having high emphasis on digital. A first condition is that there is an explicit reference to a digital intervention in the title of the project; this is further checked based on the actual contents of the digital intervention (captured from the description of the digital activities made by the respondents). If, despite an explicit reference to digitalization in the project name, it has just conducted simple digital activities such as simple training on a data collection tools, or simple use of GIS tools, the digital component is not judged as prominent, and the project is assigned to the next category. Another condition is that the project involves more than three activities among those indicated in the questionnaire.⁷ A project is assigned to a lower category also when insufficient evidence is provided.
- **“Largely digital” projects:** There are 17 projects in this category (23.61 percent). It includes projects in which there is no reference to digital in the title but involve at least three digital activities among those indicated in the questionnaire. It also includes the projects re-assigned to this category as described for the previous category. An example of a “largely digital” project

is an intervention which carried out both training activities on digital skills, developed a dedicated mobile application/digital platform, and developed a digital agriculture business model with no reference to digital in the title.

- **“Mid-level digital” projects:** This is the most numerous category, with 30 projects (41.67 percent). The condition here is that at least two digital activities are indicated or that a further check on the description of the project showed a greater importance of the digital component. A frequent example is that of a larger agriculture project which has deployed a solution (e.g. FAMEWS) accompanied by training of extension workers.
- **“Low-level digital” projects:** There are 12 projects in this category (16.67 percent). In this case, there is only one digital intervention planned; or alternatively, a further check on the description of activities showed mostly a symbolic role of the digital component.

4.2 Project implementation status

At the time of the data collection (mid-2022), and as shown in Figure 3, 35 projects were still ongoing (49 percent) while 8 projects (11 percent) were currently in a transition phase, and 29 projects (40 percent) were closed.

4.3 Subsectors, geographic focus, and programme priorities covered

Subsectors

Agriculture may be divided into four subsectors: livestock, crop production, fisheries and aquaculture, and forestry and natural resources management. Each project identified fall under one or more subsectors (which explains why

Figure 3. Project’s implementation status



Source: Authors’ own elaboration.

⁷ These include, for instance, training on the use of digital tools; digital agriculture strategy development; development of mobile applications/digital platforms; and use of digital devices (drones, sensors, etc.).

Figure 4. Subsectors covered by projects identified



Source: Authors' own elaboration.

the total does not add up to 72). The most prominent subsector is crop production, mentioned by 57 projects, which means 79 percent of the analysed projects falling under this subsector. This is followed by livestock with 38 projects (53 percent), then fisheries and aquaculture with 28 projects (39 percent) and lastly forestry and natural resource management with 20 projects (28 percent). This shows a substantial focus of digital activities implemented towards crop production and a lesser focus towards forestry and natural resources management. There are projects dealing with more subsectors: 16 percent state that they are dealing with two subsectors, 22 percent with three and 16 percent with four subsectors. In the case of two or three subsectors mentioned, livestock is the most frequently cited, followed by fisheries and then forestry and natural resources management.

Geographic distribution of projects analysed

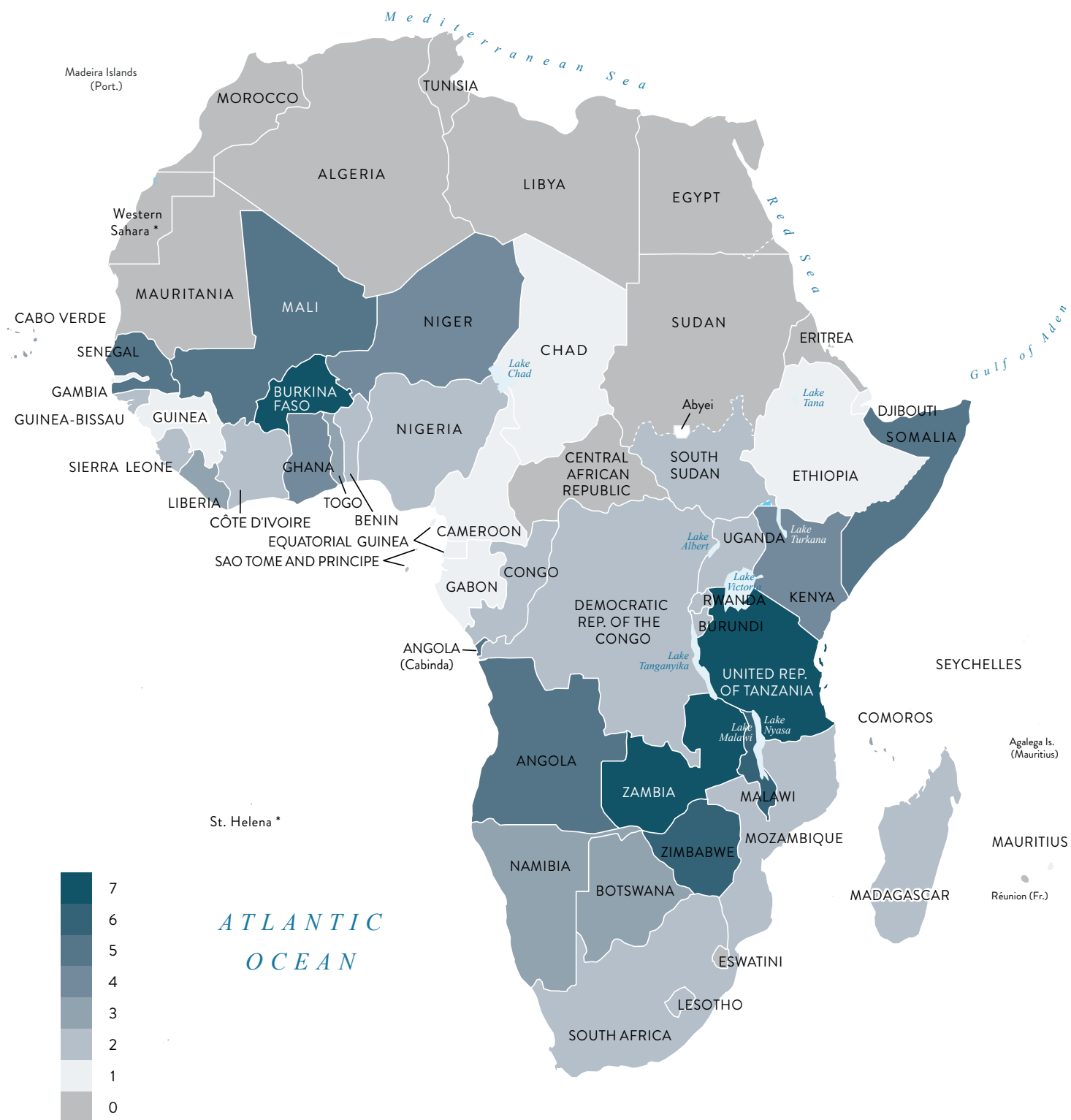
The map in Figure 5 illustrates the geographic representation of projects identified. The darker blue the colour in the map, the more projects identified in the country: from one project (light blue) to seven projects (dark blue) have been identified; the grey colour indicates there are no data available. Figure 6 gives the number of projects per country.

The largest number of projects analysed have been identified in Burkina Faso, Zimbabwe, Zambia, Malawi and United Republic of Tanzania. In 12 countries only one project was identified, including Ethiopia, Gabon, Seychelles and Sudan.



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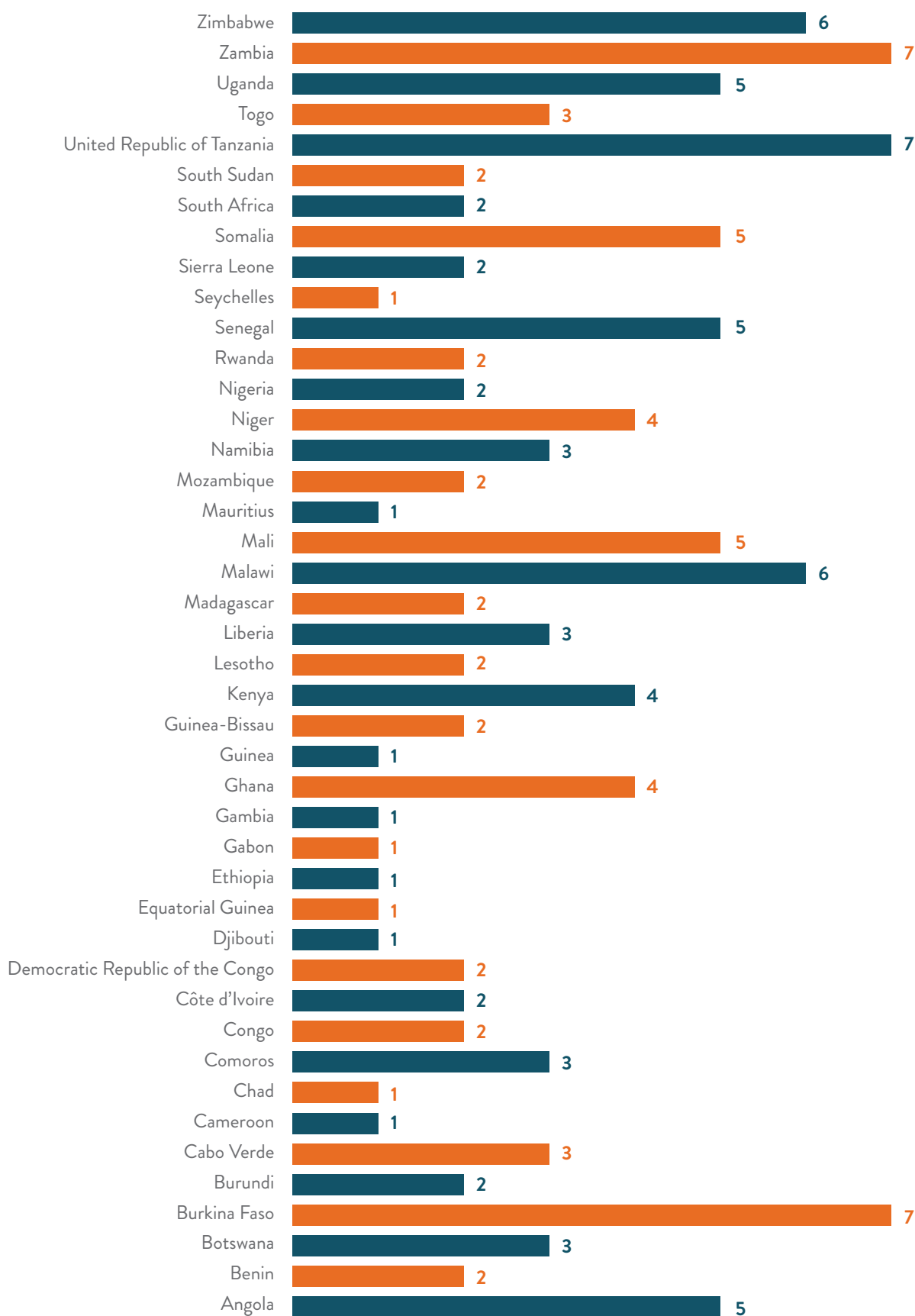
Figure 5. Geographical distribution of projects identified



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author.

Notes: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined. Final status of the Abyei area is not yet determined.

Figure 6. Number of projects implemented by country

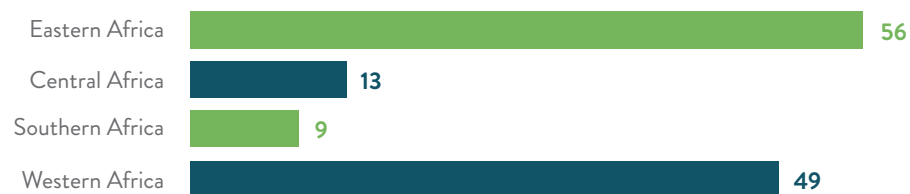


Source: Authors' own elaboration.

As anticipated in the methodological section, this is not a full representation of all FAO's work on digital agriculture across Africa. Other projects that include digital activities have not been identified, notably because the relevant project coordinators were not available to respond within the period of the survey. Some countries that have not responded have been cited by some respondents (that is why more than 40 countries are mentioned in the graphs). Some respondents have also cited projects in addition to those reported as survey entries. This is why Figures 5 (map) and 6 illustrate more than the 72 project studied.

It is important to observe that projects are sometimes implemented in more than one subregion. If, as shown in Figure 7, we consider African subregional aggregates, projects have been implemented the most across Eastern Africa, followed by Western Africa. Central and Southern Africa are much less represented. Northern Africa is also marginally represented: it does not fall under the oversight of the FAO Regional Office for Africa, but that subregion was selected by some respondents as some projects are executed simultaneously in several subregions in the world.

Figure 7. Number of projects identified by subregion



Source: Authors' own elaboration.

Linkage with FAO Programme Priorities and cross-cutting themes

Respondents were asked to select the most relevant FAO programme priorities and cross-cutting themes in Africa to which their projects were related. Overall, as shown in Figure 8, the most frequently mentioned programme priority is crop production and protection systems (45 times) which represent 63 percent of all projects.

Quite understandably, since this is the focus of the study, digital agriculture ranks second (28 times or 39 percent of all projects) and trade and market opportunities for inclusive growth ranked third (25 times or 35 percent of all projects). This is followed by scaling up climate-smart agriculture and agribusiness, inclusive and resilient agrifood value chains. Sustainable use of biodiversity, responsible governance of natural resources, decent employment in agrifood systems, and African SIDS are the less frequently mentioned priorities.

Most respondents selected more than one programme priority/cross-cutting theme; two respondents selected all 17 possibilities proposed as their project is focused on digitalization in general (for example: e-agriculture strategy development).

The fact that all FAO programme priorities and cross-cutting themes in Africa have been selected confirms

that digital agriculture activities are and can be associated with all of them. However, only 28 projects considered that they contribute/are linked substantively to digital agriculture as a key FAO theme.

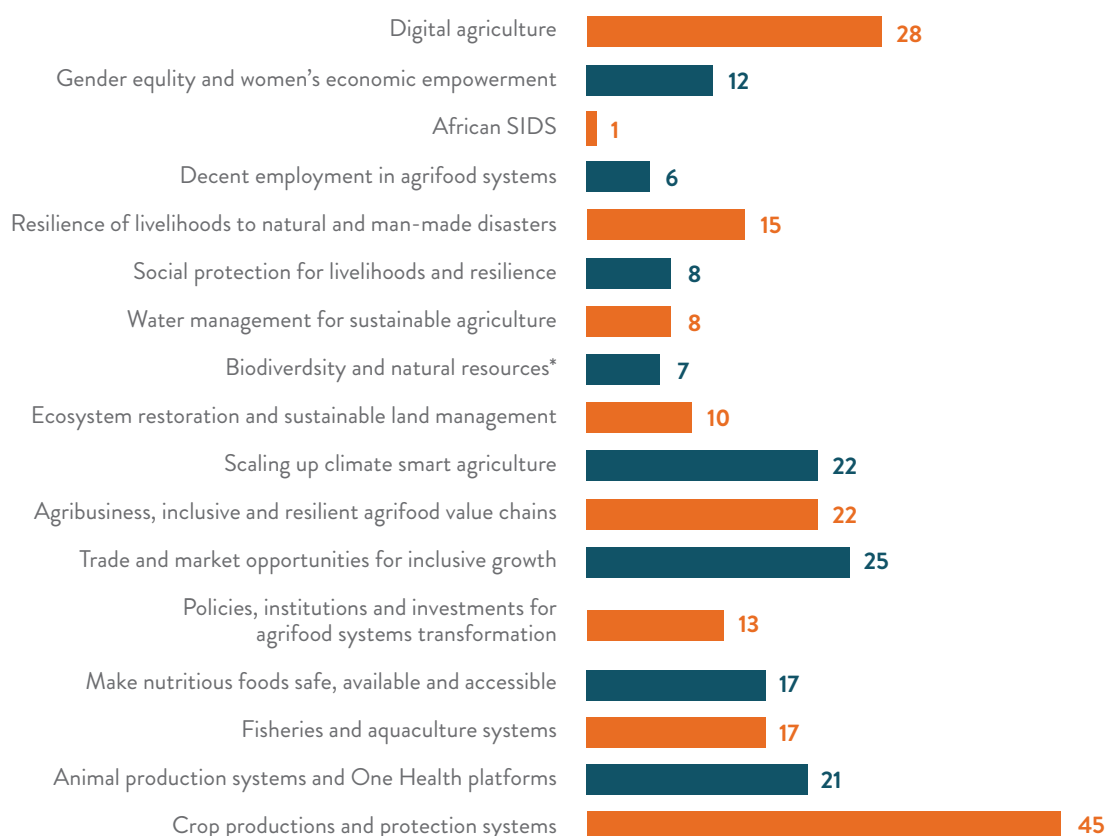
When cross-tabulating this information with the subregion of implementation (see Figure 9), we notice that, by and large, digital activities are involved in programme priorities and cross-cutting themes across almost all subregions.

The only exception is that gender equality and women's economic empowerment, social protection for livelihood and resilience, and decent employment in agrifood systems were not linked to projects implemented in Southern Africa during the period considered. Also, digital activities related to the priority on African SIDS seemed concentrated in Western Africa.

