Chapter 8

AGRICULTURAL EXTENSION SERVICES
From Transfer of Technology to Facilitation for Innovation

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Key messages

- Agricultural extension is key to providing information, services, technologies, and skills. It impacts nutrition, health, and food security; poverty reduction, livelihoods, and jobs; climate adaptation and mitigation; gender equality, youth, and social inclusion; and environmental health and biodiversity.
- Delivery methods for agricultural extension services have changed significantly over the past 50 years. From a mainly public institution focused on in-person services, extension today employs many digital methods, including AI, that supplement traditional face-to-face approaches.
- Other key changes include the growing roles of the private sector and value chain approaches, as well as a broadening of extension's mandate from simply transferring productivity-enhancing technologies to facilitating agricultural innovation and brokering relationships and services as an intermediation agency.
- As extension becomes more pluralistic in methods and providers, a major challenge is measuring and monitoring performance and evaluating impacts to remain effective and efficient and to provide accountability to clientele and funders.

- IFPRI with other research and implementation partners has contributed to conceptualization, content and knowledge management and sharing, and impact evaluation of extension programs, for which experimental methods such as randomized controlled trials are increasingly common.

Looking ahead, further research is needed to adapt and improve extension within a more pluralistic approach using digital tools:

- **Adapting governance to pluralistic advisory systems** requires a better understanding of the appropriate roles of diverse public and private sector providers, how to coordinate and finance their contributions, and how to reach different user groups equitably, while advancing more sustainable agricultural practices.
- **Strengthening capacity** for extension services is needed at both the individual and organizational levels for problem solving, digital literacy, and adaptive management. Research should identify ways to effectively develop capacities for pluralism, to develop gender- and nutrition-sensitive strategies, and to use digital tools that are relevant and equitable.
- **Improving metrics, tracking, and data quality** is essential to evaluate impact in extension services. Frameworks and indicators as well as data collection to assess performance and outcomes need to be implemented at scale, with support from national or state governments. Data quality is critical for timely and localized advice.
- **Generating evidence to inform extension methods**, such as bundling of services with complementary products, is key to cost-effectiveness and relevance. Research must look beyond addressing informational constraints to technology adoption to more holistic solutions that address a wide range of barriers to uptake of social, institutional, and technical innovations.

Agrifood systems in many low- and middle-income countries (LMICs) rely on smallholder farmers and other small-scale value chain actors to produce, process, and market the agricultural goods and services that nourish and sustain entire nations. Agricultural extension and rural advisory services play a key role in these agrifood systems by supporting farmers' efforts to enhance productivity, strengthen resilience to shocks, and conserve the natural resource base on which these systems depend. These services encompass "the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain

information, skills, and technologies to improve their livelihoods and well-being" (Birner et al. 2009, 342). For brevity, we refer to this as "extension" throughout the chapter.

Extension has long been considered a way to provide farmers with information on recommended inputs, technologies, and on-farm practices: which crop varieties to cultivate, how to apply fertilizer, and how to protect crops and livestock from pest and disease threats. But the reality of extension is far more complex and nuanced. Among the many functions of extension services today, they are expected to provide tailored educational services, linkages to value chain actors and opportunities, and technology testing and evaluation. Often, these services are also expected to support social programs, multisectoral initiatives, private sector investment schemes, and governmental administrative activities. Whether extension providers are called officers, agents, agrovets, village-based advisors, or agronauts, they are often the frontline agents of change in smallholder systems.

Innovations—both technical and institutional—have driven agrifood system change, facilitating an increase in productivity and greater capacity to cope with challenges and shocks. In part due to the success of the Green Revolution, in which research-center-developed improved crop varieties and practices such as fertilizer and irrigation increased yields, innovation continues to be viewed as a supply-driven, technical process in the context of LMIC agriculture (see Chapter 17). Governments, donors, and implementing partners have tended to develop and promote technological innovations to farmers through linear, top-down processes in a paradigm focused on research and technology without broader attention to sociocultural factors or systems thinking (Woltering 2024).

This chapter examines the global evolution of agricultural extension and rural advisory services over the past 50 years and the shift from a "transfer of technology" approach, characterized by the dissemination of information to farmers, to a more sophisticated "facilitation for innovation" paradigm. The chapter applies IFPRI's "best fit" conceptual framework, which was developed more than a decade ago to analyze extension services and systems and has since been widely used for extension diagnostics and reform efforts. The analysis focuses on exploring changes within the overall environment (*frame conditions*) in which extension operates, and how this affects the extension *characteristics* (governance, organizational capacity and management, and advisory methods and tools). In doing so, the chapter highlights key changes in paradigms and approaches, current and emerging trends, and directions for future research.

