CHAPTER 14

The Role of Digitally Enabled Smallholder Producer Organizations (SPOs) in Promoting Emerging Agricultural Technologies in Africa

Getaw Tadesse, Fidele Eric Sessou, and Augustin Wambo Yamdjeu

Introduction

Agricultural technologies play a pivotal role in driving economic transformation by enhancing productivity, improving resource efficiency, and fostering value addition across the agrifood system. The adoption of improved seeds, mechanization, irrigation systems, digital tools, and postharvest technologies not only raises farm yields but also stimulates rural employment, agro-industrial growth, and trade opportunities. Evidence shows that technological progress in agriculture has historically been the foundation of structural transformation, enabling labor to shift from subsistence farming to more productive sectors of the economy (World Bank 2007; Diao, McMillan, and Rodrik 2019). In Africa, scaling up agricultural innovations could more than double productivity while reducing poverty and food insecurity, thereby creating a strong base for inclusive growth and sustainable economic development (FAO 2021; AGRA 2022). Agricultural technologies are thus not just tools for improving farming, they are also catalysts for broader economic transformation.

Across many African countries, however, the adoption and effective utilization of agricultural technologies by smallholder farmers and other value chain actors remain a significant challenge (Suri and Udry 2022). Limited access to finance, inadequate extension services, weak infrastructure, and fragmented markets often constrain farmers' ability to acquire and apply improved seeds, mechanization, irrigation, and postharvest technologies (Fadeyi, Ariyawardana, and Aziz 2022). The challenge becomes even more pronounced with the introduction of emerging digital technologies,[1] which require not only basic infrastructure such as electricity and internet connectivity but also higher levels of digital literacy and trust among users (Smidt and Jokonya 2022). As a result, while digital innovations hold great promise for transforming African agriculture, their potential will remain underutilized unless it is accompanied by deliberate policies, capacity development, and investment in inclusive innovation ecosystems.

To a large extent, the limited technology adoption and utilization can be explained by the ineffectiveness of agricultural technology transfer models (Fadeyi, Ariyawardana, and Aziz 2022; Smidt and Jokonya 2022). In Africa, despite the implementation of various such models to promote agricultural technologies, many have fallen short of adequately supporting their wider and sustainable adoption (Orr 2018; Kpoviwanou, Sourou, and Ouinsavi 2024). Linkages among value chain actors remain weak and fragmented, particularly among research institutions, extension services, and farmers; there is also limited private sector involvement in the generation, dissemination, and promotion of agricultural technologies (Pray, Gisselquist, and Nagarajanet 2011). When it comes to emerging technologies, these challenges are even more pronounced. Compared to conventional technologies such as improved seeds or enhanced agronomic practices, emerging digital technologies face additional barriers. One such barrier is high sunk costs, that is, initial expenditures on machinery and on technologies such as new varieties of seeds. Other barriers include: the significant initial investment risks; low awareness of new technologies and poor digital literacy among farmers, extension agents, and even regulators; infrastructure deficits; and restrictive policy environments.

These challenges underscore the need for new types of institutional arrangements that are tailored to both the unique characteristics of these technologies and to the specific realities of African smallholder farmers, who often have limited access to finance, weak bargaining power, and low literacy. In this context, revitalizing Smallholder Producer Organizations (SPOs)[2] presents a promising avenue for the sustainable promotion and integration of emerging food system technologies. With enhanced business orientation and capacity building, SPOs can act as intermediary service providers and can play a critical role in creating beneficial connections between farmers and the private sector, researchers, innovators, and appropriate technologies.

1 In this paper, emerging agricultural technologies are defined as advanced and innovative solutions that are currently evolving and reshaping agriculture by boosting productivity, sustainability, and efficiency. These technologies use cutting-edge tools and scientific techniques to address pressing challenges such as climate change, food insecurity, limited market access, and resource scarcity. Examples include precision agriculture, smart farming, biotechnology, vertical farming, AI-enabled applications, robotics and automation, sustainable practices, agri-fintech solutions, mobile-based advisory services, and digital platforms for input and output markets.

2 SPOs are associations, groups, or cooperatives of smallholder agricultural producers that are formed mainly to help members engage in collective actions for production, resource acquisition, processing, or marketing. SPOs and agricultural cooperatives are thus interchangeable concepts.

This chapter explores the agricultural technology transfer model that is best suited to embracing and promoting emerging agricultural technologies. We argue that the effectiveness of a model in supporting technology adoption depends on two key factors: 1) the type of technology, and 2) the specific characteristics of the institutions involved. A strong alignment between the nature of the technology and the institutional framework of the model is essential for success. To this end, we begin by reviewing the agricultural technology transfer models that have been commonly implemented across Africa. We then focus on the potential of SPOs, which we identify as one of the most promising technology transfer models for advancing Africa's adoption and integration of emerging AI-based digital agricultural technologies and services.

Review of Agricultural Technology Transfer Models in Africa

Agricultural technology transfer in Africa has historically been shaped by linear, top-down models such as the Research–Extension–Farmer (REF) approach and the World Bank–backed Training and Visit (T&V) system. These models emphasized a one-way flow of technologies from research institutions to extension agents and then to farmers, which largely treated farmers as passive recipients. While these approaches helped introduce improved seeds, fertilizers, and farming practices during the Green Revolution era, they often achieved limited adoption because they overlooked local knowledge, provided weak feedback loops, and struggled to sustain themselves after donor support ended.