Other interpretations may look at which subregions promote the most digitalization in a specific programme priority according to the data gathered for the study. For example, the graph shows that Eastern Africa promoted digitalization and gender equality more than all other subregions. Similarly, the water management for sustainable agriculture programme priority involved digital agriculture activities in Central Africa and Western Africa more than in Southern Africa and Eastern Africa.

For the interpretation of this graph, it is also important

Figure 8. Programme priorities and cross-cutting themes in identified projects



Source: Authors' own elaboration.

to understand that it gives the relative distribution of digitalization in programme priorities by subregion. It does not give the absolute value. For instance, there is only one project related to the African SIDS programme priority identified by the study, and it was implemented in Western Africa. Therefore, if more African SIDS projects were available or identified by the study, the results could have been different. As a conclusion, these interpretations need confirmation to be generalized for the Organization's operations in sub-Saharan Africa.

4.4 Beneficiaries involved

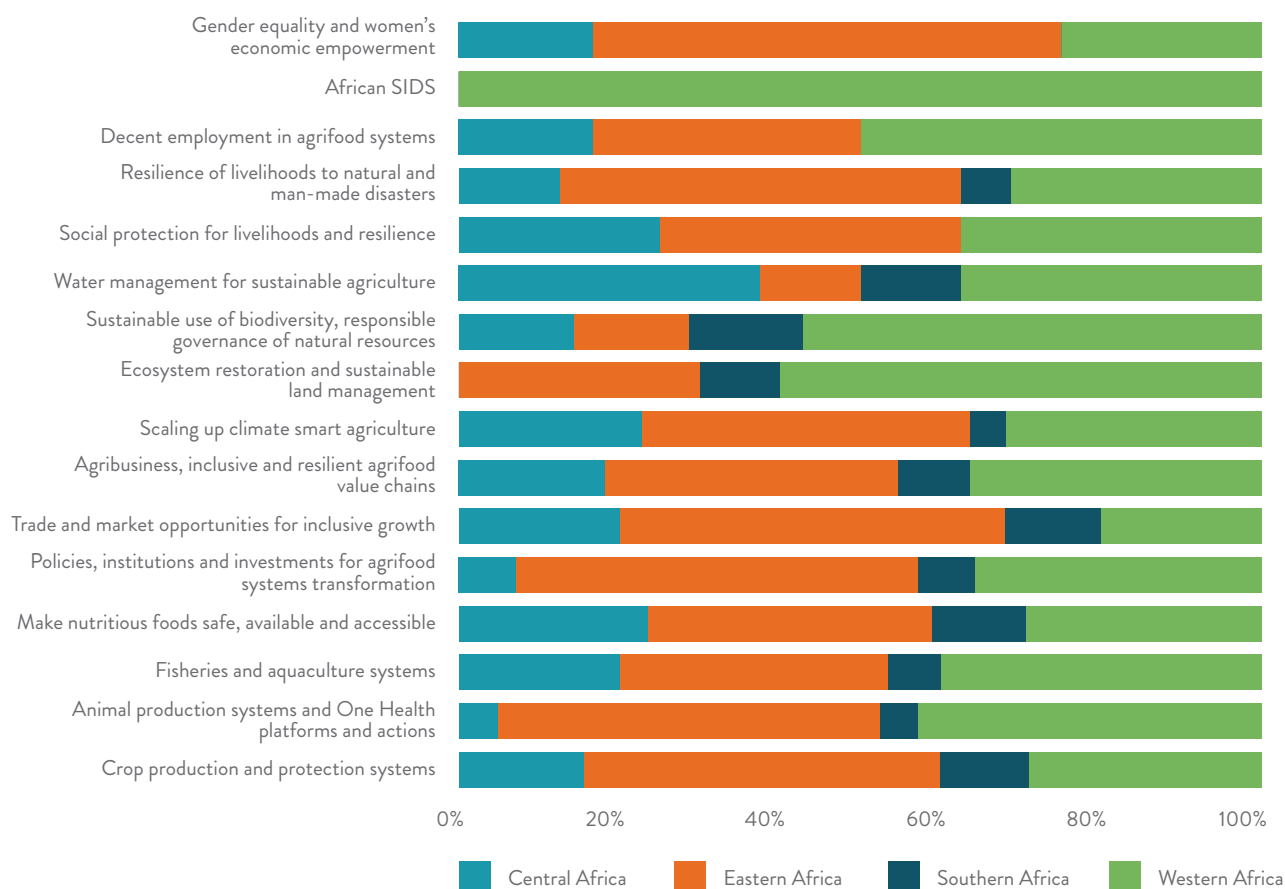
This section gives an overview of the beneficiaries of the digital interventions. Respondents could select more than one option, and this explains the fact that the total number of occurrences exceed by far the 72 projects identified. As shown in Figure 10, the most represented group of beneficiaries is government agricultural institutions such as extension, R&D, etc. Also, policymakers and subregional/regional intergovernmental organizations may be added to the group of government-related stakeholders. This

reflects the fact that FAO's institutional mandate put the relationship with governments and public organizations in the foreground. Other well-represented beneficiaries include youth, farmers, farmers' organizations and cooperatives and women. The less represented beneficiaries are agrifood/business, stakeholders specialized in digital technologies and services (ICT stakeholders), displaced persons as well as indigenous populations.

Focus on women beneficiaries

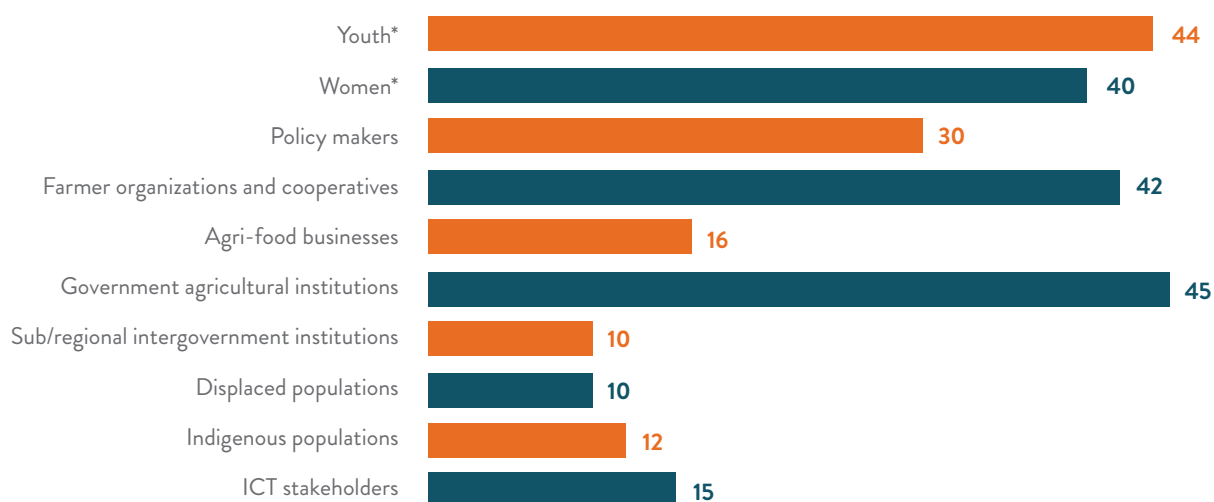
A cross-analysis was done between projects where women are cited as beneficiaries (56 percent of the total), projects that were associated to the gender equality cross-cutting theme (only 16 percent of the projects) and projects where women are explicitly mentioned in the name or description of projects (only 6 percent of projects had this feature). It is assumed that projects of the third category have put a greater emphasis on women's involvement (we refer to this indicator as "primary focus on women" see Figure 10). These three indicators provide a more complete picture for women engagement in the projects selected. A conclusion may be that while women may be involved at a large

Figure 9. Integration of digital agriculture in programme priorities by subregion (in percentage)



Source: Authors' own elaboration.

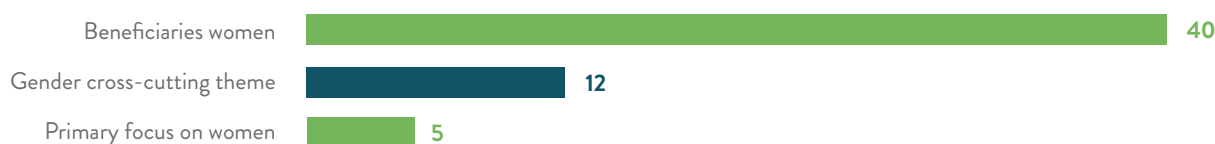
Figure 10. Project beneficiaries



* The categories "Youth" and "Women" include farmers, pastoralists, fisher folks and other young and women agrifood entrepreneurs.

Source: Authors' own elaboration.

Figure 11. Different levels of women’s involvement in projects



Source: Authors’ own elaboration.

extent as beneficiaries in many projects integrating digital agriculture, they are not strongly benefiting from many projects.

These findings seem consistent with what has been indicated in the report on gender stocktaking of

digitalization projects (FAO, 2022a) by the FAO Regional Office for Africa, where 78 percent of all projects considered mentioned gender at some point in their rationale, but only 33 percent clearly identify gender gaps in their problem statement and benefited to a relatively good extent to women.

BOX 1. EMPOWERING WOMEN IN THE COMOROS

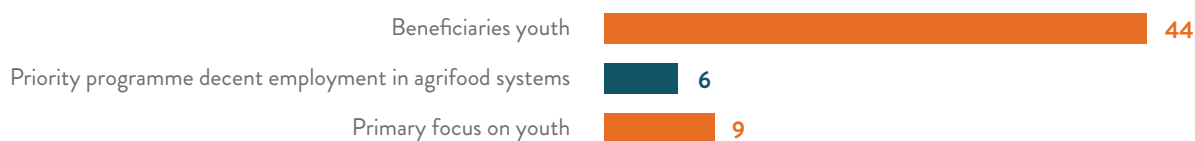
The project “Empowering women in food systems and building local capacity and resilience of SIDS in agribusiness”, now closed, was implemented in the Comoros. It had the explicit objective of empowering women in food systems, providing them with more access to financing and to the market.

It facilitated financial literacy, including the use of mobile banking offered by the digital banks Holo and Mvola. It also built business capacity for women, notably on how to sell and advertise on social media (WhatsApp, Facebook, Instagram). The project contributed to the empowerment of women in the Comoros through proposed innovations.



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Figure 12. Levels of involvement of youth



Source: Authors' own elaboration.

Focus on youth as beneficiaries

Based on the data from the questionnaire, we also made a similar analysis for youth engagements. There are 44 projects (61 percent) where youth is cited as beneficiaries. However, if we look at other elements that should indicate if the projects have made a more substantial contribution on this, we see for example that the respondents linked only six projects to the priority programme on decent employment in agrifood systems (largely dedicated to youth). Using youth as a keyword in open-ended questions, such as the description of the project digital activities, made it possible to identify a slightly higher number of projects (nine), as shown in Figure 12.

This also shows that while youth are generally targeted as beneficiaries, they are not very often the focus of these projects. This may be seen as a missed opportunity as youth are generally digitally savvy and strongly contribute to the transformation of food systems through their digital innovations, according to literature. Concrete activities mentioned were: promoting employment opportunities and agripreneurship among youth and women; training young rural agripreneurs in digital technologies for agriculture; enhancing the digital skills and innovation capabilities to foster agripreneurship among youth; enhanced knowledge and application of digital solutions in agriculture with particular focus on youth and women; and development of a youth agricultural incubator.

FAO has been supporting youth entrepreneurship in agriculture as a strategy to foster youth engagement in the sector, promote digital solutions and develop job opportunities. Initiatives developed include those introduced in the box on p29.

4.5 Digital technologies and solutions

Digital technologies and solutions promoted

The most represented digital technologies are mobile applications or SMS/USSD or interactive voice response (IVR) services, together with the use of computers, as shown in Figure 13. The preference for relatively simpler technologies suggests that FAO programme officers may have observed that the mostly targeted beneficiaries need basic digital skills. The weak digital literacy of farmers and the increasingly important penetration of mobile phone-based services in Africa (as also confirmed in literature) may explain why these technologies are preferred.

Besides these technologies, the most frequently mentioned ones are agricultural information systems and platforms, including social media (for example, Facebook and Whatsapp accounts increasingly used for business promotion and marketing even in rural areas). More advanced technologies (ranging from satellite information and drones to IoT devices and ICT-enabled machinery, data processing techniques such as artificial intelligence (AI), blockchain technologies, big data), are less represented.

While this focus on simpler technologies corresponds to the current prevailing need in rural Africa, it is useful that FAO also pay attention to the need for advanced solutions, considering the full spectrum of its stakeholders. This implies investing more, when needed, on the support to more advanced technologies like drones, IoT devices, blockchain, artificial intelligence, etc.

Blockchain was cited by one project only as one of the technologies implemented, while three others mentioned it among the technologies promoted. Blockchain is an innovative technology which promises to introduce many improvements in agrifood value chains, for instance, to ensure traceability and transparency in food production, processing, and consumption. In the following box, we introduce a project in Uganda where the application of blockchain has been analysed from different points of view.

BOX 2. DIGITAL AGRICULTURE COMPETITIONS

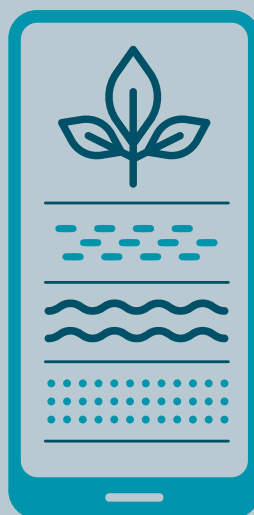
The FAO Regional Office for Africa supported in 2021 and 2022 the organization of the Pitch AgriHack digital agriculture competitions, held by the African Green Revolution Forum (AGRA, now called Africa Food Systems Forum). One of its experts served as a judge of the competition and provided other technical inputs. This has resulted in the identification and promotion of various digital agriculture entrepreneurs and solutions.



These include: the Robocare platform in Tunisia (which uses drones and artificial intelligence for pest management in greenhouses), FarmIT in Kenya (which innovatively combines crop-mapping and market linkages to support vegetable farmers) and SAYeTECH Company Limited in Ghana (which designs and manufactures climate-smart agricultural machinery that increases productivity of smallholder farmers).

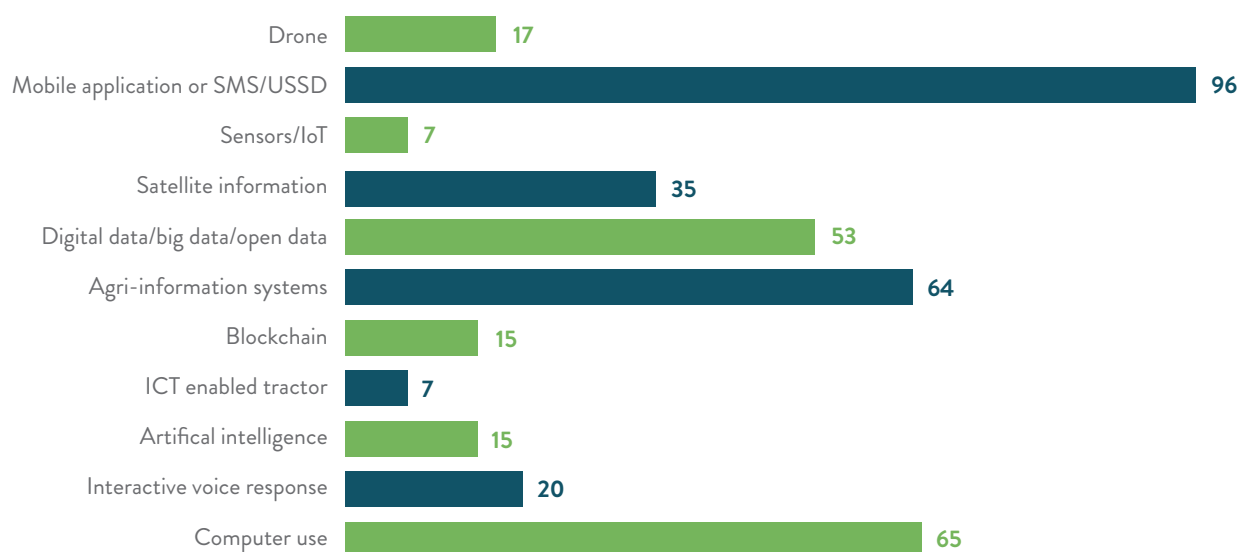


Similarly, the Regional Office supported France Médias Monde, a consortium of French public media, including Radio France International (RFI) and France 24 (French international TV), when they organized the Challenge App Afrique 2022. This seventh edition of the competition aimed at developing innovative solutions that promote sustainable agriculture. Winners were Crop's Talk (Tunisia), a mobile application that helps small-scale farmers improve their productivity and resilience in the face of climate change; OGPM (Cameroon), which supports soil analysis and facilitates the technical and commercial management of farms; and Clinicagro (Cameroon), a start-up that designs apps that support soil nutrient diagnostics.



The Regional Office also supported different activities of the competition Global AgriInno Challenge (GAC), co-organized by FAO headquarters and Zhejiang University (ZJU) from China. Three editions of GAC have been organized to date, and many African digital innovators have been recognized and promoted. These include Farmer LifeLine technologies in Kenya (which helps farmers manage pests and pathogens by leveraging solar-powered cameras data analytics and machine learning) and Grow For Me from Ghana (which operates a crowd-farming platform, among others).

Figure 13. Digital technologies promoted in projects



Source: Authors' own elaboration.

The use of satellite, GIS and geospatial technologies (cited by 17 projects) is increasingly prominent in FAO's work as geospatial technologies strongly support evidence-based policymaking. A key geospatial solution designed and promoted by FAO is the Hand-in-Hand Initiative geospatial platform (see Section 4.8) which is increasingly used in Africa, including in Uganda.

The project "Geographic Information System (GIS)-based approach for aquaculture in the Lake Victoria" implemented in Kenya, United Republic of Tanzania and Uganda, which leverages geospatial information, is introduced in Box 4 (p32).

Origin of digital solutions

The digital solutions used in the projects have been developed by FAO or are owned by third parties who have been contracted. A couple of dozens of digital solutions developed by FAO (in country offices, with the support of the Information Technology Unit at corporate level or in collaboration of other partners), were used and promoted. These platforms are sometimes directly managed by governments. The platforms include (in order of occurrence in responses):

- FAMEWS;⁸
- Event Mobile Application (EMA-I);⁹
- eLocust3m;¹⁰
- Self-evaluation and Holistic Assessment of Climate Resilience of Farmers and Pastoralists (SHARP+);¹¹
- Services agricoles et d'inclusion numérique en Afrique (SAIDA)/DSP;
- EmA-FSS;¹²
- ARTFISH;¹³
- IDEA;¹⁴
- Wapor;¹⁵
- Adaptation and Monitoring Assessment Tool (AMAT);¹⁶
- CSFAM tool (FAO/WFP Crop and Food Security Assessment Mission);¹⁷
- Form Management Tool (FMT) in Somalia;
- Zambia Integrated Agriculture Management Information System (ZIAMIS);
- Kenya Integrated Agriculture Management Information System (KIAMIS); and
- Lesotho Integrated Agriculture Management Information System (LIAMIS).

Some of the most used FAO tools are briefly described below:

⁸ See FAO, 2022b.

⁹ See FAO, 2019a.

¹⁰ See FAO, 2009a.

¹¹ See FAO, 2023d.

¹² See FAO, 2021b.

¹³ See FAO, 2023e.

¹⁴ See FAO, 2023f.

¹⁵ See FAO, 2023g.

¹⁶ See FAO, 2019b.

¹⁷ See FAO and WFP, 2022.

BOX 3. BLOCKCHAIN AND RELATED DIGITAL TECHNOLOGIES FOR SUSTAINABLE AGRIFOOD VALUE CHAIN DEVELOPMENT IN UGANDA

This project aims at developing knowledge on different potential applications of blockchain and other digital technologies to improve access to and create value addition for agriculture markets. It is a Technical Cooperation Programme running from 2020 to 2023.

The project has identified key areas of blockchain application, conducted assessments on key enablers and incentives, increased awareness and knowledge on blockchain and other digital technologies among relevant stakeholders in the public and private sectors. It has so far developed 35 examples of applications of such digital technologies in support of value chains, including digitally-enabled market linkages, supply chain management and traceability. The value chains currently targeted are coffee, tea and fisheries. For instance, with reference to coffee, the project has investigated the application of blockchain technologies to create traceability for the off-takers.

The project held various workshops where players from the government, private companies operating in the selected value chains, IT service providers and other stakeholders gathered. It created complementary materials such as case studies, databases, and learning materials. It also created synergies with existing initiatives by the government

and important collaborations between public and private sector. The potential impact of blockchain was also scrutinized from the perspective of gender and youth, with the support of the FAO Monitoring and Evaluation team.

Critical gaps were identified as well as possible pilots for testing the opportunities provided by blockchain technologies to strengthen value chains, especially for aggregators and financial institutions. One of the critical factors for the application of this technology is the digitization of the entire value chain.

There is now a phase 2 planned, where blockchain will be piloted in two value chains, including in aquaculture. FAO Uganda does not have as yet a significant data collaboration with value chain actors that would allow access to datasets and leverage mutual competences. A recommendation for FAO has been to strengthen its collaboration with private actors.

As mentioned by one of the interviewees, this will be a very useful experience to move “from excitement to real implementation”, looking at several aspects such as the existing digital infrastructure, costs, actual usefulness for farmers, data ownership and overall sustainability of the applications.



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- **Digital Services Portfolio (DSP):** It is a suite of mobile applications including systems such as Weather and Crop Calendar, AgriMarket Place, Livestock, and more. It is called Services agricoles et d'inclusion numérique en Afrique (SAIDA) (Agricultural services and digital inclusion in Africa). (For more information, see FAO, 2023h.)

EMPRES-I: This is the global animal disease information system of the Emergency Prevention System (EMPRES) of FAO which helps fight transboundary animal and plant pests and diseases and reduce the adverse impact of food safety threats. This information system has supported early warning and surveillance of animal diseases within the veterinary services in various countries. (For more information, see FAO, 2023i.)

FAMEWS: Through this digital solution, data on fall armyworm can be collected at the farm level and collated for sharing at local, national and global levels to manage pest, identify priority areas, and foster early-warning mechanisms for all stakeholders. (For more information, see FAO, 2018.)

eLocust app: It is a set of digital platforms that FAO has been using for several years for desert locust control. It is a highly effective data recording and transmission system for crop pest monitoring. It consists of a robust tablet and custom-designed software, which enable field staff to gather data and transfer it in real-time via satellite from the field to their national locust centres, before transmission to the Desert Locust Information Service (DLIS) at FAO headquarters in Rome. (For more information, see Cressman, Van der Elstraeten and Pedrick, 2016.)

- **The IDEA platform:** This system has been set up by the FAO Emergency and Resilience Office as an information platform to help manage assistance provided to countries during emergencies, but also for resilience and other development assistance support. It is in use in ten countries (including Burkina Faso, Central Africa Republic, Democratic Republic of the Congo, Ethiopia, Mali, Mozambique and Uganda). It is expected to become the information management system used by FAO across all countries for secure data collection, delivery, and monitoring for assistance to beneficiaries of emergency services. It has been developed by leveraging the Form Management Tool

BOX 4. GEOGRAPHIC INFORMATION SYSTEMS (GIS)-BASED APPROACH FOR AQUACULTURE IN THE LAKE VICTORIA (TRUEFISH PROJECT)

A Geographic Information Systems (GIS)-based approach is used for aquaculture zoning in the Lake Victoria as part of the TRUEFISH project.

The objective of the TRUEFISH project is to contribute to the development of competitive, gender-equitable and sustainably commercial aquaculture in order to support economic development and sustainable management of natural resources in the Lake Victoria basin (across Kenya, United Republic of Tanzania and Uganda).

TRUEFISH has introduced the use of GIS on its approach to spatial management (zoning) of aquaculture development. The approach to zoning has focused on initial definition of zones, setting and monitoring of carrying capacity limits on feasible areas for development of the aquaculture zones.

TRUEFISH applies a sequential methodology for zoning, in which different sources of information and data are identified, gathered, validated and mapped, using GIS, for producing different layers of information. Commercial business operators were identified and mapped. Satellite imagery was used to establish initial mapping of farms. An aquaculture situational analysis was undertaken. Climate-change data has also been created by analysing historical data for lake-surface temperature and making projections for 2030.

Aquaculture spatial planning reduces risks of aquaculture development. The project started implementing zoning-related activities in 2021. It is financed by the European Development Fund, for the benefit of the Eastern African Community (EAC).

(FMT) platform developed by FAO Somalia to provide similar support.

The Food Price Monitoring and Analysis (FPMA) tool is an advanced technical solution for the analysis and dissemination of price information. The first version of the tool was released in 2010 as part of FAO’s initiatives to address the soaring food prices at that time. Several iterations of the tool since then have introduced enhanced features for analysis and ensured that the tool is up to date with latest technologies. The most recent version of the tool (version 4) was released in mid-2022. (For more information, see FAO, 2023j.)

Other platforms used in projects were developed by third parties, including CASHVIEW (for example, in the framework of monetary transfer in Burkina Faso), Survey Solutions and Kobo Collect Toolbox (for data management), Ecofarmer (the mobile farming platform of the Zimbabwe mobile operator Econet), etc. Customization of existing data collection tools (mostly Kobo Collect Toolbox) is common across countries as a key FAO digital agriculture support to countries have been around farm data collection, monitoring and management.



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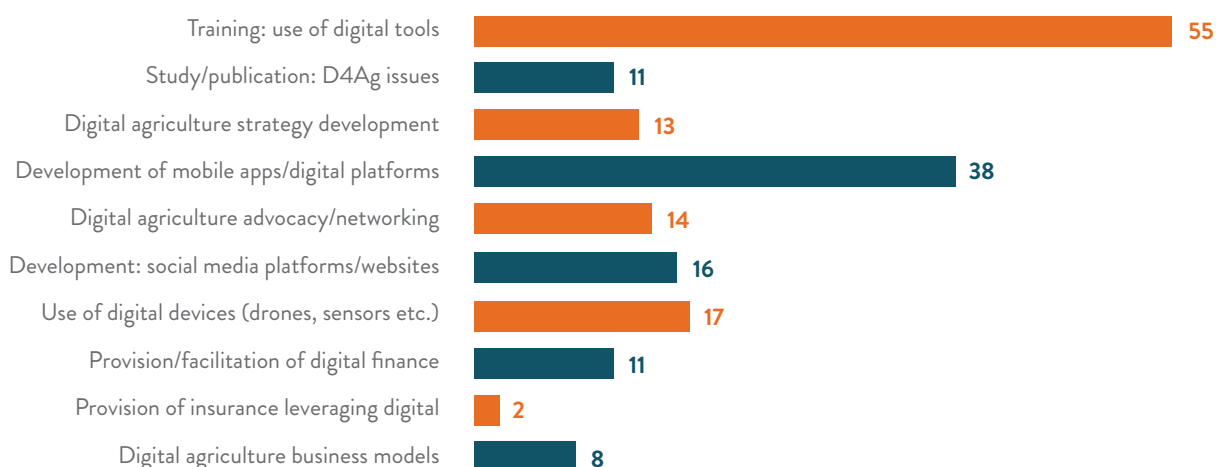
4.6 Types of digital activities

As shown in Figure 14, training on the use of digital tools ranks first, which indicates that capacity development is one of the areas in which FAO places greater emphasis. The direct role FAO often plays in the development of mobile applications and digital platforms is also prominently mentioned. As explained earlier, FAO has been playing for many years the role of developer of digital solutions which

are or act as digital public goods used by governments that need them.¹⁸

Few activities or projects addressed digital agriculture business model development to support stakeholders' initiatives (particularly youth digital businesses). Examples of initiatives developed in this sense are described in the following boxes.

Figure 14. Types of activities/outputs of the digital interventions



Source: Authors' own elaboration.

BOX 5. SUPPORTING DIGITAL BUSINESS MODEL DEVELOPMENT BY AND FOR THE YOUTH

From November 29 to December 20, 2021, the FAO Regional Office for Africa collaborated with the training centre IDEP of the United Nations Economic Commission for Africa (ECA) for the organization of a one-month online training dubbed “Harnessing Digital Transformation to Accelerate Youth Agri-Entrepreneurship and Business Growth in Africa”. The training sought to enhance the understanding of digital agriculture and effective business modelling in that area by youth entrepreneurs and policymakers working with them. It provided learning to young agricultural entrepreneurs on how they may design digital strategies for their businesses. Delivered via IDEP’s e-learning platform and through a targeted webinar,

the training benefited several dozens of African entrepreneurs and policymakers. The African Union’s division in charge of youth also collaborated on that activity.



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¹⁸ The Organization does this to contribute to digital public goods (DPGs) in critical areas where needed, particularly to support governments’ food or climate emergency-related interventions. Many of FAO’s digital tools have been included in the international DPG directory promoted by the international Digital Public Goods Alliance (<https://digitalpublicgoods.net>). In total, more than 100 digital tools have been developed or co-developed with other stakeholders at corporate level.

BOX 6. THE #HACKAGAINSTHUNGER/AFRICA

Through its IT Division (CSI) in headquarters and with the collaboration of its Regional Office for Africa, FAO launched in July 2018 an innovation challenge targeting young digital innovators on the continent. Over 100 proposals were submitted from 22 different countries across the continent. Out of this pool, 24 finalists were selected from seven countries (Benin, Cameroon, Nigeria, Rwanda, Senegal, Uganda and Zambia). They convened in Kigali for a two-day intensive programme and had the privilege to gain specialized knowledge and skills from experts in IT development, food and agriculture, and business modelling. A jury panel comprised of FAO experts and African entrepreneurs declared the top three winners (Agripredict from Zambia, Afririce Agrobusiness from Benin, and STES Group from Rwanda).



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Facilitating access to agriculture insurance services leveraging digital (index-based, etc.), is also seldom mentioned. This may be, among others, related to the known difficulties in the adoption of agricultural insurance products in Africa, to a lack of need of that service by FAO's stakeholders, or to a gap in FAO's support in Africa.

If we consider only training on the use of digital tools and relate it through a cross-tabulation to the beneficiaries, it turns out that this is aimed above all at youth, then at government agricultural institutions, women, and finally policymakers. It is no surprise that the use of digital tools, as well as the development of mobile apps, lead the types of activities. Both are crucial and are the lowest hanging fruits in the digitalization of the agricultural sector. Digital tools and mobile apps can be easily implemented, and they are accessible for a growing number of beneficiaries, given that mobile penetration keeps increasing in sub-Saharan Africa (GSMA, 2021).

4.7 Use cases

Use cases give an indication of the domains of major application or the types of major activities for which the digital solutions are implemented. The use case categorization presented in Table 4 is the one developed for the questionnaire and the report's analysis. It builds on

digital agriculture use cases proposed by CTA and Dalberg (2019) and the GSMA (2020).

In Figure 15 we see that data analytics for agriculture policymaking and digital advisory services are the most frequent use cases mentioned, followed by market access. Procurement and supply chain management is the less often cited use case.

The two most cited cases are consistent with the data on beneficiaries indicated in a previous section: FAO projects are aimed, on the one hand, at government organizations (which importantly need data analytics for policy implementation) and on the other, at smallholder farmers (including young people and women) who strongly need farm advisory services. Access to market is also very important. The weaker involvement of FAO in Africa in other use cases may indicate a weaker support to these types of activities (smart farming, procurement and supply chain management, and digital financial services) from digital technologies viewpoint.

In Figure 16 we are looking in more detail at the most frequently cited use cases for some of the beneficiaries of the projects: youth, women, farmers and farmers' organizations, and finally government stakeholders, including agricultural institutions and policymakers.

Table 3. Definition of digital agriculture use cases

Use case	Definition
Digital advisory service	Digital solutions providing agricultural (farming, livestock, agroforestry, etc.) advisory to farmers, e.g. through mobile phone apps or dedicated platforms
Market access	Digital solutions that facilitate access of farmers and other actors in the value chain to input or output markets; they may include price information systems and virtual marketplaces/e-commerce solutions
Smart farming	The use of on-farm and remote sensors to generate and transmit data about a specific crop, animal or practice to enable mechanization and automation of on-farm practices. It is usually coupled with digital solutions
Digital financial services	Digital solutions facilitating access to and management of finance by/for agriculture stakeholders, including credit and insurance provision
Procurement and supply chain management	Digital solutions supporting different actors in a value chain, including procurement, traceability, and enterprise resource planning (ERP) solutions
Data analytics for agriculture policymaking	Models, data processing solutions, dashboards allowing the extraction of indicators and analytics for policy analysis

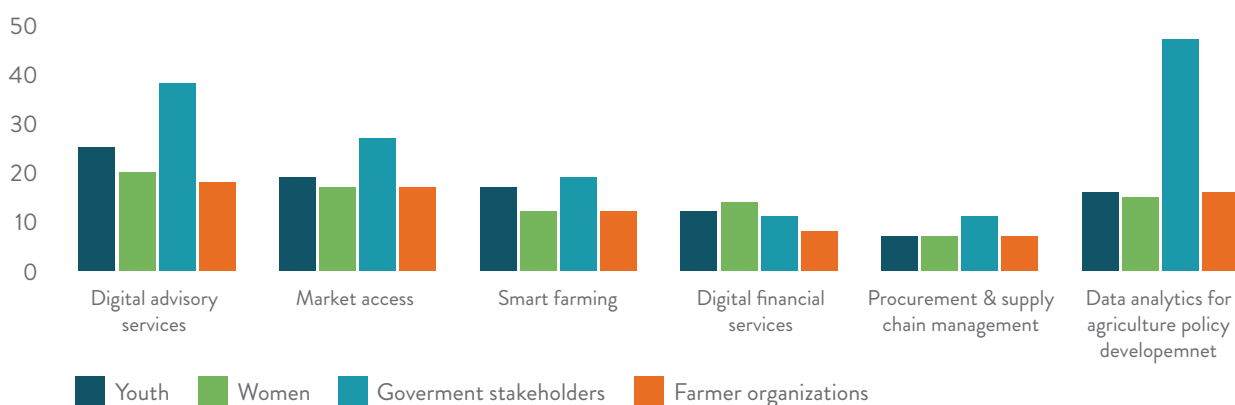
Source: Authors' own elaboration.