In recent decades, there has been a shift toward more inclusive and dynamic models of technology transfer that recognize farmers as active participants in the innovation process. Agricultural Innovation Systems (AIS), participatory approaches such as Farmer Field Schools (FFS) and participatory plant breeding (PPB), and market- and value-chain–oriented models emphasize collaboration among diverse actors, including farmers, researchers, private companies, and policymakers. The rise of digital platforms and mobile-based advisory services has further transformed knowledge sharing, enabling real-time communication and feedback loops, and broader outreach at a lower cost. These new models have improved the relevance, adoption, and scalability of agricultural technologies in Africa, though persistent challenges remain in ensuring equity, institutional coordination, and sustained financing.

Table 14.1 shows the list of agricultural technology transfer models commonly practiced and applied in Africa. As shown in the table, several models have been implemented to support learning, knowledge sharing, and technology generation and transfer in agriculture. Some models are specifically designed to ensure that technology transfer to farmers is effective and successful; these include the REF approach, participatory research approaches, and agricultural innovation platforms. Others, including contract farming and producer organizations, go beyond technology transfer by also facilitating access to input and output markets. These approaches are more comprehensive, aiming to create incentives on both the supply and demand sides to encourage farmers to adopt new technologies.

None of these transfer models, however, are without limitations. As outlined in Table 14.1, some weaknesses are inherent to the design of the models; others stem from implementation challenges such as limited capacity or lack of sustainability. Despite these issues, the models have played an important role in driving technological change in African agriculture and in reshaping the research-extension landscape across the continent.

A comprehensive review of the extension methods was conducted by Mapiye and Dzama (2024). According to this review, most of these models were developed to promote conventional agricultural technologies such as improved seeds, enhanced agronomic practices, and better livestock management techniques. Overall, they have proven effective in the dissemination of basic technologies. The REF approach in Ghana, for example, resulted in improved technology adoption that contributed to a 34 percent increase in crop yields and a 64 percent rise in net farm revenues (Mohammed and Awudu 2022). Structured learning models such as the FFS approach have also demonstrated strong results. In Tanzania, for example, Kenya et al. (2017) reported that more than 65 percent of FFS participants adopted about 80 percent of the innovative rice production practices introduced by the program.

Similarly, technology transfer based on contract farming has proven to be a powerful tool for promoting the adoption of climate adaptation strategies, especially in northern Ghana (Azumah, Donkoh, and Ansah 2017). Innovation platforms have also emerged as essential mechanisms for encouraging

TABLE 14.1—THE STRENGTHS AND WEAKNESSES OF AGRICULTURAL TECHNOLOGY TRANSFER MODELS THAT ARE USED IN AFRICA

Agricultural technology transfer model	Description	Strengths	Weaknesses	Sources
Research–extension–farmer forums	An organized, regular forum that includes researchers, extension agents, and farmers in discussions of new technologies, identification of problems, and planning of solutions	Collaboration and participation enhance technology adoption and result in increased relevance and adaptability	Mostly top-down technology dissemination; weak/loose feedback mechanisms	Mapiye and Dzama 2024 Mohammed and Awudu 2022
Training and Visit (T&V) approach	A top-down extension approach introduced by the World Bank in the 1970s; based on regular, structured training of extension agents by subject-matter specialists, followed by scheduled visits to farmers to pass on technical messages	Improved expertise and experience; more efficient communication and information flow; higher levels of flexibility and adaptability	Insufficient and/or costly resources and staffing; vulnerability to exogenous factors such as changes in government policies and funding cuts; limited opportunity for continuous learning; imited adaptation to local needs	Van den Ban and Mkwawa 1997 Musa, Aboki, and Audu 2013
Participatory agricultural research approaches	Development of technologies with farmers' participation; activities move from problem identification to testing and demonstration	Enhanced adoption of innovation; increased relevance of technologies; good integration of local/Indigenous knowledge	Time and resource-intensive; limited scalability; institutional barriers	Chambers 2014 Mapiye and Dzama 2024
Farmer field school approach	A group-based learning approach that teaches farmers and informs/advises them about new technologies and field-based experiences	Empowerment through experiential learning; enhanced community cohesion and collective action; adaptability to diverse contexts	Dependency on skilled facilitators; high per-farmer costs; fiscally unsustainable	Mapiye and Dzama 2024 Kenya et al. 2017
Lead farmer extension approach	A participatory agricultural extension method whereby selected innovative and motivated farmers ("lead farmers") are trained in improved farming practices and technologies; they then demonstrate and share their knowledge and skills with neighboring farmers, serving as role models and local resource persons	Builds peer-to-peer learning, trust, and networks Cost-effective	Selection bias toward wealthy and educated lead farmers; lead farmer may lose motivation over time; equity concerns	Baraka, Mhando, and Malisa 2025
Agricultural innovation platforms	Multistakeholder forums where farmers, researchers, representatives from agribusiness, policymakers, NGOs, and other actors come together to identify problems, share knowledge, and co-develop solutions to agricultural challenges	Enhanced stakeholder collaboration and co-innovation; capacity building and skills development; network expansion and collective advocacy	Dependency on external facilitation; high resource and time demand	Fatunbi et al. 2016 Abebe et al. 2023
Contract–farming–based technology transfer approach	A contractual arrangement between private agribusinesses and farmers in which the former provide technical advisory services and inputs to farmers, and farmers, in turn, supply their outputs to agribusinesses	Access to inputs and technology; enhanced market access; guaranteed sales	Risk of contract non-compliance; farmers often experience limited bargaining power	Azumah, Donkoh, and Ansah 2017
Smallholder Producer Organizations	A contractual arrangement between private agribusinesses and farmers in which the former provide technical advisory services and inputs to farmers, and farmers, in turn, supply their outputs to agribusinesses	Enhanced access to information and training; improved market access and bargaining power; empowerment and inclusion	Coordination requirements; dependency on external support	Abebaw and Haile 2013 Manda et al. 2020 UNECA 2021

Source: Authors' compilation based on the sources cited above.

technology adoption (Fatunbi et al. 2016; FARA 2024). By fostering inclusive, participatory, and adaptive engagement, these platforms help close knowledge gaps and promote the spread of agricultural technologies among diverse farming communities in Africa (Fatunbi et al. 2016).

The 2021 UNECA report discusses strategies for enhancing technology transfer in Africa, with a focus on the role of SPOs in facilitating the adoption of sustainable agricultural practices. It outlines the need for strengthening SPOs to improve their capacity to disseminate and support the adoption of new technologies (UNECA 2021).

In terms of the promotion of emerging technologies such as digital agricultural technologies, however, these technology transfer models are inadequate, and some are even inappropriate; by definition, they demand specific institutional setups to address sunk costs, indivisibility, economies of scale, and knowledge intensity. We argue that, given their nature and ownership structure, SPOs are relatively better positioned to facilitate the advancement of emerging digital technologies and their services. The subsequent section delves into this potential.

The Role of SPOs in the Promotion of Emerging Agricultural Technologies and Services

The evolving roles of SPOs

Several studies have highlighted that SPOs in Africa have undergone significant reforms in the process of responding to emerging demands and evolving political contexts. In Ethiopia, for instance, agricultural cooperatives have transformed from primarily supplying farming inputs to engaging in the commercialization of agricultural products, and from being state-controlled entities to being self-governed, member-owned organizations (Tefera, Bijman, and Slingerland 2016). Mercier (2016) further notes the growing diversification of cooperatives and their expanding roles in addressing market access challenges. Similarly, Badiane (2016) explored the contributions of SPOs since independence, emphasizing the need for these organizations to revitalize themselves in light of emerging digital technologies and to fill the gaps left by parastatals following structural reforms.

Other empirical studies underscore the pivotal role of SPOs in shaping the adoption and effective utilization of agricultural technologies among small-scale farmers. Through collective action and unified negotiation, SPOs enable farmers to address key barriers to technology adoption, including high costs, limited access, and scale inefficiencies. By aggregating resources and facilitating joint decision-making, these organizations fundamentally transform the economic dynamics of technology diffusion within smallholder systems. Abebaw and Haile (2013) provided empirical evidence from Ethiopia that shows cooperative membership to have significantly increased the likelihood of an individual farmer adopting improved technologies, such as modern seeds and fertilizers. These organizations enable collective purchasing, promote knowledge sharing, and provide training, thereby lowering transaction costs and reducing the individual risks associated with adopting new technologies. In Zambia, cooperative membership was shown to have increased the probability of technology adoption by 11 to 24 percent (Manda et al. 2020).

In a 2018 paper, Ton et al. also highlighted that well-structured farmer organizations not only improve market access but also foster innovation by linking farmers with research institutions and private sector actors. In Rwanda, Francesconi and Heerink (2011) found that cooperatives with strong governance and active member participation had a significantly greater impact on the adoption of productivity-enhancing technologies, and a more recent report from Kenya (CABI 2025) underscores the increasing role of SPOs in attracting young members while also serving as intermediaries for agricultural technologies and providers of rural services. As such, SPOs serve as vital intermediaries between research and practice, accelerating the uptake of technology and contributing to agricultural transformation.

Figure 14.1 summarizes the evolving roles of SPOs in Africa, particularly agricultural cooperatives. After independence, many African governments adopted cooperatives as key instruments for rural development and agricultural modernization. National cooperative unions were established with strong state involvement and support, and ministerial mandates were expanded to include cooperative affairs with agriculture and rural development. In several countries, these cooperatives were aligned with socialist political ideologies and were often seen as mechanisms for collective farming. They were tasked with distributing agricultural inputs, providing credit, organizing marketing services, and disseminating agricultural knowledge.

From the 1980s and 1990s onward, however, state support for SPOs declined sharply following the implementation of Structural Adjustment Programs

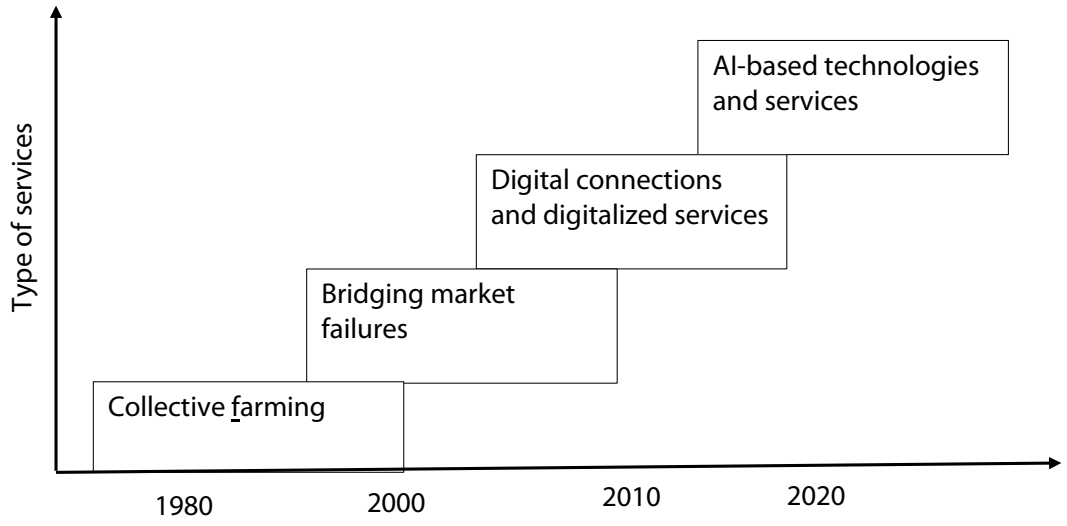
(SAPs) led by international financial institutions. With government withdrawal from the provision of inputs and market regulation, many cooperatives collapsed due to limited resources, poor governance, and an inability to compete in liberalized markets.