Figure 15. Use cases related to the promoted digital technologies



Source: Authors' own elaboration.

Figure 16. Use cases per group of main beneficiaries



Source: Authors' own elaboration.

We observe that, in the case of youth, women and farmers, the most cited uses cases are digital advisory services followed by market access. These are the applications that are more directly connected with the regular activities and decision-making processes of these two types of stakeholders.

In the case of government stakeholders, the use case mostly cited is data analytics for agriculture policy development. This may illustrate the mandate of governmental organizations which is primarily concerned with analysing data for policy, planning and management purposes. Digital advisory services are also important and are consistent with the governments' role in the extension systems of most African countries.

A note on the use digital tools for resilience and emergency interventions

A key area of FAO's work has to do with supporting countries and communities to face resilience and emergency situations caused by food, conflict or climate-related crises. This is illustrated particularly via activities of

the Office of Emergency and Resilience at headquarters (with subdivisions at regional or subregional levels) and by Programme Priorities Areas such as Social protection for livelihoods and resilience and Resilience of livelihoods and agrifood systems to natural and human-made shocks. OER's activities benefit from important financial resources and many digital platforms have been (co-)created or mobilized by FAO to support these activities for a couple of decades.

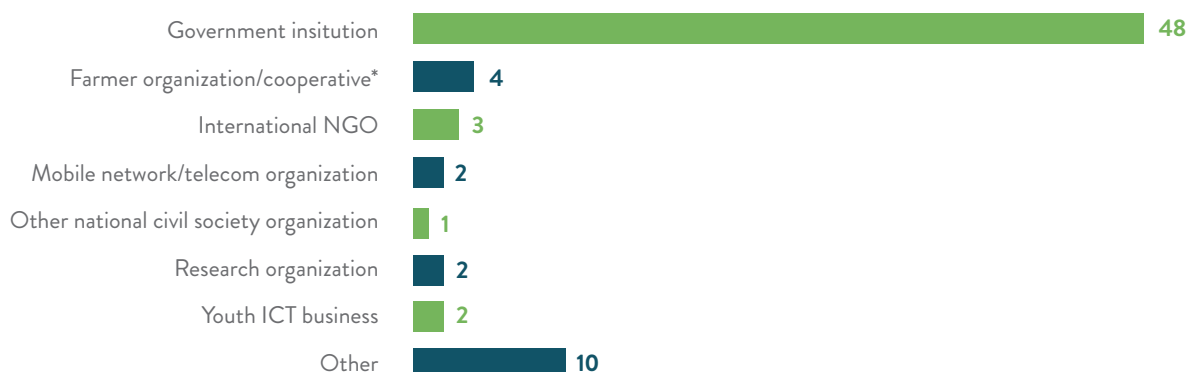
Several use cases mentioned above may be linked to emergency and resilience digital interventions, particularly when targeting smallholders: advisory services, market access and financial services. Examples of existing platforms used in Africa in this framework include the solution called E-Platform in Somalia (also called Form Management Tool); the eLocust digital platform (presented in Figure 17) used in several countries (such as Namibia, Zambia and Zimbabwe) to combat desert locust invasions (FAO, 2009b) and IDEA deployed in nine African countries.

Figure 17. The eLocust platform and its different digital solutions



Source: eLocust3 website www.fao.org/locust-watch/activities/dlis-home/en

Figure 18. Types of implementing partners



Source: Authors' own elaboration.

4.8 Engagement with partners

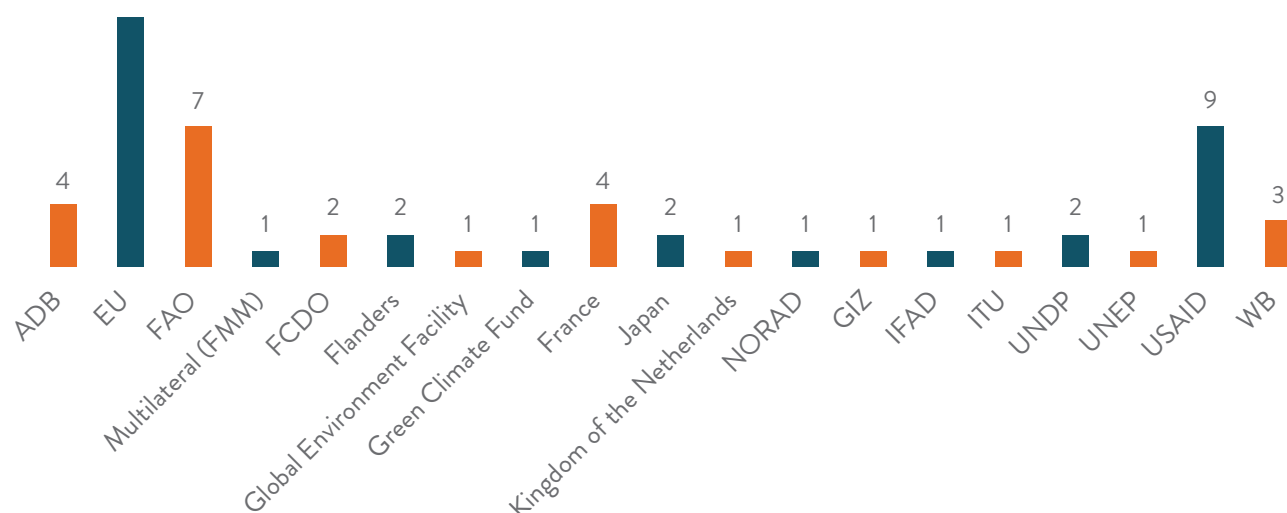
Implementing partners

As shown in Figure 18, government institutions are by far the most important implementing partner, followed by farmer organizations and cooperatives and international NGOs. The category “others” is also frequently mentioned. It refers to a multiplicity of international, regional, and local organizations (examples are regional fisheries management organizations, University of Stirling, etc.).

Funding partners

Apart from FAO itself, funding partners are represented by multilateral funds, other United Nations and international agencies, national development cooperation agencies, and a limited number of other funders. Figure 19 shows their relative importance. The European Union is by far the most important funder of projects identified. Among bilateral cooperation agencies the United States Agency for International Development (USAID) is the most prominent funder followed by France. We have not considered African national governments' co-funding,

Figure 19. Funding partners



Source: Authors' own elaboration.

which occurs in the majority of projects. We should also note that this figure may have been influenced by the fact that not all respondents provided an answer to this question.

FAO corporate initiatives

At corporate level, FAO has been implementing special catalytic programmes referred to as key initiatives. They include programmes such as the “Digital Villages Initiative», the “Hand-in-Hand Initiative”, the “Green Cities” and the “One Country One Priority Product” (OCOP). The first two initiatives (introduced in the following boxes) are focused or have a strong component on the use of digital tools.

4.9 Challenges met and results achieved

Key challenges

The following statistics are based on a close-ended question. As illustrated in Figure 20, the key challenges mentioned were infrastructural barriers (poor or unavailable connectivity, lack of electricity), capacity (digital illiteracy) of the beneficiaries, and high access costs/unwillingness to pay for connectivity or digital devices.

These challenges largely correspond to those highlighted by the studies we presented in Chapter 2. Less cited challenges were unsustainable business models, and legal challenges. Some informants gave more detailed

BOX 7. THE DIGITAL VILLAGES INITIATIVE IN AFRICA

FAO has launched the corporate programme 1000 Digital Villages Initiative (DVI) with the goal of converting globally at least 1000 rural localities into digital village hubs in which a variety of ICT-based services will be offered. The DVI is an integrated development vision that enshrines digitalization at the core of rural transformation and prosperity, addressing farm and off-farm socioeconomic elements. A pilot project has been launched in Africa.

Its activities revolve around three pillars: the first involves activities focusing on advisory services and smart farming and are related to interventions that may improve productivity by using relevant digital solutions. The second involves activities related to market linkages and access to finance services. The last focuses on the village as a whole and involves digital services that support rural transformation, with the aim of enhancing the delivery of public services in health, education, jobs, welfare and tourism, such as ecotourism and agritourism.

Nine countries have undertaken some official DVI activities. These are: Ghana, Kenya, Liberia, Malawi, the Niger, Nigeria, Senegal, Somalia and Zimbabwe. In most of these countries, assessment reports on the local landscapes and on the conditions for successfully implementation of the DVI have been prepared. Some activities have been piloted on the ground in countries such as Senegal and Somalia.

In some countries, the DVI can be implemented as part of a larger project. This is the case in Liberia, where its activities are carried out with the joint UN project “Building Resilience of Youth, Women, and Vulnerable Groups through Social Protection Floor in Liberia Using ICT”.

More information on the Initiative in Africa are available in the publication Pilot Digital Villages Initiative in Africa (FAO, 2023b).



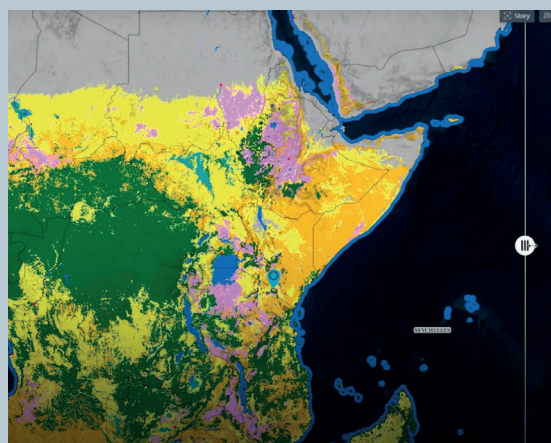
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BOX 8. THE HAND-IN-HAND INITIATIVE



The Hand-in-Hand Initiative (HIHI) is an evidence-based programme to accelerate the Sustainable Development Goals (SDGs), particularly SDG 1 and SDG 2. Among others, it includes an advanced geospatial modelling and analytics platform, an innovation data lab, and a monitoring and evaluation dashboard. The platform brings together over 20 technical units from multiple domains across FAO, from animal health to trade and markets, integrating data from across FAO on soil, land, water, climate, fisheries, livestock, crops, forestry, trade, social and economics, among others.

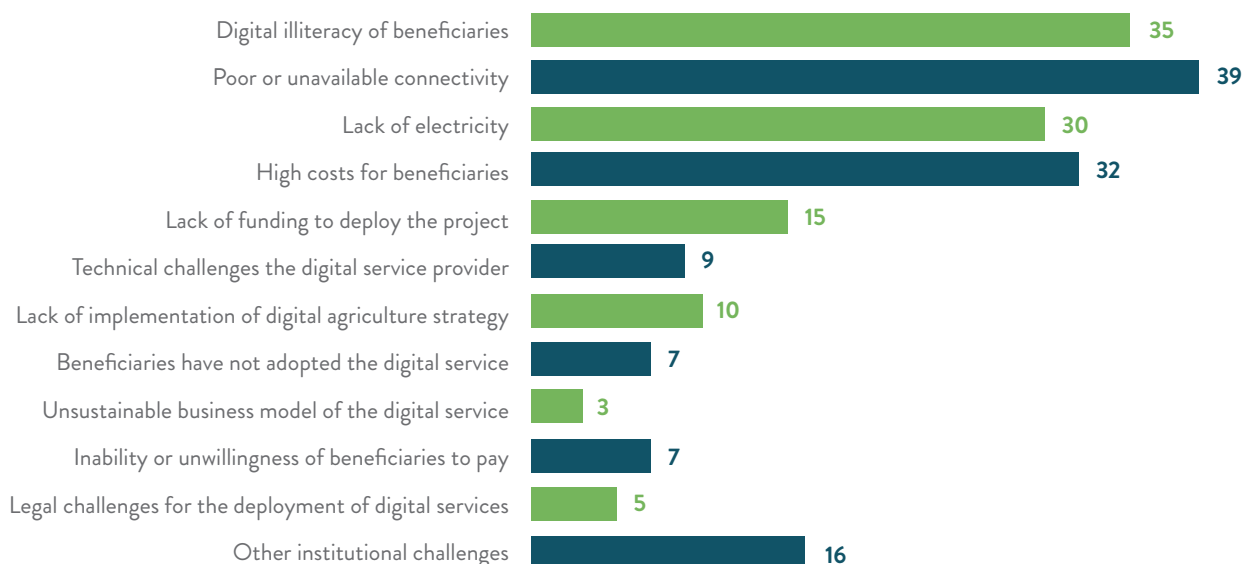
The HIHI geportal data can be combined with other sources. Several African countries are involved in the Initiative.



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Source: FAO's Hand-in-Hand Initiative website <https://www.fao.org/hand-in-hand/en>

Figure 20. Key challenges of deployment



Source: Authors' own elaboration.

descriptions and mentioned additional challenges. For instance, security conditions in the area of implementation have been identified as a major challenge for three projects. Some of these other challenges mentioned are reported as verbatim in Box 9.

BOX 9. ADDITIONAL CHALLENGES MENTIONED

- need for national-level scalability;
- unavailability of key stakeholders to make and implement decisions;
- competing digital solutions;
- very slow progress from partners despite high level of interest;
- non-trustable baseline data, or even total lack of data, at regional level for modelling projections;
- lack of readily available high-resolution satellite imagery;
- lack of mobile devices and data to collect information; and
- cost and limitations in project funding.

Contribution to the overall project/programme outcomes and impacts

We have also analysed how the digital interventions contributed to the overall project or programme outcomes and impacts. Insights captured were extracted from an open-ended question, complemented in some cases by responses provided during interviews, or elements extracted from project documents. It is important to recall that not all projects were fully focused on digital agriculture and that most digital activities or projects analysed supported larger agrifood projects or programmes. When asked about the contribution of the digital activities to projects or programmes, about half of the respondents referred to their original objectives, and not to the actual (observed) outcomes or impacts. A reason for this is that about half of the projects were still ongoing at the time of the study. We have therefore retained only answers that referred to observed results.

The contributions of the digital intervention that were most frequently cited are the facilitated data collection, analysis and sharing, which are all effectively orienting decision-making. Indirectly, they positively affect the following impacts:

- (a) increased production and productivity, including crop protection;
- (b) successful building of climate resilience and addressing of climate hazards;

- (c) improved opportunities for youth;
- (d) improved market integration and transparency, and reduction of transaction costs; and
- (e) improved financial inclusion.

In the following section we look, through several examples, at how digital interventions have helped projects and programmes to achieve the expected impacts.

(a) Increased production and productivity

Respondents have frequently mentioned that digital interventions helped delivering effective services that in turn, contributed to increased production and productivity. This is especially related to the procurement of high-quality inputs, the delivery of farm advisory and early warnings, and with reference to pest and disease surveillance systems (e.g. for the reinforcement of veterinary services and locust response).

(b) Successful building of resilience and addressing of climate hazards

Responses from the survey indicate that digital solutions promoted by several projects contributed to strategic site-specific interventions and to the development of community- and village-level risk prevention and climate change adaptation plans. In some projects this was achieved through dissemination and integration of methodologies and practices derived from the Farmer Field Schools (FFS).

Resilience in the face of COVID 19 have been supported through diverse projects leveraging digitalization such as the one presented in Box 11.

(c) Improved opportunities for youth

The analysed projects contributed directly or indirectly through increased digital capacity to preparing youth for better employment or for the growth of their businesses. There is, however, no figures given regarding new employment creation. Some activities targeting youth are introduced in Box 12.

(d) Improved market integration and transparency, and reduction of transaction costs

Digital platforms were mentioned that support e-market and supply chain solutions, allowing traceability in the distribution of products and in the purchase of inputs. This is the case for instance of the Digital Villages Initiative in

BOX 10. STRENGTHENING COMMUNITY RESILIENCE TO CLIMATE CHANGE IN MALAWI

The project “Strengthening Community Resilience to Climate Change in Blantyre, Zomba, Neno and Phalombe Districts” in Malawi made use of geospatial digital tools and satellite data for land degradation hot-spots assessment to inform on strategic site-specific interventions and the development of community and village-level adaptation plans. This resulted in a holistic approach that blends disaster risk reduction and climate change adaptation, addressing multiple threats to livelihoods with short- and medium-term interventions such as sound safety nets and good agricultural practices.



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BOX 11. DIGITAL TOOLS TO SUPPORT MIGRATION-PRONE YOUTH IN THE DEMOCRATIC REPUBLIC OF THE CONGO

In the context of the project *Capacités des jeunes agripreneurs enclins à la migration dans les zones rurales et urbaines à s'adapter à l'impact de COVID-19* (Capacities of migration-prone young agripreneurs in rural and urban areas to adapt to the impact of COVID-19), the FAO in the Democratic Republic of the Congo (DRC) received funding to build the capacity of young rural agripreneurs in digital technologies for agriculture and stimulate their employment in the context of economic and health crises. To this end, a number of agripreneurs were trained, 49 percent of whom were women, selected from seven regions of the country. It is reported that the young people trained have improved their agricultural production through the use of digital tools, which were once ignored or underestimated.