During the 2000s, the failure of structural adjustment reforms and the private sector's limited capacity to fully develop rural markets led to a renewed interest in cooperatives. From that point, cooperatives again became increasingly recognized as crucial institutions for addressing market gaps and empowering smallholder farmers. With support from governments, NGOs, development partners, and farmer-based organizations, a new generation of cooperatives emerged across the continent. These modern cooperatives focused on promoting democratic governance, financial transparency, gender inclusion, and market-oriented services.

As shown in Figure 14.1, since the new millennium, the rise of digital technologies has further transformed the roles of SPOs. New digital tools have enabled more efficient market transactions, financial services, and agricultural extension delivery. The adoption of platforms such as e-marketing, e-extension, and e-finance has significantly enhanced the capacity of cooperatives and SPOs to serve their members. As a result, they have experienced a significant expansion in their role as intermediaries in improving market access, boosting productivity, and enhancing the welfare of small-scale farmers. As these organizations have become well established and recognized, they have come to serve as essential mechanisms for addressing market failures and empowering rural communities (Chowdhury, Ghosh, and Rao 2024).

Quayson, Bai, and Osei (2020) have illustrated the role of SPOs in promoting digital inclusion among smallholder farmers, which proved to be instrumental in enhancing resilience to systemic shocks such as the COVID-19 pandemic. These findings collectively suggest that SPOs are central to advancing digital transformation and sustainability in post–COVID-19 agricultural supply chains, particularly for smallholders who are integrated into global value chains. This, in turn, demonstrates how systemic shocks and emerging digital technologies are shaping the role of SPOs in digitalization and the expansion of digital services.

FIGURE 14.1—EVOLVING ROLES OF SMALL PRODUCER ORGANIZATIONS IN AFRICA



Source: Authors.

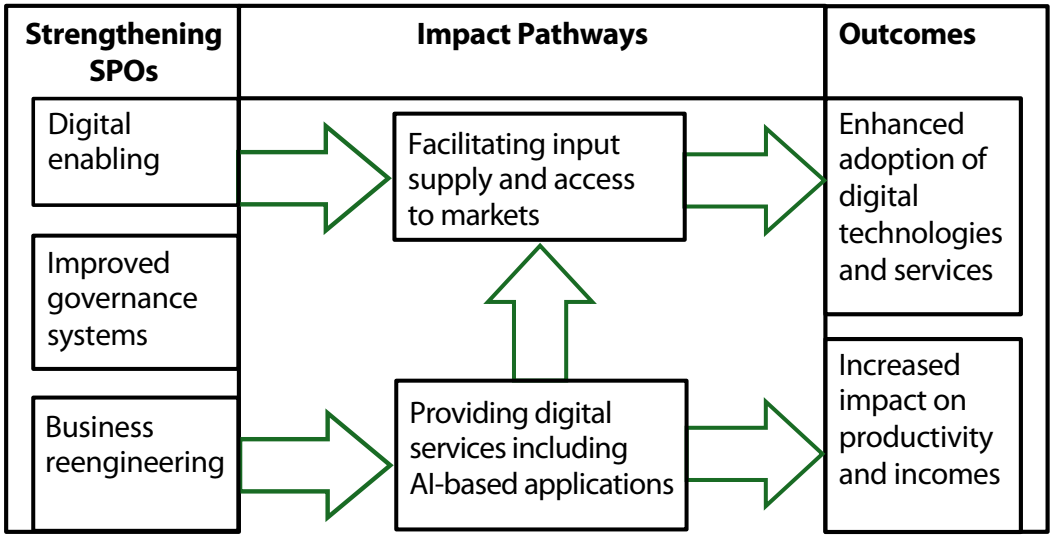
In summary, SPOs have played a critical role in facilitating members' access to agricultural inputs, in supporting the commercialization of agricultural products, and in promoting the adoption of improved technologies and digital services. The advent of AI-based technologies and applications, however, has generated a new wave of demands on SPOs that is centered on the digitalization of services, information, and knowledge. Meeting these emerging demands requires them to develop new capacities, adopt more business-oriented approaches, and strengthen their governance systems in order to effectively deliver digital services. The following subsection discusses how SPOs are uniquely positioned to serve as key vehicles for transferring and integrating digital technologies into smallholder farming systems.