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BOX 12. TRAINING OF YOUNG RURAL AGRIPRENEURS FROM THE CONGO IN DIGITAL TOOLS

A training of young rural agripreneurs in digital technologies for agriculture in the Congo was organized in 2021 by the Decent Employment programme of the FAO Regional Office for Africa. The activity aimed to (a) raise awareness and train young agripreneurs in the use of digital tools; and (b) enable young people to better benefit from the agricultural and entrepreneurial development opportunities.

The training involved the use of mobile agriculture applications, the production of online videos, and the use of e-commerce platforms, etc. The activity was carried out in collaboration with the NGO KABU “Le partage,” which is a local civil society organization. It helped beneficiaries to improve the management of their businesses and prepared them to effectively contribute in other projects such as the Opportunities for Youth in Africa (OYA) project implemented by FAO and the United Nations Industrial Development Organization (UNIDO).



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BOX 13. SAWLOG PRODUCTION GRANT SCHEME IN UGANDA

The “Sawlog Production Grant Scheme” project in Uganda developed, in partnership with the Uganda Timbers Growers Association, a Market Intelligence Information System based on mobile apps and agriculture information systems. The system consists of a software solution built to bridge the gap between timber farmers (the traders) and the end users of timber products (the buyers). It involves a review of the market drivers and recommendations from monitoring market performance. The system targeted 670 members of the Association.

The concrete outcome of the project was that it enabled timber farmers to invest in downstream processing, making them knowledgeable of what the timber supply is and will be in terms of volume, species, quality and origin as well as of what the prices on the market are.



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BOX 14. ESTABLISHMENT OF A LESOTHO NATIONAL FARMER REGISTRY AND ELECTRONIC VOUCHER MANAGEMENT SYSTEM

The Lesotho Integrated Agriculture Management Information System (LIAMIS) hosts the national farmer registry and the eVoucher management system. It was developed, deployed and piloted in three districts. The eVoucher system is a digital solution that sends electronic vouchers to farmers' phones via SMS, which they can use to purchase agricultural inputs at a set price from agrodealers. A total of 11 349 farmers were registered and the voucher redeeming, which related to maize and beans seeds and fertilizers, was tested involving 3 076 farmer households.

The Ministry of Agriculture and Food Security (MAFS) officials at national and district levels have now access to farmers' information to also support planning and programming. The digital intervention of the project has contributed to financial inclusion but also to improved market integration and transparency and reduced transaction costs, and better transparency in supply chains. Indirectly, it has provided opportunity to farmers to access high-quality inputs and to increase productivity.

Senegal, with the digital marketing platform for producers named Senlouma.org. Another experience is the one developed in Uganda and summarized in Box 13.

agri-inputs. An example of successful eVoucher system is given in Box 14.

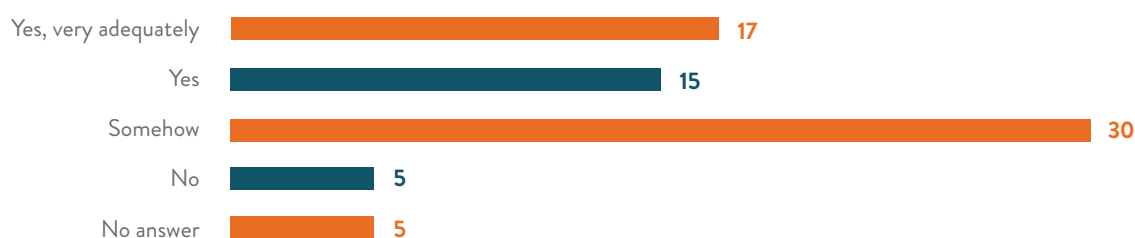
(e) Improved financial inclusion

Some activities have increased capacity in digital financial literacy, as stakeholders were trained on mobile money systems (such as in the case of the project in Comoros cited earlier, or the activities of the Digital Villages Initiative in Somalia). Cash transfer management systems such as eVouchers are also instrumental for financial inclusion in general and even more so when reaching people in the most remote and insecure areas. The eVoucher systems implemented by FAO (in Mozambique, Somalia and other countries) are mostly part of emergency or resilience projects to support communities and in many cases they also facilitated financial inclusion and market linkages for the sale of products and procurement of

4.10 Adequacy of FAO's response to digital needs

Respondents to the survey were also asked to indicate whether FAO has responded or is responding to the needs of the country in terms of digital agriculture. Respondents could choose between "Yes, very adequately", "yes", "somehow", and "no", or could withhold their answer (Figure 21). Most answers indicated that FAO responded adequately. In 30 cases the response was "somehow", which means there is room for improvement. In five cases the response was "no" and five respondents provided no answer.

Figure 21. Adequacy of FAO's response



Source: Survey respondents.

4.11 Insights from a country that has not responded to the survey

Relevant officers seemed not available in four countries to respond, while three countries claimed they did not have projects related to digital agriculture. An interview was thus made with one country office that has not responded to the survey to understand why they were not in a position to do so and gather their views on digital agriculture.

The colleagues first asked for clarification on what was considered as part of digital agriculture and what was not, i.e. where to draw the line. These specifications were however already provided when the request to fill out the survey was sent, including in reminders shared. They informed that they had a project where geotagged photos made by farmers with their smartphone were

used to ascertain crop conditions in the field. They have been also designing a new project related to early warning and climate change services, where digital components are included. The fact that they did not register projects for the survey seemed rather related to an incomplete understanding of what qualifies a project as related to digital agriculture.

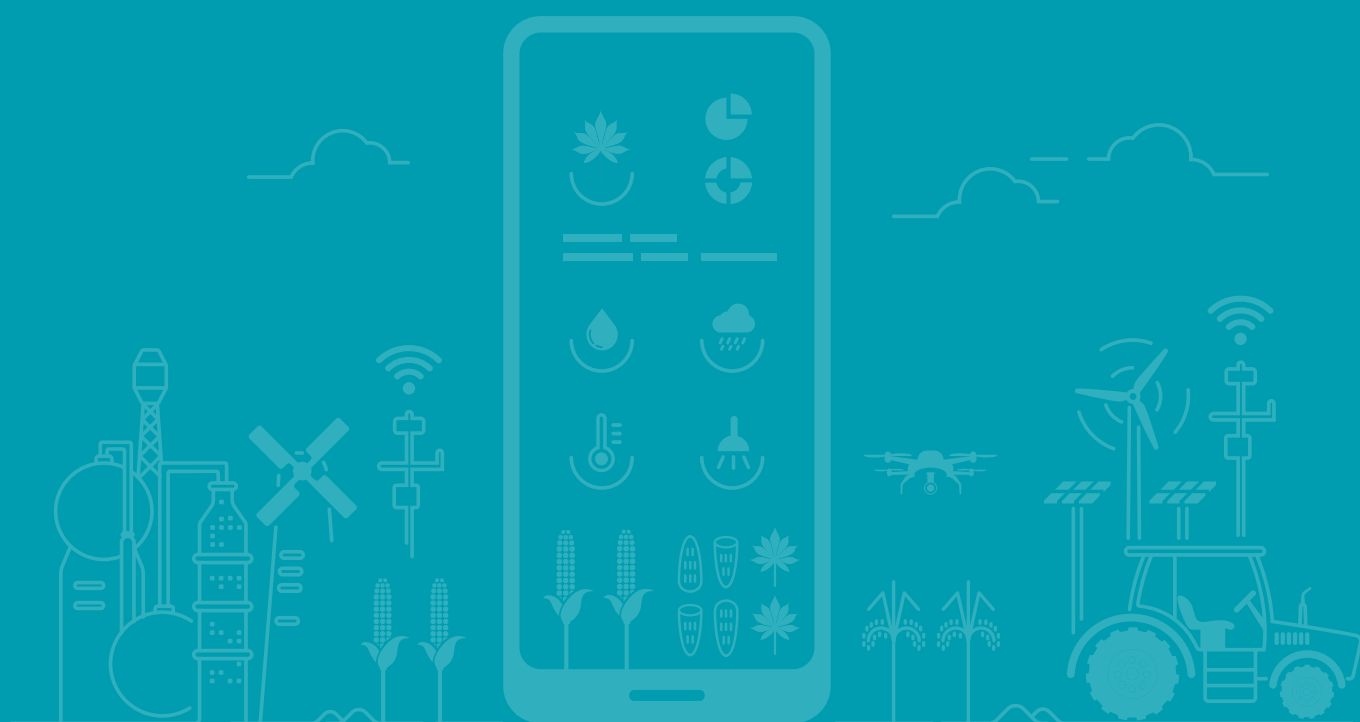
In general terms, the colleagues believe that digital agriculture is important. They highlighted that their country has a very young population and digital agriculture can be attractive to them, because it promises to reduce difficulties in agriculture, potentially improve the marketing of agricultural products and facilitate other benefits.

These perceptions might be similar in some other countries that had not filled out the questionnaire.



5

Special focus on crop production and value chain competitiveness



As part of the study, FAO undertook specific analyses (deep dive) with a focus on how digital solutions contribute to:

- improving crop production and protection and reducing other production risks; and
- enhancing value chain competitiveness.

To address these questions, we looked at findings from FAO-implemented digital agriculture activities and beyond. On the one hand, we started with the survey's (close-end) questions to zoom in into relevant projects and then harvested as much information as possible from the open-ended questions, complementing them with project documentation and interviews. On the other hand, we have complemented the analysis of FAO projects with experiences made by other organizations which could provide insights on the two issues at stake. We also learned from literature.

5.1 Improving crop production and protection and other production risk management

In this section, we looked at how the use of digital solutions have improved or can improve:

- crop production;
- crop protection; and
- other production risk management.

(a) A synthetic view of how FAO projects addressed this theme

To get insights from the survey, we filtered all projects that have been associated with FAO programme priority on crop production and protection systems. We then looked at open-ended questions to ensure that we did not mistakenly exclude any projects that dealt with the theme. As a result, we initially obtained 45 projects to examine.

The theme is very broad and we have therefore opted to include only projects that have a direct connection with primary production and underlying factors. In this sense we included extension and early warning-related activities but excluded projects on national agricultural statistics and information systems, generic training for agripreneurs, or those in support of value chains, for instance. By applying these criteria, we had nine projects selected, in which mostly extension services have been offered using digital tools. Other selected projects dealt with other subjects such as land and water productivity and early warning

systems. A total of 12 projects were specifically about crop protection: they mostly dealt with combating African migratory locusts (AML) and Fall Armyworm monitoring, or with other topics such as insecticide spraying with drones, and animal disease monitoring using digital tools. All together, we considered 21 projects for this deep-dive theme.

As discussed in Chapter 4, crop production and protection systems is the most frequently mentioned FAO programme priority (cited by 63 percent of projects) to which digital activities have been linked. The activities were mostly implemented in Western Africa, followed by Eastern Africa (some projects are carried out in more than one region). Considering **implementing partners**, the vast majority is government (ministries of agriculture and others), followed by research organizations and international NGOs and then, by other stakeholders, more or less as portrayed in the analysis of all projects.

The most cited digital **activities** are training on the use of digital tools (15) followed by development of mobile applications/digital platforms (11) and then digital agriculture advocacy/networking (7), and development of social media platforms or websites (5). Less cited are all the other digital activities identified (i.e. use of digital devices (drones, sensors, etc.) on the field/on livestock, studies, digital agriculture strategy development, etc.).

The **digital technologies** that have supported crop production and protection are mostly mobile applications or SMS/USSD (14); followed by agriculture information systems, web platforms, or social media tools (WhatsApp, Facebook, etc.) (9); computer use (6); and digital data/open data/big data (4). Satellites (3), drones (2), Artificial Intelligence (1) are less represented and there are no cases where IoT devices or blockchain technologies are applied.

Examples of tools used in FAO projects to support crop protection and production are presented in Table 4.

Key challenges are generally the same as highlighted in Chapter 4: above all, the high costs of connectivity or for digital devices for beneficiaries (with 15 respondents mentioning this challenge), followed by digital illiteracy and poor quality or unavailability of connectivity (13 each). Lack of funding to deploy the project as planned, lack of implementation of the digital agriculture strategy developed, inability or unwillingness of beneficiaries to pay for the digital service, and finally institutional challenges are also mentioned but less frequently.

Table 4. Examples of FAO tools used that supported crop production and protection

Type of platforms	Name of tools	Function and other details
Crop production	DSP	Crop calendar, weather information, etc. (developed by FAO)
Crop production and protection	Drone	Spraying, mapping
Crop production and protection	Kobo Collect	For data collection related to various production activities
Crop production	WAPOR	Database of geospatial information on water use and management (see Box 15) (developed by FAO)
Crop production and protection	Mobile phone and social media (Facebook, WhatsApp)	For communications in general
Crop protection	Elocust3 app	To fight desert locusts (developed by FAO)
Crop protection	FAMEWS	To combat fall armyworm (developed by FAO)
Crop protection	Plant Village	Platform that uses machine learning and artificial intelligence to provide advice to farmers to combat fall armyworm

Source: Authors' own elaboration.

With reference to crop production, the digital interventions have generally **contributed** to improving advisory services and early warning systems, including through digitizing farm coordinates and the sharing of productivity information. For crop protection, and more specifically for pest and disease management, the use of the digital tools permitted near real-time reporting and effective management, eradication or reduction of pests, capacity building for beneficiaries on how to manage these tools, etc.

Apart from pests, diseases and climate risks, other production risks include the risk of producing for an unfit market. A proactive knowledge of the market and its needs can help address this. Tools, including market information systems and supply chain management platforms, are used in this case. These solutions are discussed in the section on value chain competitiveness.

(b) Insights from other initiatives and the literature

Crop production and protection is the domain where there is the largest number of digital solutions globally and in Africa. In the Digital Agri Hub platform managed by the Wageningen University (Digital Agri Hub, 2023) over 70 percent of the solutions registered in sub-Saharan Africa

include farm management and advisory. One can therefore find a great variety of products and services linked to this theme. Some of the most successful are described hereafter and further summarized in Table 6.

The 8028 Farmer Hotline in Ethiopia developed by the now called Ethiopian Agricultural Transformation Institute (ATI) is an example of a digital crop production advisory system which has proven to be successful. After eight years of operation, in 2021, the 8028 Farmer Hotline had more than 5.8 million registered users, 6.5 million push-based alerts, and received approximately 51 million calls. It is based on an IVR/SMS platform, and provides contextualised agronomic advice based on crops and agroecological zones to smallholder farmers across Ethiopia. Farmers call into the service via toll free number 8028 and get agronomic advice and best practices. The 8028 Farmers Hotline plans to add more features and use cases bundled together with farm advisory. It has, for instance, recently added basic financial literacy content with useful information in areas like financial planning, loans and credit management, savings, investment, etc.

The digital literacy content was developed by AGRA and managed through the Mercy Crops' AgriFin **Sprout Platform**. The Sprout Open Content Agriculture

BOX 15. THE WAPOR PORTAL

The Water Productivity through Open access of Remotely sensed derived data (WaPOR) is an FAO geospatial database that uses near real-time satellite information for the monitoring of agricultural water use and productivity. The database is at the heart of the WaPOR project (managed at FAO headquarters) which helps partner countries to improve their ability to enhance water and land use efficiency, including both rainfed and irrigated systems. It addresses the challenges posed by the decreasing availability of freshwater resources and the necessity to sustain agricultural production to ensure food security in the context of climate change. It aims to increase agricultural output while simultaneously reducing water consumption.

WaPOR covers Africa and the Near East and provides information with a temporal coverage from 2009 to present. It is based on open-access

remote-sensing data and algorithms, and can generate indicators on the impact of drought, conflict, pests, etc., on agricultural production. It can thus be very useful for the provision of advisory services to farmers. Its data can be accessed via an existing API, which facilitates the development of services by third parties, including via mobile applications.

Capacity has been built for many African countries, for example in the framework of the project “Improving land and water productivity in the Sudano-Sahelian belt,” which has involved countries such as Chad and Burkina Faso. Cases such as the use of the platform to support pastoralism in Mali were explored.

The portal can be accessed at:
<https://wapor.apps.fao.org/>



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BOX 16. AFRICAN MIGRATORY LOCUST RESPONSE TO MITIGATE IMPACTS ON FOOD SECURITY AND LIVELIHOODS IN NAMIBIA

An example of crop protection projects is the “African migratory locust (AML) response to mitigate impacts on food security and livelihoods”. It covered countries in the Southern African subregion (Angola, Botswana, Namibia, Zambia and Zimbabwe). With a surveyed area of over 8 million ha and more than 2.8 million beneficiaries reached, it was considered a success in adopting a control strategy based on early detection and rapid reaction, ultimately leading to a significant reduction in production losses and increased food security. Improved surveillance capacity at all levels (national by government locust control units, and local by community locust scouts) was an essential success element which was supported digitally by the eLocust3m solution.

The project developed other digital components. For example, it facilitated the exchange and analysis of digital data within and between different countries, each with its own surveillance protocols: this was the basis for generating georeferenced locust maps

and reports, integrated by aerial surveys, then used by locust response teams and decision-makers for the planning of field operations; the use of social media (WhatsApp group) for the coordination and exchange of information was promoted initially during the COVID 19 pandemic and it is now common practice among the communities involved; training in digital skills was organized which involved over 500 locust monitoring personnel supported by 6000 community locust scouts. The project altogether raised the digital awareness and skills of local communities and government organizations, making it already possible now (as in the case of food security assessments) or in the future (as regards other integrated pest/disease surveillance and management, natural resource planning and management, and yield and production estimates) to expand the use of digital technologies to other use cases.



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platform, developed together with the German Agency for International Cooperation (GIZ) and the Kenya Agricultural and Livestock Research Organisation (KALRO), is an innovative example of a solution where global agricultural experts and farmer organizations meet to share digital ready contents and services on agriculture, financial literacy and climate-smart agriculture. By providing a centralized open platform, local, regional and global expert content creators can share their knowledge while content users can identify and distribute high-quality content at a lower cost more rapidly to smallholder farmers.

SmartFarm is a farm data management solution that monitors all processes leading up to harvest. The solution leverages ground-truth data, weather advisory, and accurate insights based on satellite monitoring to enable data-driven farm and business operations. By tracking, managing and monitoring every step – from input to execution – all in one place, SmartFarm helps achieve efficiency and improves traceability and output predictability.

Ignitia provides daily, monthly and seasonal weather forecasts specifically tailored to the tropics through SMS disseminated directly to subscribed farmers. The forecasts also feature monthly and seasonal predictions and details such as the likelihood, timing and intensity of the weather parameters.

With reference now to solutions related to plant protection, we would like to mention the Pest Risk Information Service (**PRISE**) by CABI (2023). To forecast

the risk of pest outbreaks, PRISE uses a combination of disparate datasets, including EO technology, computational and modelling expertise, real-time field observations, and plant-pest lifecycle to deliver a science-based advisory for sub-Saharan Africa. Expansive, novel crowd-sourcing reports are also developed to strengthen and validate the system. PRISE is currently deployed in Ghana, Kenya, Malawi and Zambia. Although still in a research and development phase, it has delivered pest alerts to over 1.8 million farmers since 2017. During the 2019/2020 short rains season in Kenya, PRISE model outputs were integrated in the MoA-INFO SMS service. At the end of this season, 59 percent of farmers who received the service changed their practices based on PRISE recommendations for fall armyworm, with the most common outcomes being a reduced population of the pest and an increase in maize harvest.

In partnership with **iCow** in 2021, the development of a maize SMS service, which integrated PRISE Data Cube model outputs, saw participating farmers report an increase in yields by 109 percent and a reduction in pest damage by 70 percent.

Table 5 summarizes these solutions, indicating the primary application, the geographic coverage, the solution provider and the delivery technologies.

As it can be seen, there are possibilities for FAO to deepen its use of digital tools that support crop production and protection. There is notably room for developing forms of collaboration with providers of the most innovative solutions and also, as much as possible, promote

Table 5. Examples of noteworthy digital solutions for crop production and crop protection in Africa

Solution	Primary application	Geographic area covered	Provider	Delivery technologies
8028 Farmer Hot-line	Farm advisory	Ethiopia	ATI	IVR, SMS
SmartFarm	Smart farming; farm management and advisory	Around 13 countries in Africa	Cropin Technology Solutions	IVR, Mobile app, SMS, video
Ignitia	Weather forecasts	Ghana, Mali, Niger, Nigeria, Senegal	Ignitia	SMS, APIs
PRISE	Plant protection	Ghana, Kenya, Malawi	CABI	SMS
iCow	Farm management and advisory, record-keeping	Zambia	Green Dreams Tech	Call centre support, SMS

Source: Authors' own elaboration.

interoperability between these tools and FAO systems.

5.2 Enhancing value chain competitiveness

Factors of value chain competitiveness and potential of digital solutions

This deep-dive analysis focuses on how digital activities supported, and may in future projects support, value chain competitiveness, particularly for small-scale producers. Insights leveraging non-FAO initiatives and from literature are provided.

The assumption is that the use of digital solutions may help make value chains more competitive and, in turn, more attractive for investors, either private or public, including producers and other actors in the value chain. In conceptualizing value chain competitiveness, we considered the following factors:

- business capabilities and operational efficiency;
- market opportunities, integration and profitability; and
- business resilience.

Improving **operational capabilities and efficiency** in agribusiness activities contribute to increasing business performance, reducing operational costs, and making value chains more competitive. For small-scale producers, operational efficiency may be achieved directly through digitizing farming activities, using solutions that improve farm operations management, including by means of digital farm/field books. Supporting the digital registration of farm activities and providing improved early warning and advisory systems equally support increased productivity and performance. Improved management, digital capabilities and reduced transaction costs (through ERP, better supply chain management solutions, digital tracking solutions, etc.) could improve business capabilities and value chain competitiveness. The readiness of value chain actors to embrace technologies is thus very important.

Increased market opportunities and profitability can be generated through better market facilities, more transparent value chain and increased trust among value chain actors (from producers to consumers), better sales and cost reduction. Digital tracking solutions (including with IoT devices) as well as digital certification systems (environmental and social) effectively support some of these conditions and processes. Market information systems facilitate the availability of market opportunities, including information on prices (for the selling of

produce or purchasing of inputs). Market information systems together with e-commerce marketplaces (for the actual sale of products) and matchmaking platforms (for connecting value chain actors) also contribute to increased market opportunities as well as to **increased market integration and profitability**. This will require that value chain actors enter and actually benefit from formal markets, beyond small-scale producers. Solutions introducing non-bank, cashless transactions such as eVouchers and eWallets also contribute to expanding opportunities and market integration.

Increased business resilience to both slow onset events (such as climate change and pandemics), rapid onset events (such as floods and storms), and other socioeconomic business challenges can be attained, for example, with the availability of economic safety nets, or de-risking value chain operations. Digital finance solutions, including insurance solutions, can support value chain actors in face of such negative events through compensation of losses or provision of the needed capital.

It is worth noting that when digital solutions are specifically directed to production, they play a key role in facilitating investments in value chains. In other words, higher yields and higher and better-quality production indirectly contribute to attracting buyers, financial institutions and investors. This aspect, however, is already covered in the previous deep-dive analysis. In this section the focus will be on how digital interventions can increase value chain competitiveness.

(a) A synthetic view of how FAO projects have addressed this theme

Like for the previous deep dive theme, the domain covered here is also very broad as earlier illustrated. To select FAO projects that dealt more directly with the theme in the survey, we have filtered first those associated by respondents to the programme priorities on agribusiness, inclusive and resilient agrifood value chains, and trade and market opportunities for inclusive growth, or to the use case of market access. We then looked at open-ended questions to ensure that relevant projects were not excluded. The keywords “value chain” and “market” were used for this purpose. As a result, 42 projects were selected.

Concerning subregions of implementation of identified activities, Eastern Africa and Western Africa always come first, followed by Southern Africa and then Central Africa.

The most frequent types of digital **activities** carried out are training on the use of digital tools (31), followed by development of mobile applications/digital platforms (25), development of social media platforms or websites (12), and provision/facilitation of digital finance (11). Less cited were development of digital business models, use of digital devices (drones, sensors, etc.) on the field/on livestock, studies, digital agriculture strategy development, and provision of insurance leveraging digital (index-based, etc.). Box 17 provides more details on a project especially focused on training and women empowerment through financial and management tools.

Digital technologies involved are mostly the more general-purpose ones, such as mobile applications or SMS/USSD systems, (31), computer use (17), digital data/open data/big data (14), and IVR (6). Agricultural information systems, web platforms, or social media tools (Facebook, WhatsApp, etc.) are used for digital marketing in 23 cases. Interestingly, less frequently mentioned technologies are also the more advanced ones, such as artificial intelligence (5), blockchain (5) and sensors/IoT device/RFID tag (1). Also cited are satellites (9 cases) and drones (4).

Digital solutions: Very frequently, solutions implemented relate to the digitization of agriculture practices and processes across the value chain¹⁹ as well as to other

data-collection tools for tracing transactions for several purposes. This often entails the use of the Kobo Collect Tool. There are various projects connected to farmers' registries, agricultural management platforms such as the Zambia Integrated Agriculture Management Information System (ZIAMIS), the Lesotho Integrated Agriculture Management Information System (LIAMIS) and the Kenya Integrated Agriculture Management Information System (KIAMIS). EVoucher systems (which promote financial inclusion) were also used.

Market access and electronic commerce solutions have been supported in various projects: in Rwanda through capacity development and promotion;²⁰ in the Democratic Republic of the Congo and Senegal through the dedicated platforms AgroMwinda and Senlouma, respectively; in Zimbabwe via the platform Kurima Mari (FAO, 2017); in the sawlog production grant scheme in Uganda (Box 9); in the PROMOVE Agribiz project in Mozambique; through TimberMart in Uganda and Climis in South Sudan. More details on the Rwanda project are given in Box 17.

The FAO platform Food Price Monitoring and Analysis (FPMA) (FAO, 2023j) is currently deployed in countries such as Angola, Malawi and Zimbabwe, although at varying stages of use. The principal idea of the tool is to strengthen governments' capacities to disseminate food price data

BOX 17. SUPPORT CAPACITY DEVELOPMENT FOR LOCAL SUPPLIERS AND PROMOTION OF E-COMMERCE FOR AGRICULTURAL VALUE CHAINS IN RWANDA

The project conducted a situation analysis for mapping existing e-commerce interventions in the agricultural value chain, organized sensitization meetings for 2 800 community members and local administration to discuss e-commerce adoption in the agricultural value chain. It also built the capacity of 50 existing value chain actors and engaged numerous local suppliers and representatives from the Rwanda Pig Farmers Association in discussions on e-commerce in the agricultural value chain. It developed webpages to introduce local suppliers online and connect them to regional, national and international markets, as well as an e-commerce strategy (2021–2026) for the agricultural value chain in Rwanda, aligned with the country's vision for 2050. That e-commerce strategy is currently playing an important role for adoption of e-commerce by local suppliers.



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¹⁹ This consists very often in the digital registration and profiling of farmers and other actors in the value chain, as well as integrated agriculture and value chain management information systems.

²⁰ "Support local suppliers capacity development and promotion of e-Commerce for agricultural value chains in Rwanda."

BOX 18. THE PROJECT 'PROMOVE AGRIBIZ' IN MOZAMBIQUE

PROMOVE Agribiz promoted digital services initially addressing emergency and social protection goals by providing mobile redeemable vouchers to pre-established agrodealers. This was supported by the use of mobile apps for farmers' registration and the FAO-developed IDEA platform.

The project helped agrodealers and their trading partners (farmers and suppliers) to develop strong and trusting relationships. It also helped generate an increase in availability and sales of improved agricultural inputs and an increase in the number of customers (farmers), progressively moving to increasing amounts of co-payments by farmers. It achieved an outreach of 20,000 beneficiaries with an adoption rate of 99 percent. An ad hoc impact study has shown that the eVoucher programme supported the livelihoods, resilience and the economic self-sufficiency of farmers. The programme is found to

have had an impact on (i) the decision to plant maize and beans, (ii) an increase in the number of hectares of maize and beans cultivated, (iii) an increase in the number of kilograms of maize and beans harvested, (iv) an increase in income earned from agricultural sales, (v) an increase in household consumption (proxied by expenditures), and (vi) the diversification of agricultural production and revenues.

It was also reported that the creation of eVoucher systems has allowed the inclusion of small-scale producers in structured market channels. The project acted as an enabler in this process and achieved noteworthy outcomes for making value chains more attractive. The emphasis here is on the digitization of the value chain, the establishment of trust-based market linkages between value chain actors, enabling market integration and value chain development.



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and perform price analysis, as well as give greater ability to monitor SDG Indicator 2.c.1 on food price anomalies, for which there is an inbuilt calculation in the tool. FAO also supported the development of an agribusiness information systems, for example for cooperatives in Togo.

Many of the solutions addressing market linkages have strengthened the integration of value chains, a key factor for its competitiveness as indicated at the beginning of this section.

The three **key challenges** are the same as for the previous deep dive: mainly poor quality or unavailability of connectivity (25), digital illiteracy of beneficiaries (21) and lack of electricity (20). This is followed by high costs of connectivity or digital devices for beneficiaries (18). Also important are lack of funding to deploy the project as planned (9) and institutional challenges (9). Other challenges, such as unsustainable business models,

lack of implementation of the digital agriculture strategy developed, inability or unwillingness of beneficiaries to pay for the digital service, are also mentioned but less frequently.

Regarding **results achieved**, most of the respondents emphasized the fact that digital solutions promoted the effective collection and analysis of digital data across the value chains, starting with the registration of data on producers and other players. Market intelligence information systems promoted trade based on known supply data and oriented decision-making. Social media platforms have also enhanced marketing.

In Box 18 and Box 19, we describe examples of representative projects.

(b) Insights from other projects and analysis

BOX 19. SUPPORT FOR THE MARKETING OF AGRICULTURAL PRODUCTS IN THE DEMOCRATIC REPUBLIC OF THE CONGO

This project, funded by the Government of the Democratic Republic of the Congo with support from the World Bank, aimed to support the implementation of the second phase of the Agricultural Sector Rehabilitation and Revival Support Project (PARRSA) by structuring the agricultural value chain and improving commercial security and income for operators. Specifically, the project aimed to strengthen and connect village warehouses and seed producers and establish an electronic commercial platform capable of efficiently managing the agricultural value chain and seed subsector. The project provided technical and/or material assistance to 70 local warehouses, 90 multiplier agents (warehouse managers and associated entrepreneurs), and 10,000 market actors to improve the marketing of agricultural products and income for agricultural sectors (maize, rice, peanuts, cowpeas, cassava and seeds) of farmer organizations adhering to PARRSA. This was achieved through the structuring and interconnection to the AgroMwinda e-commerce platform. Various awareness and training sessions were organized, material support was provided (organization structuring, warehouse equipment, tablets, SIM cards, etc.), and business collaborations were encouraged.

By the time the project was closed, over 6000 tonnes of commodities had been stored in the warehouses. The project facilitated the marketing of 15 percent of this stored quantity, amounting to 949 tonnes of agricultural products sold through the electronic commercial platform for a value of over USD 130,500. However, while the interventions made some warehouses operational that were not being utilized by the beneficiaries, online purchases were still modest.



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In the Digital Agri Hub, over 38 percent of the solutions registered in sub-Saharan Africa include the use cases “market linkages” (equivalent to access to markets), 28 percent for the use case “finance” (same as “financial services” in this study) and 24 percent for the use case “supply chain management” (referred here as “procurement and supply chain management”). When looking only at digital solutions which are more mature, we have found 62 of them deployed in 38 countries in sub-Saharan Africa. We have chosen a few among them that are examples of popular and innovative solutions, with their different primary applications, area and value chain focus, delivery technologies and name of providers.

AgroCenta is a technology company based in Ghana and focused on market linkage and financial inclusion problems in the agricultural value chain. It operates two integrated digital platforms (Cropchain and LendIt). In addition, Velociti is a digital solution which uses big data and artificial intelligence (AI), for accelerating the access to digital financial services (microlending, mobile payments, insurance, savings and pensions) for underserved small-scale farmers in the African agricultural ecosystem. In the next five years, Velociti targets more than 15 million smallholder farmers in Africa.

Agritask is an agricultural operations platform, designed to enable fact-based decision-making for agricultural businesses. Agritask integrates a wide array of agronomic technologies, tools and data sources into one brain that analyses data, quantifies risks and produces alerts, recommendations and actionable insights. Data sources vary from sensors and machinery, aerial images, forecast data, etc.

eProd is a specialized ERP, based in Kenya, and operating in many countries, addressing supply chain management needs. Most of the subscribers are exporters, food processors and aggregators of different agricultural products. Among the others are farmer groups, cooperatives and unions. The system also assists field officers to register and monitor planting information, implement training programmes and certifications. It manages the procurement from farmers, implementing full traceability through a mobile application that can fully operate offline, and payment can be made through integrations with mobile money providers, online banking systems, and e-wallets.²¹ A stock module assists clients to monitor stock levels at the different aggregation centres,

the field and the packhouse.

agCelerant is Manobi’s service platform for agricultural business development, including value chain digitalization, agronomy advisory, market linkage, and supply chain management. It encapsulates the concept of phygital agriculture, the combination of physical asset management with digital solutions to ensure trust and scalability of service. It unlocks primary bank and industrial investments for smallholder markets, ensuring final product quality, value and returns to small-scale producers and other agricultural stakeholders.

The **QuickPay** of the Multiple Internet Payment System (MIPS) is a private sector fintech payment ecosystem that allows a secured alternative. For instance, in connection with agri-wallets, it can be used to replace a mail/telephone order, to allow direct payment on a bank account by email, SMS, QR code or WhatsApp. Payments go through authentication procedures from the buyer, which drastically reduce the risk of fraudulent transactions. It is currently deployed in Madagascar, Maldives, Mauritius and Seychelles.

Royal Famgate is an e-commerce website that also collects and processes big data from food consumers to help smallholder farmers, food processors and food retailers acquire post-demand data. The enterprise also shares data with food delivery service providers to help limit food waste and post-harvest losses.