SPOs as potential intermediaries for AI-enabled digital technologies

AI-based digital agricultural technologies include AI-powered drones, automated machinery, remote sensors, satellite imagery, Geographic Information Systems

(GIS), and other agricultural applications. The rise of these technologies requires new types of agricultural technology transfer models to serve as technology intermediaries in the coming decades. SPOs enhance the adoption and impact of agricultural technologies through two main pathways. First, they facilitate direct access to markets, finance, and inputs that support the uptake of new and emerging technologies; second, they provide digital services and platforms that accelerate innovation adoption by offering farmers timely, tailored information and strengthening decision-making across the value chain. Digitalization enables effective monitoring and evaluation of technology impacts, which ensures more efficient scaling and greater resilience within Africa's agrifood systems. Digitalization also reinforces the core functions of SPOs, such as facilitating access to markets and finance, which will further accelerate the adoption of agricultural technologies (Figure 14.2). These impact pathways help to raise two important questions: 1) why should SPOs be the preferred option for the sustainable digitalization of African agriculture, and 2) what should be done to help SPOs most effectively play the role of digital intermediary.

FIGURE 14.2—IMPACT PATHWAYS OF SMALL PRODUCER ORGANIZATIONS ON AGRICULTURAL DIGITALIZATION AND TECHNOLOGY ADOPTION



Source: Authors.

For several reasons, SPOs are uniquely positioned to facilitate the diffusion and integration of digital technologies in African agriculture. First, they play a critical role in sharing the substantial sunk costs associated with emerging AI-based digital technologies. By their very nature, AI-based technologies require significant initial investments in infrastructure, devices, data, and knowledge acquisition, which are often unaffordable for individual smallholder farmers. SPOs, by aggregating large numbers of members, create economies of scale that reduce the per-farmer cost of adopting such technologies. This collective approach enables smallholders to access AI-enabled digital innovations that would otherwise remain out of reach. In doing so, SPOs not only lower financial barriers but also facilitate knowledge sharing, training, and peer-to-peer learning, thereby enhancing the effectiveness and adoption of digital solutions across the farming community.

The second reason African SPOs are well-placed to promote the diffusion and integration of digital technologies is that they can play a crucial role in facilitating partnerships between farmers and private digital technology service providers. It is typically private sector actors who develop and offer emerging digital technologies such as precision agriculture tools, mobile-based advisory services, and digital marketplaces. For these providers to engage directly with individual smallholder farmers, however, is often impractical and costly due to the dispersed nature of smallholder agriculture. SPOs, on the other hand, can aggregate members and thus bridge this gap, thereby enhancing farmers' business credibility and making them more attractive partners for private technology firms. SPOs can also coordinate access to government programs, research institutions, and development partners, ensuring that technological innovations are effectively tailored, adopted, and scaled within farming communities. By serving as intermediaries, SPOs can reduce transaction costs, improve trust between farmers and service providers, and foster more sustainable and inclusive adoption of digital technologies.

Third, SPOs are well-positioned to promote digital technologies among farmers because they serve as trusted local institutions that are deeply embedded within the

community, which gives them a unique credibility and legitimacy. This trust strengthens social cohesion and creates a supportive environment where members feel more confident in experimenting with and adopting new technologies. The rate of uptake is thus often higher than in cases where interventions are designed and delivered exclusively by external agencies whose unfamiliarity with local contexts and whose limited community trust can hinder acceptance and long-term sustainability.

The fourth reason for the potential effectiveness of SPOs is that they already perform critical intermediation functions that connect farmers and other value chain actors to essential resources and markets. These functions include: the distribution of agricultural inputs such as seeds, fertilizers, and tools; the aggregation and marketing of outputs in order to secure better prices and wider market access; and the facilitation of credit and other financial services that enable members to invest in their farms. By leveraging AI-enabled digital solutions, these functions can be strengthened, streamlined, and modernized, for example, through digital platforms that enhance transparency in pricing, mobile applications that ease access to credit and savings, or data-driven systems that improve the efficiency of input supply chains. This modernization not only improves the effectiveness of SPOs but also increases their ability to deliver inclusive, timely, and scalable services to their members.

The fifth and final reason is that SPOs have an established presence in rural communities and are increasingly recognized by governments and development actors as effective partners in capacity building, data collection, and digital service delivery. These attributes position SPOs as essential actors in bridging the gap between smallholder farmers and the opportunities offered by the rapid technological development of the Fourth Industrial Revolution.

Besides the traditional roles SPOs play in input supply, product aggregation, and value addition, they can also play the new role of enhancing business credibility by linking farmers with private sector actors who provide digital technology services. SPOs can increasingly serve as technology centers that directly provide technological services to their members.

African agricultural SPOs, however, must revisit their intermediation business models, empower governance structures, and build their digital capabilities. Many African SPOs have rigid business models and are not as open as they could be to tapping into emerging opportunities. Their boundaries are also not always rationally defined, which can leave them little room to work with the private sector and make them heavily reliant on public support. The next section discusses what is required for SPOs to become effective digital technology intermediaries.

Strategic Actions to Enable SPOs to become Effective Intermediaries for Emerging Digital Agricultural Technologies

As discussed above, SPOs can play a pivotal role as technology service intermediaries, bridging the gap between smallholder farmers and the rapidly evolving world of agricultural technology. They can only deliver these services effectively, however, if they revisit their strategic orientations and build operational capacities. Below are the key strategic and operational issues that need to be addressed to allow African SPOs to serve as competent digital technology intermediaries.

Improving digital capacity and partnerships

Capacity building is essential. SPOs must be equipped with digital literacy skills and training to understand, manage, and use digital tools effectively, and to disseminate them effectively among their members. This includes training the organization's leaders and extension agents to become digital champions. Capacity-building initiatives should prioritize mentorship and technical assistance, particularly targeting extension workers and community-based agents who serve as key intermediaries between innovation systems and smallholder farmers. Training programs must include instruction on the application of smart farming technologies, thereby equipping SPOs to function as effective knowledge brokers and data interpreters within their communities.