Khusa is a village savings App by Angle Dimension and deployed in Malawi. It is an online platform that allows community savings groups to automate and connect to the formal financial sector by leveraging secure and trusted payment channels. The platform aims to enhance trust and bridge the divide between rural groups and banks, mobile money and microfinance institutions. Khusa enables groups to digitize their transactions, calculate their portfolio, and securely save and transfer money. The solution is available on a number of platforms, namely, Mobile App, Web portal, WhatsApp chatbot and USSD.

It is important to notice once more the variety, in terms of primary applications, of the solutions that can potentially support the attractiveness and competitiveness of value chains. All types applications are potentially needed to support:

- both the digitization of farmers’ processes and the registration and profiling of beneficiaries;

²¹ This refers to secure money-management digital solutions that allow to make purchases with retailers on-site, transfer or send money.

Table 6. Examples of noteworthy value chain-related digital solutions

Solution	Primary application	Geographic area covered	Delivery technologies	Provider
AgroCenta	e-commerce	Ghana	mobile app, SMS	AgroCenta
Agritask	supply chain management	Botswana, Lesotho, Mozambique, Namibia, South Africa	email, mobile app, social media, web-based applications	Agritask
eProd	supply chain management	About 22 countries in Africa and many more in other geographical areas	Email, IVR, Mobile app, SMS	eProd Solutions Ltd.
agCelerant	supply chain management	Benin, Burkina Faso, Mali, Niger, Senegal	web-based applications	Manobi
QuickPay	mobile money, eVoucher	Madagascar, Maldives, Mauritius, Seychelles	mobile app	MIPS
Famgate	e-commerce and market intelligence	Niger, Nigeria	CABI	Royal Famgate
Khusa	Credit	Malawi	Green Dreams Tech	Angle Dimension

Source: Authors' own elaboration.

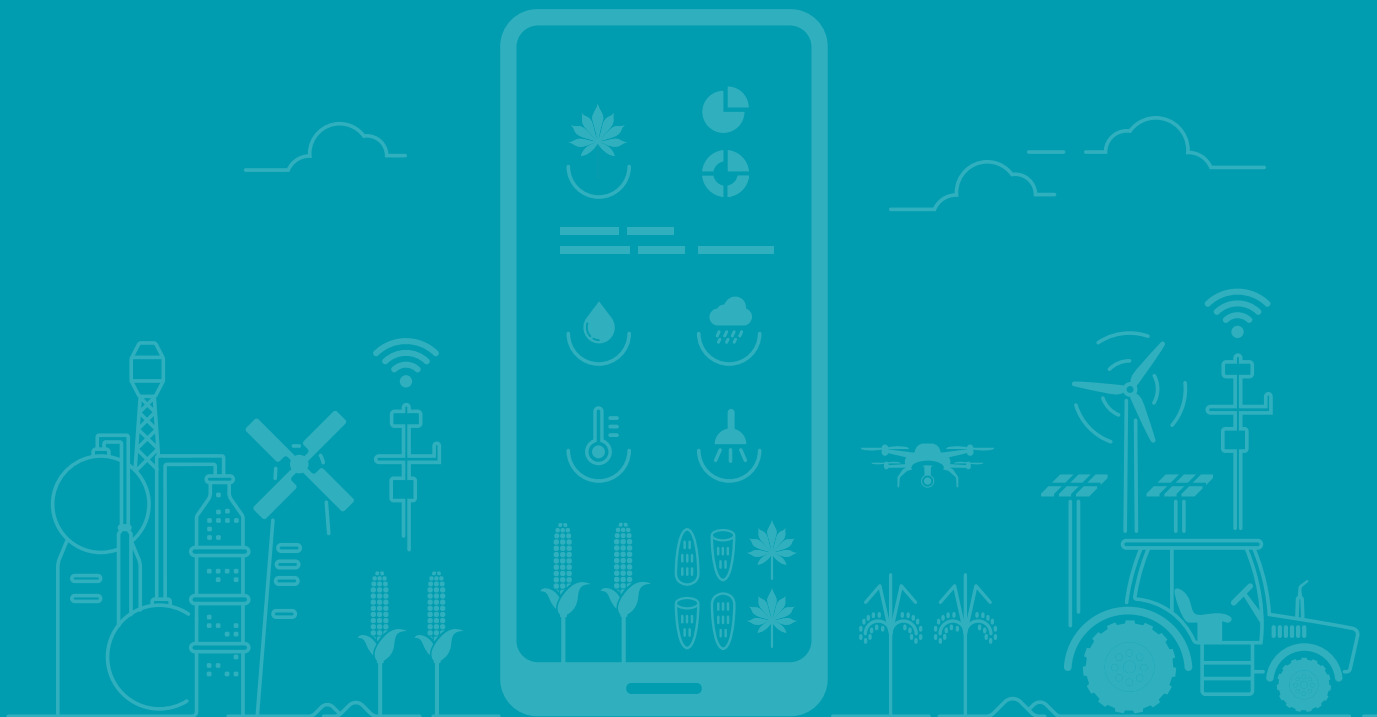
- transparency, trust and integration of the value chains, including through eVouchers systems;
- supply chain management systems,
- e-commerce and market intelligence platforms, where the most innovative and sustainable solutions seem to come from commercial providers; and
- digital financial services, including insurance services.

were effective in making value chains more competitive and attractive for investors. However, information shared by respondents indicate that many projects increased opportunities for market access (cases of the projects in Comoros, the Congo, Rwanda, etc.), and some projects very likely improved competitiveness of value chains (Promodev Agribiz in Mozambique, for example).

The context of the research has not permitted to assess with more details whether the targeted FAO interventions

6

Recommendations



To define a comprehensive set of recommendations, we were guided by several sources:

- recommendations made by respondents to the survey and gained through the interviews;
- our own analyses, notably building on literature and other experiences.

The recommendations are structured into two categories. The first is related to actions FAO may undertake towards its beneficiaries to improve their adoption of digitalization (outward-looking recommendations). The second category is concerned with bolstering FAO's internal digital agriculture readiness in Africa (inward-looking recommendations) so that the Organization better responds to the need of its stakeholders.

6.1 Outward-looking recommendations

These recommendations are clustered in relatively homogeneous areas. Some of them correspond to the impact pathways listed in analytical framework while some are cross-cutting, and hence, apply generally.

6.1.1 Foster digital awareness, knowledge-sharing and capacity

This is the cluster of recommendations for which the highest number of references were recorded. The suggestions made refer to creating more awareness and sharing best practices on generic digital solutions and tools (e.g. mobile-based data-collection applications, data management, computer skills, smartphone, feature phone, GIS, etc.), and on specific solutions and tools covering all use cases (advisory services, market linkages, etc.).

Creating awareness on digital solutions in general and for specific stakeholders on new technologies such as artificial intelligence, blockchain, drones is imperative for FAO projects to remain connected to the fast-evolving innovations and opportunities. When relevant, such awareness-creation can be organized, bringing together all actors (digital solution providers, knowledge and research organizations, farmer organizations, agribusiness and traders, governments, telecommunication companies, etc.), as it was the case for the blockchain project in Uganda. This would create a collective commitment around the applications that are promoted and could allow for the formulation of projects with multistakeholder interest.

As it has been highlighted in many reports, capacity building is critical for all potential beneficiaries, but also for FAO personnel, notably because innovations are evolving constantly. Adequate resources should be mobilized in that framework:

“There needs to be enough resources to adequately build capacity for the beneficiaries.”

(Locust response project, Subregional Office for Southern Africa [SFS])

“[We recommend creating] a compendium of good practices.”

(African migratory locust response to mitigate impacts on food security and livelihoods project, Namibia)

One of the most interesting initiatives recently developed to promote innovations, knowledge-sharing and capacity building is the so-called innovation hubs which host exchange sessions, training, and innovation development activities on digital agriculture. Examples are the FAO's project “A Global Network on Digital Agriculture Innovation Hubs” (notably operating in Ethiopia) or the experience of Smart Agri Hubs in Europe. Some of these hubs are supported by living labs involving a strong presence of academic and agrifood partners, including farmer organizations. The possibility of using local languages should be considered to favour inclusivity. Many of such tech hubs and incubators exist in Africa but are not giving much prominence to agricultural innovations. Knowledge-sharing on digital agriculture (available solutions, best practices, lessons learned) can also be implemented through national or regional associations and international partners' platforms like the Digital Agri Hub hosted by the Wageningen University and Research (Kingdom of the Netherlands), the World Bank (Open Learning Campus), etc.

FAO should create or strengthen collaboration with these existing initiatives to amplify impacts and reach.

6.1.2 Advocate for improved digital access, telecommunications and relevant infrastructure



The upgrading of the telecom infrastructure in rural areas, the last-mile GSM coverage, as well as the development of access to digital devices for farmers and other agriculture stakeholders (including public institutions) were also often mentioned as key enabling factors for the implementation of digital agriculture projects. The need to improve rural electricity was also mentioned. Some of these suggestions go beyond the direct mandate and capacity of FAO, and are addressed to third parties (governments, telecom companies, mobile network operators, energy companies) which are able to make the necessary infrastructure investments.

“There is an urgent need to invest in last-mile connectivity to strengthen the digital infrastructure.”

(Stratégie nationale d’agriculture numérique du Bénin (SNAN-Bénin project, 2021-2025))

“[We should] invest heavily on utilization of solar-powered systems to enable digitization in rural areas.”

(Digital Villages Initiative (DVI) pilot project, Malawi)

“The quality of gadgets used are generally poor.”

(African migratory locust response to mitigate impacts on food security and livelihoods project, Zimbabwe).

Even though addressing directly the installation of telecom or energy infrastructure falls outside FAO’s mandate, the Organization can still advocate for it where this continues to be a critical barrier, pointing out critical issues to governments, donors, and telecom operators and other partners such as the International Telecommunication Union (ITU). On another note, ministries in charge of agriculture and other agricultural agencies should be encouraged to better mobilize finances for adequate equipment in digital resources (computers, tablets, mobile phones, drones, etc.) that extension officers, research institutes and other agents need to be more effective.

Though this has not been stressed by many respondents, our analyses and exchanges with some FAO staff suggest that it is also important to improve public agricultural data infrastructure, such as national spatial data infrastructures (SDIs), farmer registries, agricultural databases, etc.

This is particularly true with the ongoing development in data analytics and artificial intelligence, which strongly depend on availability of quality data and data infrastructure. Developing public digital infrastructure (DPI) for agriculture is therefore critical (see also the next recommendation).

6.1.3 Promote data-driven agriculture, data ethics and improved data interoperability

Improving collection of data, innovative use of data, data ethics and interoperability of data systems was regarded as an important pathway for the successful implementation of national digital agriculture interventions by many respondents.

FAO is encouraged to continuously promote access to important data sources in a logic of open data and based on principles of fairness and reciprocity.

“I would recommend FAO to further assist partners (national statistics offices, ministries of agriculture) in developing solutions that allow researchers, students, policymakers, etc. to query data online, as per their needs, beside making microdata available to the general public.”

(Census of agriculture, livestock and fisheries project, Angola).

The types of data sets and initiatives referred to include higher-resolution satellite data, crop data and key in situ data like on soils and individual farmers and farms.

Interoperability between systems developed by FAO and third parties' systems, as well as between third party tools, was stressed as key.

FAO should strengthen its activities, promoting interoperability standards for data exchange in Africa, promote data integration between farmer registries and other national platforms, and contribute to the design or enhancement of national data-sharing policies, etc.

Developing partnerships with local stakeholders on data exchange across platforms is recommended in order to contribute to defragmenting data collection and use, and to promote the emergence of innovative farmer services. As

a matter of fact, FAO is already working to encourage the use of DPGs and APIs it has developed, as indicated in the recommendations section of its report on digital villages (FAO, 2023b).

Promoting ethics in data collection, use or sharing, including in terms of farmers' data ownership and data privacy, is also recommended as key.

“There is also the need to pay attention to farmers' data protection and confidentiality in case of monetization of data by private providers.”

(PROMOVE Agribiz, Mozambique)

The establishment of agriculture data codes of conduct and policies, underpinned by robust data governance frameworks, can address some of these concerns.

6.1.4 Support the scale-up of effective and sustainable digital agriculture solutions

Another area of recommendation refers to further development (when needed) and scaling up of effective digital technologies, solutions and systems. These range from simple mobile-based applications to the development of more complex solutions and innovative technologies. Platforms may be supported for all types of digital agriculture use cases (market access, advisory services, etc.)

Below are examples of direct quotes referring to some specific areas of support:

“Support in use of geospatial technology in agriculture monitoring, crop type, production, yield forecasting, and crop-precision farming is vital.”

(Establishment of a Lesotho National Farmer Registry and Electronic Voucher Management System project).

“[We need to] strongly support countries with water and agricultural technologies, including database

management, GIS, satellite image manipulation, statistics, and digital literacy. Promote data standardization, archiving and methodologies/ software.”

(Building Adaptive Capacity and Resilience of the Forestry Sector in Cabo Verde project).

“Strengthening early warning systems (where they are less developed) through digital solutions: setting up sentinel sites.”

(Development of a data-driven geospatial information system to analyse risks and shocks in Sierra Leone)

As access to finance is one of the most daunting bottlenecks for smallholder farmers’ businesses, it is important to stimulate tailored and inclusive digital finance solutions. Different schemes, including digital finance and some eVoucher programmes, can be effective in reducing transaction costs, which typically represent one of the barriers to access financial services in rural areas.

Many digital solutions are not providing compelling value to farmers and/or are not sustainable. Support on the establishment of effective business models may be considered, particularly targeting young entrepreneurs. Attention was placed by the respondents on the need for co-designing the solutions with the final beneficiaries.

It is important to highlight that while some advanced technologies may be relevant for supporting smallholder farmers even in rural areas, they must be integrated in projects only after proper assessment of their relevance for the specific targeted beneficiaries and for the project’s objectives, sociotechnical and economic conditions.

Finally, promoting public–private partnerships in this area will help support the scaling-up and the sustainability of the digital solutions.

6.1.5 Enhance enabling digital policies and governance

The improvement of enabling policies and governance represents an important impact pathway that is mentioned by several respondents. Continuing helping for the

development and implementation of digital agriculture strategies is an example of activities in that framework. An example of a verbatim quote from a respondent is as follow:

“Continue to create awareness on country’s need for e-agriculture policy and strategy to regulate the digital space and ensure that stakeholders are providing and accessing adequate and accurate services.”

(Enhancing e-agriculture structures and mechanisms for extension, surveillance and early warnings project, Ghana)

As a matter of fact, FAO increasingly supports national strategies for digitalization or e-agriculture strategies. For example, see the guide developed together with ITU on that matter. (FAO and ITU, 2023). Between 2021 and 2022, FAO supported digital agriculture development in Madagascar, the Niger and Rwanda, and provided technical advice on the digital agriculture strategy of the African Union Commission. It is recommended that FAO continue to play this role, bringing together interested stakeholders to avoid fragmentation of actions, and make efficient use of resources.

6.1.6 Promote institutional coordination and partnerships

Recommendations were made by many respondents for improved coordination and partnerships between FAO, government organizations and the private sector on the continent. This recommendation aligns with the request made to FAO at the international level to lead in collaboration with other stakeholders an International Digital Council for Food and Agriculture to advise governments and foster international dialogue and knowledge-sharing on that subject matter.

A specific aspect of this recommendation involves better collaborating with the private sector, for instance, to ensure the development of the needed infrastructure in Africa.

“FAO has done a lot on digital agriculture in African countries, but it needs more private sector engagement in innovation to ensure success and sustainability.”



(Strengthening of Tanzania Food and Nutrition Security Information System for Quality, Timely and Reliable data project).

“[We recommend] partnership with private sector in ensuring availability of infrastructure to support digital agriculture initiatives.”

(Strengthening the Livelihoods Resilience of Pastoral and Agro-Pastoral Communities in South Sudan cross-border areas with Sudan, Ethiopia, Kenya and Uganda project).

6.1.7 Enhancing digital agriculture inclusion

Inclusion in digital agriculture is important not only to ensure that no one is left behind, but also to facilitate the mobilization of the diverse stakeholders composing the agrifood system, towards its betterment. The need to improve benefits for and better engage with women, youth and other stakeholders that may not sometimes be sufficiently onboarded (including in some cases pastoralists or fisherfolks) and all vulnerable groups has been recommended by several respondents. In the following

section, we focus on recommendations relating to women and youth.

Gender-responsiveness

In Section 4.4, women as beneficiaries were given special attention and a conclusion was that, while women may be involved as beneficiaries in many projects integrating digital agriculture, they are not necessarily substantively benefiting from them. Therefore, more specific measures for mainstreaming opportunities for women ought to be designed. To do so, it is recommended that, right from project-design level, gender analyses are executed to (1) provide context-specific intersectional analyses on how digitalization and digital technologies can impact women and men differently; (2) investigate constraints and needs of different groups; and (3) define the specific gender-focus activities.

An FAO internal report proposes a gender-responsive approach, clearly suggesting how to identify gender needs and responses (FAO, 2022a). Sex and age-disaggregated data will help project formulators to better understand the context, appreciate gender differences, and design appropriate interventions. These data are also critical to have appropriate baseline data. Project formulation and implementation, irrespective of the funding source and donor requirements, should highlight and clearly

address the gender-related issues identified in the area of intervention to help close the gender digitalization gap. Identifying key stakeholders such as women organizations and/or gender experts can help provide stronger accountability and promote participation and inclusion towards the achievement of outcomes of gender equality. Consulting women's groups and inviting them as active partners can also help amplify the participation and voices of women in project design, implementation and monitoring (FAO, 2022b).