Furthermore, ensuring access to affordable digital devices and reliable connectivity are essential steps in overcoming barriers related to cost and infrastructural limitations. In parallel, enhancing the capacity of SPOs to negotiate with technology providers and to facilitate access to agricultural inputs, financial services such as credit and insurance, and market opportunities is critical for strengthening their strategic position within agricultural value chains. Collectively, these interventions support the development of resilient, digitally enabled smallholder systems capable of leveraging innovations to improve productivity and sustainability.

Partnerships with tech providers, research institutions, technology companies, governments, and NGOs should be expanded. This can facilitate access to affordable, user-friendly technologies that are tailored to smallholder contexts. Public–private partnerships (PPPs) play a critical role in the scaling and dissemination of agricultural technologies. Within this collaborative framework, government entities typically offer an enabling environment through supportive policies, regulatory frameworks, and institutional backing; concurrently, private sector stakeholders contribute essential resources, including financial investment, technological innovation, and expanded distribution networks.

Infrastructure should be improved. Mobile connectivity and access to electricity in rural areas, for example, are vital to ensuring the consistent and inclusive use of digital services.

By adopting these digital capabilities, SPOs can act as effective intermediaries for transferring emerging digital technologies to smallholder farmers; they can thereby enhance productivity, improve access to agricultural inputs and other services, expand market access, and shore up resilience to climate change and other contemporary challenges. Box 14.1, below, describes how SPOs can be digitally enabled to play a role in digital technology intermediation. It details how they can serve as trusted intermediaries for **data aggregation and analysis**, enabling farmers to make more informed decisions by helping them interpret satellite imagery, weather forecasts, and market trends. When empowered, SPOs can bridge the gap between digital innovation and grassroots applications, transforming agriculture through scalable, community-led technology adoption.

Strengthening governance

As observed by AgriGRADE (2025), good governance is the backbone of any successful cooperative. It determines how decisions are made, how transparent and accountable systems are, and how the interests of members are protected. In many countries, governance presents both a persistent challenge and a major opportunity for unlocking the potential of cooperatives as engines of inclusive rural development. Despite its central role, however, governance is often one of the least tangible and most sensitive components of cooperative development. It deals with power, leadership, accountability, and internal control, all of which are areas that can be politically delicate or socially uncomfortable to address.

BOX 14.1—A GLANCE AT THE DIGITALLY ENABLED RESILIENCE AND NUTRITION POLICY INNOVATIONS (DERPIN) PROJECT

The DERPIn project was implemented in 2023 by AKADEMIYA2063 and the Pan-African Farmers' Organization (PAFO). It seeks to strengthen agrifood systems policies and strategies in Africa by increasing access to the information needed for better-informed decision-making. It leverages artificial intelligence, remote sensing, and predictive modeling to fill key data gaps and to strengthen the capacities to access, understand, and use data and evidence in a targeted manner. Its analytical workstreams include AI-driven crop mapping and yield forecasting, as well as tools to evaluate micronutrient adequacy and multidimensional vulnerability at the household and community levels. These insights are disseminated through open-access dashboards and mobile platforms, thus facilitating timely and widespread use.

DERPIn generates disaggregated data and forward-looking analytics that assist stakeholders in understanding risks and designing evidence-based responses. Its digital platforms facilitate more effective, anticipatory decision-making through policy simulation tools, maps, datasets, and targeted knowledge products. DERPIn serves policymakers, government planners, researchers, private sector firms, NGOs, farmers, farmer organizations, and donors. Its first phase (2023–2025) is active in Benin, Ghana, Malawi, Senegal, and Uganda, focusing on knowledge generation, capacity building, and policy dialogue.

The project empowers African smallholder farmers by equipping them with digital tools and data-driven insights that are tailored to their local realities. Through participatory design, farmers and cooperatives in the project countries cocreate technologies that support informed agricultural decision-making. The project uses big data, AI, and remote sensing to help farmers map crops, forecast yields, and assess nutrient and climate risks. Extensive training ensures that farmers not only collect useful data but also learn how to interpret and act on it effectively. DERPIn strengthens the digital capacity of farmer organizations, enabling them to advocate for more responsive and inclusive agricultural policies. As a result, farmers are better able to adapt to environmental stress, improve productivity, and influence policy discussions. This approach fosters greater resilience and sustainability within African food systems.

Source: AKADEMIYA2063 (2025).

This is particularly important for the effective delivery of digital services that require responsive leadership and transparent data governance systems.

The effectiveness of SPOs is frequently hindered by internal governance challenges. Enhancing governance, leadership, and management systems is essential if SPOs are to scale their operations effectively while maintaining the trust of members and external partners. Empirical evidence suggests that SPOs operate more efficiently when guided by democratic principles that ensure inclusive participation in decision-making processes (Quiroga et al. 2018). Such participatory governance fosters a sense of ownership among members and aligns organizational actions with collective objectives, thereby mitigating principal–agent problems that arise from a divergence between the interests of management and those of the broader membership.

The establishment and enforcement of clear governance policies, including those related to conflict of interest management, are crucial for preventing the misappropriation of organizational resources and strengthening intra-organizational trust. Furthermore, the adoption of transparent financial management practices enhances accountability and member confidence; these practices include standardized accounting systems, routine financial reporting, and compliance with legal and regulatory requirements.

Periodic, transparent, and equitable elections for leadership positions are vital to averting elite capture and entrenched leadership structures, and to promoting institutional renewal and adaptability. Additionally, fostering diversity in leadership and membership, particularly through the inclusion of women and youth, both broadens the range of perspectives within the organization and enhances its legitimacy and its capacity to address the heterogeneous needs of its constituents (Olapade et al. 2014).