Youth inclusion

Again, in Section 4.4, projects that had or have a focus on young people were examined, especially in terms of enhancing youth opportunities, including job creation. One of the findings, similar to the case of women, is that while youth are regularly included as beneficiaries, more efforts must be accomplished to increase digital opportunities and digitally enabled decent jobs for them. The objectives and context of the study did not allow to consistently assess impacts in terms of job creation. Future efforts can be directed at that.

Although as illustrated in this report some activities on youth and digitalization have been carried out, no specific recommendations emerged directly from the survey. However, the importance of this theme, particularly for the emergence of better agricultural youth jobs and the development of innovations in agriculture, is recognized in some of the interviews held as well as in the decent employment programme priorities, as exemplified by various FAO and other organizations' projects²² and in the literature. It is therefore important to enhance these activities at FAO in the African region (Lohento and Ajilore, 2015; Pafumi and Arimbi, 2022). In terms of programme design and development, an equivalent approach to the one described in the case of women could also be developed. Identifying a framework of indicators and tools for assessing achievements and the most impactful interventions, especially in terms of generation of decent employment, is also important.

6.2 Inward-looking recommendations

Actions points suggested in this category of recommendations will help FAO in Africa (at regional,

subregional and country levels) to strengthen its internal digital agriculture capacities in order to better serve stakeholders. However, FAO needs to consider both the inward- and outward-looking recommendations as they are complementary.

6.2.1 Strengthen the mainstreaming of digitalization in FAO programme priorities

As it has been illustrated by the report, all Programme Priority Areas of the FAO Regional Office for Africa have benefited or can benefit from digitalization. As the national and subregional priorities are in line with the regional priorities, implications for countries can be easily derived.

In Chapter 4, it has been observed that, beside the cross-cutting theme of digital agriculture (largely cited as it is the focus on the study), the seven most cited priorities of the FAO Regional Office for Africa by the survey respondents are, by ranking:

- crop production and protection systems;
- trade and market opportunities for inclusive growth;
- scaling up of climate-smart agriculture;
- agribusiness, inclusive and resilient agrifood value chains;
- animal production systems and One Health platforms;
- fisheries and aquaculture systems; and
- resilience of livelihoods to natural and human-made disasters (it is important to note that digital platforms supporting emergency activities have benefited from considerable FAO investments, notably in Eastern Africa).

This may suggest increasing digital investments on these issues while the other priorities must not be neglected. Specific observations and recommendations may be highlighted for some Programme Priority Areas selected as examples.

Regarding **crop production and protection systems**, while analyses in Chapter 5 illustrate that advisory services and pest management supports have been widely provided, the use of advanced digital tools that have proven their effectiveness in Africa (including smart mechanisation tools) need to be better promoted.

Analyses in the same chapter recommend that digital tools should be better mobilized to enhance the attractiveness and competitiveness of **agribusiness value chains** by FAO in Africa. For now, mostly basic uses of e-commerce

²² Apart from initiatives mentioned in this report, examples of youth in agriculture and digitalization projects that may be mentioned include the FAO African Youth Agripreneurs (AYA) platform; the ARDYIS and AgriHack Talent Projects of the now closed CTA (outputs of activities implemented are available online); and the African Food System Forum (formerly AGRF), which has pursued the organization of the Pitch AgriHack competition.



platforms, mobile money services and electronic vouchers are implemented to promote the access to market and digital financial inclusion. Here as well, the promotion of more advanced solutions related, for example, to digital supply chain management services or digitally enabled insurance services, need to be explored further when relevant for the targeted populations. Few projects have addressed **digital finance**. However, it is an essential pillar in the transformation of value chains and food systems, empowerment and inclusion of smallholders, women and youth. FAO Uganda recently started an innovative activity on digital finance, involving the Uganda Development Bank, the start-up Ensibuuko, the United Nations Capital Development Fund and the European Union, which may serve as a model. New digital technologies (such as blockchain, big data and analytics, artificial intelligence and satellite information) have started playing an important role in stimulating, for example, the penetration of insurance products and the reduction in credit costs, with personalized solutions in some cases. In this respect, FAO can play a key role, not only in raising awareness on the existence or the need for such technologies and related services, but also by encouraging or providing technical assistance to financial services providers to design specific products and services that are tailored to the actual needs of farmers. FAO should also play a critical role in making sure that such services are farmer-friendly and ensure that the introduction of such services fosters inclusion, and not the other way around.

Considering the acceleration of **climate change** and its impacts on agrifood systems, FAO should streamline and increase activities on digital climate-smart agriculture. Better leveraging digital data will benefit all programme priorities, including for **agriculture policymaking and monitoring**. Suggestions regarding **decent employment** and **gender equality** have been included in an earlier specific recommendation addressing inclusion issues in the outward-looking recommendations.

Some priorities or themes, based on the data of this report, have benefited from much fewer digital activities in FAO's interventions in Africa. We may cite nutrition and digitalization, One Health and digitalization, etc. Analyses should be made to identify how these programme priorities may better benefit from and embed digitalization.

6.2.2 Develop practical guidelines for programme managers on digital agriculture project implementation

It will be useful to develop guidelines on practical steps to mainstream digital agriculture in projects and, if possible, in some programme priorities that have less embed digitalization for now, for the benefit of FAO personnel in the region.

“[This may] help catalyse ideas, some concept notes, assist with quick project formulation and adaptation of ideas.”

(African migratory locust response to mitigate impacts on food security and livelihoods project, Namibia)

6.2.3 Promote internal knowledge-sharing and capacity building on digital agriculture

Digital agriculture upskilling for all FAO personnel involved in programme design and implementation will help them better leverage opportunities of digitalization, better apprehend its limitations, and better interact with partners during project design and implementation. The Regional Office periodically organize digital agriculture, awareness-creation and networking webinars. Networking sessions involve the invitation of experts, start-ups and other organizations implementing digital agriculture initiatives. These activities can also be held at national level. Outputs coming from their organization need to be adequately shared among personnel. FAO personnel in Africa interested in digital agriculture should be encouraged to join global communities of practice or exchange on platforms established at FAO corporate level on issues such as the Digital Villages Initiative, artificial intelligence, etc.

6.2.4 Empower focal points at national, subregional and regional levels

It is recommended to appoint, where they don't exist, units or focal points on digital agriculture at national and subregional levels, and institutionalize that role when possible, to avoid discontinuation of the provided support. The focal point role should build on the existing IT support available at all these levels, and/or may be linked to an existing programme role. When possible, it can be formalized through a specific personnel position, as it has been done by the FAO Country Office in Kenya.

At regional level, the existing focal point role should be strengthened so that it responds more adequately to national and subregional needs. This is in line with recommendations by respondents.

“ [We recommend to] install an FAO technical hub per region directly and strongly supporting countries.”

(Building Adaptive Capacity and Resilience of the Forestry Sector in Cabo Verde project)

The technical hub proposed by the respondent here seems to go beyond digital agriculture support. Raising the profile of digital agriculture from cross-cutting theme to Programme Priority Area (as established at corporate level) should be considered.

The existence of such points of support will also help to improve the synergy around digital activities promoted at FAO corporate level and field levels. Indeed, in some cases, there is no knowledge of successful solutions which are piloted or promoted at corporate level with some test countries by the required personnel in non-participating country offices.

6.2.5 Enhance the value of FAO’s digital solutions

It is recommended that FAO periodically reviews digital solutions that it has developed, co-developed or commissioned to support governments, and ensure that they remain effective and define clear sustainability strategies with the governments. It is proposed that some of the solutions proposed by the Organization be integrated. It is also important that FAO improves the effectiveness of digital agriculture solutions of which development it has directly supported or those that it is promoting.

“ Merge FAMEWS (used to eradicate fall armyworm) with elocust3m (used for locust management) app due to their similarity.”

(Rapid Response to the African Migratory Locust Outbreak in Southern Africa project, Zambia)

“ There is a need to ensure interoperability of systems developed by FAO and define clear sustainability plans.”

(AMR surveillance data management project, Zimbabwe)

“ FAO should pay more attention to sustainability and business models of the projects we are promoting, learning from experiences which work already.”

(PROMOVE Agribiz project Mozambique)

When responding to government requests for digital solutions, FAO should first ensure that there are no existing solutions that can be reused and adapted. In addition, as expertise in the development of digital solutions is now increasing in African countries, it is suggested that FAO engages in the development of new solutions only after evaluating the possibility for the private sector (if possible local companies) to develop them.

FAO should consider better supporting innovative solutions that are weakly deployed in its projects in Africa (use of drones, etc.) as well as piloting some of the emerging solutions such as generative artificial intelligence (ChatGPT, Gemini, etc.), targeting relevant stakeholders for this (for example, extension agents, etc.).

6.2.6 Expand the scope of digital agriculture activities

As per the categorization adopted in Chapter 4, most projects analysed were low-level or mid-level digital projects, as they involved few digital activities. It has also been identified that many projects involved only basic digital activities (for example, data collection using a tablet and training of technical officers on tool used) though this may be relevant. As indicated in Chapter 4 as well, three countries even stated that they don’t have any digital agriculture activities the last couple of years in their portfolio. An analysis of project activities shows there is the potential of increasing the scope of digital interventions in many projects.

It is therefore recommended that at design stage, the inclusion of digital interventions is considered for various project (sub-)components, and that more consistent digital activities are considered while making sure that there is actual relevance and clear value provided to farmers or targeted beneficiaries. Collaborating with innovative digital agriculture service providers will contribute to this. When possible, more dedicated digital agriculture projects (“predominantly digital” or “largely digital” projects as per the categories adopted in the analysis) may be implemented. Adequate resource mobilization should also be undertaken so that larger projects are implemented to increase impacts. As a matter of fact, the possibility to implement digital activities with larger scope will often depend on the availability of adequate budget.

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ANNEX

List of all projects identified and covered in the analysis

Information source (FAO country, sub-regional or regional office)	Name of project or programme
Angola	Fortalecimento da Resiliência e da Segurança Alimentar e Nutricional em Angola (FRESAN)
Angola	Census of Agriculture, Livestock and Fisheries (CALF/RAPP)
Angola	Serre hydroponique surveillée par des capteurs environnementaux connectés à l'internet. Système de collecte des informations de suivi par portables et base de données en ligne
Benin	Stratégie nationale d'agriculture numérique du Bénin (SNAN-Bénin 2021–2025)
Burkina Faso	Renforcement des capacités pour les systèmes d'innovation agricole CDAIS
Burkina Faso	Intégrer la résilience climatique à la production agricole et pastorale pour la sécurité alimentaire dans les zones rurales vulnérables à travers l'approche Champ école des producteurs
Burkina Faso	Projet d'appui à la mise en œuvre du Plan de Réponse et de Soutien aux Acteurs de l'Élevage affectés par la Crise de la COVID 19 au Burkina Faso (PRSAE-C 19)
Burkina Faso	Assistance aux ménages vulnérables à l'insécurité alimentaire et aux ménages victimes de conflits communautaires dans la Région du Centre
Burundi	Integrated Approach Pilot – Food Security (IAP-FS) Appui à la production alimentaire durable et l'amélioration de la sécurité alimentaire et la résilience climatique dans les hautes terres du Burundi
Burundi	Réhabilitation des paysages naturels et adaptation au changement climatique dans les provinces de Bujumbura et Bujumbura Mairie à travers l'approche des champs écoles des producteurs
Cabo Verde	Building Adaptive Capacity and Resilience of the Forestry Sector in Cabo Verde
Cameroon	Projet d'appui à l'intensification de la production maraîchère dans les zones péri-urbaines de Douala et Buea
Chad	Improving land and water productivity in the Sudano-Saharan belt
Comoros	Autonomisation des femmes dans les systèmes alimentaires et renforcement des capacités locales et de la résilience des PEID dans le secteur agroalimentaire
Comoros	Assistance technique à la gestion des connaissances et de l'information
Côte d'Ivoire	Soutien au Programme de sécurité sanitaire mondiale (GHSA) dans la lutte contre les zoonoses et le renforcement de la santé animale en Afrique
Côte d'Ivoire	Promouvoir une production de cacao sans déforestation pour réduire les émissions en Côte d'Ivoire (PROMIRE)
Democratic Republic of the Congo	Projet d'appui à la réhabilitation et à la relance du secteur agricole (PARRSA)
Equatorial Guinea	Strengthening the production of agricultural and SAN statistics in Equatorial Guinea
Ethiopia	A Global Network of Digital Agriculture Innovation Hubs Ethiopia
Ghana	Scoping Assessment Digital Village Initiative

Continued overleaf

Information source (FAO country, sub-regional or regional office)	Name of project or programme
Gabon	Appui à l'Initiative Gabon familles vertes
Gambia	Agriculture for Economic Growth
Ghana	Antimicrobial Resistance Multi-Partner Trust Fund
Ghana	Enhancing e-agriculture structures and mechanisms for extension, surveillance and early warnings
Guinea	Assistance d'urgence pour la lutte contre la chenille légionnaire d'automne
Guinea	Emergency assistance for the fight against the Fall Armyworm
Guinea-Bissau	Appui à la lutte contre la Chenille légionnaire d'Automne
Kenya	Strengthening capacity for effective agriculture data and knowledge management through the Kenya Inte-grated Agriculture Management Information System (KIAMIS)
Lesotho	Establishment of a Lesotho National Farmer Registry and Electronic Voucher Management System
Liberia	Strengthening soil analysis and information systems to enhance sustainable soil management and support evidence-based decision-making in Liberia
Liberia	Linking Extension and Research to Farmers for Sustainable Agriculture, Food Security and Nutrition project
Madagascar	Appui à l'innovation et la digitalization des systèmes agroalimentaires
Malawi	Strengthening Community Resilience to Climate Change in Blantyre, Zomba, Neno and Phalombe Districts
Malawi	Co-financing from various project
Malawi	KULIMA Project - Revitalising Agricultural Clusters and Ulimi wa Mdandanda through FFS in Malawi
Malawi	Digital Villages Initiative (DVI) pilot project
Mali	Renforcement de la résilience des éleveurs au Sahel
Mozambique	PROMOVE Agribiz
Namibia	African migratory locust response to mitigate impacts on food security and livelihoods
Namibia	Strengthening the capacity of farmers to manage climate-related risks in Northern Namibia
Niger	Appui au processus d'élaboration de la Stratégie nationale pour une agriculture digitale (e-agriculture) et formulation d'une note conceptuelle sur l'agriculture urbaine et péri urbaine
Nigeria	Nigeria REDD+ Readiness Programme
Regional Office for Africa	Enhancing Livelihoods, Food Security and Maritime Safety in the African Coastal Countries of the Indian Ocean
Regional Office for Africa	True Fish Farming Story in Lake Victoria Basin
Congo	Capacités des jeunes agripreneurs enclins à la migration dans les zones rurales et urbaines à s'adapter à l'impact de COVID-19
Congo	Projet Système Permanent Intégré des Statistiques Agricoles (SPISA)
Rwanda	Support to Agricultural Services and Digital Inclusion in Rwanda
Rwanda	Support local suppliers' capacity development and promotion of e-Commerce for agricultural value chains in Rwanda

Information source (FAO country, sub-regional or regional office)	Name of project or programme
Senegal	Digital Village Initiative (DVI)
Sierra Leone	Development of a data-driven geo-spatial information system to analyze risks and shocks
Sierra Leone	Supporting the Global Health Security Agenda (GHSA) to address Zoonotic Disease and Animal Health in Africa
Somalia	Improving and Sustaining Food Security in Rural Somalia
Somalia	Digital Villages Initiative
South Africa	Up scaling of FAW Activities in South Africa
South Sudan	Strengthening the Livelihoods Resilience of Pastoral and Agro-Pastoral Communities in South Sudan cross-border areas with Sudan, Ethiopia, Kenya and Uganda
South Sudan	Strengthening the Resilience of Rural Communities in South Sudan
Subregional Office for Southern Africa (SFS)	Locust Response project
Togo	Appui de la FAO à la mise en œuvre du Projet National de Promotion de l'Entreprenariat Rural
Uganda	Sawlog Production Grant Scheme
United Republic of Tanzania	Building capacity for resilient food security
United Republic of Tanzania	Supporting the Global Health Agenda to address zoonotic disease and animal health in Africa
United Republic of Tanzania	Strengthening of Tanzania Food and Nutrition Security Information System for Quality, Timely and Reliable data
Zambia	Blockchain and related digital technologies for sustainable agrifood value chain development in Uganda
Zambia	Rapid Response to the African Migratory Locust Outbreak in Southern Africa
Zimbabwe	African migratory locust response to mitigate impacts on food security and livelihoods
Zimbabwe	National Port Health and Food Safety Information System
Zimbabwe	Zimbabwe Livelihoods and Food Security
Zimbabwe	Livestock Information Management System
Zimbabwe	Promoting Sustainable Management of Human–Wildlife Conflict and Appropriate Agricultural Practices among Vulnerable Communities in Northern Zimbabwe

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