Research focusing on Rwandan cooperatives revealed that agricultural performance is significantly impacted by organizational characteristics; for example, cooperatives with effective governance structures and active member participation were more successful at improving productivity and market access for smallholder farmers (Verhofstadt and Maertens 2014). This underscores the importance of internal organizational dynamics in determining the success of SPOs.

Revising business orientations

SPOs can amplify smallholders' access to innovation by adopting boundary-spanning practices such as cocreating solutions with farmers and firms and forging equitable Public–Private Partnerships (PPPs). Success hinges on institutional reforms that recognize SPOs as vital nodes in agricultural value chains, coupled with investments in digital infrastructure and participatory governance. A study in Ethiopia has empirically tested whether the observed (weak) performance of producer cooperatives in Africa is explained by their organizational boundary, that is, by the type and range of goods or services they provide to members (Tadesse, Abate, and Ergano 2019). The results confirm that producer cooperatives that provide club goods[3] and a limited range of services are found to be more competitive than cooperatives that are involved in multiple services and a wide range of products.

Besides defining the range of services and products, it is important to build strategic partnerships by collaborating with agritech startups, research institutions, NGOs, and private sector actors to access new technologies, markets, and expertise. Rwanda's agricultural transformation provides compelling evidence of how collaborative approaches between the private and public sectors can enhance SPOs' effectiveness as technology service intermediaries. The partnership between the International Finance Corporation (IFC) advisory project, the Rwanda Grain Markets project, and the World Bank-funded Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project demonstrates how coordinated interventions can improve farmers' yields and product quality for markets. This collaborative approach engaged all stakeholders, from producers to policymakers, and resulted in a 15 percent increase in farmers' profit margins and a reduction in maize rejection rates from 90 to 60 percent (GAFSP 2025). The Global Agriculture and Food Security Program's (GAFSP) experience with producer-organization-led investments provides additional evidence of the potential for enhanced intermediary functions when organizations are empowered with direct funding and decision-making authority.

3 A club good is a good or service to which access can be restricted by a pay wall, but which is non-rivalrous in that use by one person does not restrict or diminish use by another; examples are toll roads or internet services.

Private sector engagement models must move beyond traditional buyer–seller relationships to encompass genuine partnerships that share risks, resources, and benefits among all stakeholders. The emergence of public–private–producer partnerships (4Ps) provides a framework for creating win–win collaborations that respect smallholder farmers as partners rather than mere suppliers. These partnerships must be supported by comprehensive capacity-building programs that develop the technical, commercial, and organizational skills necessary for producer organizations to function effectively as intermediaries in increasingly complex agricultural value chains.

Building trust and reputation for effective digital service provision

Trust constitutes the fundamental building block for successful collective action in producer organizations, particularly in contexts that require collective commercialization and technology adoption. Research conducted through randomized controlled trials in Senegal demonstrates that trust significantly enhances both member participation and organizational effectiveness (Tanguy et al. 2015). Unfortunately, significant numbers of farmers have very limited trust in their organizations and their fellow members (Tadesse and Kassie 2017). The probability of trust increases when members actively participate in cooperative governance, are less diverse, stay longer in the cooperative, and when cooperatives are older.

The development of trust within SPOs requires strategic attention to multiple dimensions of organizational relationships. Research identifies several key approaches to building trust that directly support technology service intermediation. The first approach involves creating inclusive environments that foster meaningful engagement of all stakeholders, including individual cooperative members, hired workers, women, youth, ethnic groups, and Indigenous peoples (FAO 2024). This inclusiveness proves particularly important for technology adoption, as diverse perspectives can identify potential barriers and solutions.

The adoption of digital technologies by smallholder farmers faces particular trust-related challenges, which SPOs are well-positioned to address. Many farmers prefer face-to-face interactions over anonymous phone-based communication; this highlights the importance of combining digital advice with in-person agent guidance (Heckmann 2023). SPOs can serve as the trusted local presence that bridges this gap between digital services and farmers' needs and preferences.

The principles and values inherent in cooperative organizations naturally generate trust and perceptions of positive reputation. People tend to trust cooperatives because they perceive them as democratic organizations that ensure autonomy and maintain strong community roots. The development of integrated strategies that simultaneously build trust and enhance reputation requires careful attention to the interconnections between these organizational assets. Trust serves as the foundation for a positive reputation, while reputation enhances the organization's ability to build trust with new members and partners. A comprehensive framework for trust and reputation enhancement should incorporate multiple intervention levels, including individual member training, organizational capacity building, and external stakeholder engagement. Research demonstrates that training interventions focused on collective commercialization can significantly enhance intra-group trust while building organizational capabilities (Tanguy et al. 2015).

Leveraging SPOs to Achieve Kampala Commitments on Technological Change

The Kampala Declaration, together with the Comprehensive Africa Agriculture Development Programme (CAADP) Strategy and Action Plan 2026–2035, places farmers (particularly smallholders) and cooperatives at the core of Africa's agrifood systems transformation (AUC and AUDA-NEPAD 2025). It emphasizes their roles as both central actors and essential partners in building inclusive, resilient, and sustainable food systems. Table 14.2 below shows the specific contributions that SPOs can make to implementing the six strategic objectives of the Kampala Declaration.

Table 14.2 demonstrates how the strategic objectives of the Kampala Declaration explicitly call for attention to agricultural cooperatives, while highlighting the centrality of their roles in building resilient agrifood systems.

According to the Kampala Declaration, the role of cooperatives and farmer organizations includes: 1) acting as key players in facilitating collective action and aggregation; 2) serving as intermediaries by offering opportunities for trade and agro-industrial linkages; 3) offering entry points to their members

TABLE 14.2—AREAS WHERE SMALL PRODUCER ORGANIZATIONS CAN CONTRIBUTE MOST TO THE IMPLEMENTATION OF THE KAMPALA DECLARATION OBJECTIVES

Agricultural technology transfer model	Sources
Strategic objective	Areas where SPOs can contribute to its achievement
Strategic Objective 1: Intensifying sustainable food production, agro-industrialization, and trade	Key action areas include: 1) enabling a policy and regulatory environment that fosters the development and integration of emerging technologies such as biotechnologies, artificial intelligence, digitalization, and precision agriculture, and the development of new technologies through research; 2) building the capacity of women's groups and cooperatives and promoting aggregation into federations to improve access to intra-regional markets; 3) enhancing trade by strengthening women's and youth cooperatives along value chains
Strategic Objective 2: Boosting investment and financing for accelerated agrifood systems	This objective makes provision for two specific actions regarding agricultural cooperatives: 1) strengthening women's and youth cooperatives along value chains, and 2) developing financial mechanisms to earmark green finance for women's cooperatives and women-led businesses in agriculture
Strategic Objective 4: Advancing inclusivity and equitable livelihoods	Among the several provisions in this objective, one in particular calls for deliberate policy and institutional support and capacity-strengthening of key players in agrifood systems; more specifically, African countries are encouraged to develop credit lines and guarantees for women-led businesses and cooperatives in the agriculture sector in collaboration with private financial institutions; key actions aimed at enhancing economic empowerment and strengthening capacities include the development of green finance mechanisms and products that are adapted to women's needs and accessible to women cooperatives and women-led agribusinesses
Strategic Objective 6: Strengthening agrifood systems governance	Under this objective, the second key intervention area on "enhancing policy coherence and strengthening governance" spells out a critical action that should be taken toward strengthening rural governance and local activity; it should support the entire process and should enable the active participation of local communities, farmer organizations, and cooperatives in policy formulation and implementation

Source: AUC and AUDA-NEPAD (2025).

for tailored financial services; and 4) playing an active role in multistakeholder coordination platforms (MSPs) to ensure the transparency and participatory governance of national and regional agrifood strategies The strategic objectives do not dwell on the issue of digitalization, however, focusing more on their alignment with SPOs.

Conclusions

While this chapter set out to explore the agricultural technology transfer model best suited to embracing and promoting emerging agricultural technologies, it emphasized that the effectiveness of institutions in supporting technology adoption depends on both the type of technology and the specific characteristics of the institutions involved. Based on an assessment of technology transfer models implemented across Africa over the decades and an analysis of the potential role of SPOs in advancing the adoption of emerging digital agricultural technologies and services, the following key conclusions can be drawn.

First, the role of SPOs has evolved significantly from primarily organizing members for collective marketing to acting as intermediaries for digital services. This evolution highlights their growing contribution to African agricultural transformation by facilitating access to inputs, markets, finance, and technological services. Given the predominance of smallholder farmers in Africa, it is unsurprising that SPOs have become critical institutions for managing and supporting technology dissemination and adoption. This transition, however, also signals the need for deeper engagement between SPOs, governments, researchers, and other actors in the innovation ecosystem, underscoring the need to rethink their institutional design and governance.

A review of past and current technology transfer models and the evolving role of SPOs leads to our second conclusion: SPOs are uniquely positioned to drive the adoption and integration of AI-based digital technologies within African agrifood systems. They are effective at reducing the sunk costs often associated with emerging technologies; they also lend themselves well to fostering partnerships with the private sector and can build on the services they already provide to members. By aggregating demand, lowering transaction costs, and amplifying the collective voice of rural communities, SPOs bridge the gap between individual farmers and the rapidly changing technological landscape. The growing importance of data and technology in agriculture further positions

SPOs as inclusive conduits that will help ensure that smallholders get access to, and can benefit from, innovations.

Third, continental frameworks such as the Kampala Declaration and the CAADP Strategy and Action Plan (2026–2035) elevate and formalize the role of SPOs by aligning them with broader agricultural development priorities. SPOs and cooperatives are increasingly recognized as key enablers of innovation, sustainability, and equitable growth. The CAADP strategy stresses the active and inclusive participation of smallholders through their SPOs, not only as mechanisms for delivering inputs and services but also as central actors in CAADP governance. Their contribution to technology procurement and adoption is therefore explicitly acknowledged.

That said, SPOs can only fulfill this potential if deliberate efforts are made to strengthen their internal capacities, ensure transparent and inclusive governance, and adopt dynamic business models that reflect the needs of both members and the private sector. Experiences such as DERPIn illustrate how SPOs, when empowered with digital tools, strategic partnerships, and adequate infrastructure, can enhance productivity, resilience, and policy influence at scale. To achieve this, SPOs must revisit their operational and partnership models, invest in digital readiness, strengthen governance, build credibility, and adopt a clear strategic orientation.

Finally, key stakeholders in Africa's agricultural technology transfer landscape—including governments, development partners, the private sector, and other non-state actors—should move beyond viewing SPOs merely as passive beneficiaries of technological solutions. Instead, they must recognize SPOs as cocreators of inclusive and resilient agrifood systems and as entities with the capacity to integrate emerging technologies and shape the future of African agriculture.