Looking back

During the past 50 years, the overall environment (or frame conditions) for extension has evolved significantly in response to societal shifts, which has affected extension characteristics. Throughout this evolution, IFPRI and partners have contributed to conceptualization, content and knowledge management and sharing, and evidence through impact evaluations.

As a formal institution, extension began in the 1850s as a supply-driven approach to transfer technologies from knowledge centers to farmers (Swanson et al. 1997) and was later crucial in disseminating innovations during the Green Revolution. Fifty years ago, extension was mainly a top-down, technology-focused, and publicly provided service that primarily transferred technology from research stations to farmers through extension. An example of this type of extension was the World Bank's training and visit approach, which was designed to help professionalize LMIC public extension services through a rigid system of regular staff training followed by visits to farmers (Anderson 2007).

In the mid-1990s, this transfer-of-technology paradigm faced growing criticism of the standardized models being promoted in many countries. Interest shifted to participatory methods (Scoones and Thompson 1994), farmer-to-farmer learning, and adult education and experiential learning approaches, such as farmer field schools (Waddington and White 2014). Rather than focusing on technologies to solve researcher-perceived problems, these "bottom-up" approaches emphasized developing solutions jointly with farmers while empowering them to problem-solve. They also focus on the institutional factors, social relationships, and broader farming and market systems that affect innovation within agriculture (see Chapter 17).

Around this time, the Neuchâtel Initiative began meeting annually to exchange experiences and views and to develop a common understanding of rural extension issues. The Initiative was initially an informal group of bilateral and multilateral agricultural development agencies and researchers, including IFPRI. In 2010, the Initiative was formalized as the Global Forum for Rural Advisory Services (GFRAS), which was supported by IFPRI and several donors. Fifteen years on, the Forum has engaged in policy reform in over 25 countries, raised awareness of the need for more professionalism in extension, and trained more than 3,000 people using the global "new extensionist"[1] learning modules (GFRAS 2020).

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1 The New Extensionist is a global view of extension and advisory services (EAS) that reinvents and articulates its role in the rapidly changing rural context. It argues for an expanded role for EAS within agricultural innovation systems and development of new capacities at different levels to play this role. See Davis and Sulaiman (2014).

BOX 8.1 Agricultural innovation and the best-fit approach

Extension is a key component of a country's agricultural innovation system (Rajalahti et al. 2008). An innovation system consists of a set of interrelated agents, their interactions, and the institutions ("rules of the game") that condition their behavior in relation to the common objective of generating, diffusing, and using knowledge and/or technology (Spielman 2005). The innovation system encompasses the best-fit frame conditions and affects characteristics of advisory services. The first characteristic is *governance* structures, which are essentially the institutional setup for providing and financing services. The second is *organizational capacity and management*, which include capacity to provide advisory services and the ways that services are managed within governance structures. The third is *advisory methods* used by extension agents to interact with farmers. Together, these characteristics shape extension's performance, which not only leads to outcomes such as technical changes among farmers but also supports development of the organizational, managerial, and marketing capacities of farmers that lead to impact.

In the late 2000s, IFPRI scholars collaborated to develop a framework for designing and analyzing pluralistic extension services. This "best-fit" approach aims to help identify ways to provide and finance extension services that work best for different contexts (Birner et al. 2009) (Box 8.1). It distinguishes between extension characteristics of governance structures, organizational capacity and management, and advisory methods. Since its development, the framework has been used as the foundation for many studies and projects (Davis and Spielman 2017). IFPRI also contributed to extension thinking for the World Bank's *Agricultural Innovation Systems: An Investment Sourcebook* (World Bank 2012). The sourcebook is a comprehensive document on identifying, designing, and implementing investments, approaches, and complementary interventions to strengthen innovation systems and promote agricultural innovation and equitable growth. It is an important resource for the research community and nongovernmental organizations as well as the private sector, farmer organizations, and individuals with an interest in agricultural innovation.

Many extension scholars now put the focus of extension and advisory services on (1) brokering functions (Klerkx and Leeuwis 2009) that link farmers to various services, (2) communication for innovation (Leeuwis 2004),[2] and

2 This evolution can be seen in the retitling of the book from *Agricultural Extension* to the current title, *Communication for Rural Innovation: Rethinking Agricultural Extension*.

(3) scaling of support (Schut et al. 2022) for rural and agricultural actors in the innovation system. This more encompassing view of extension is known as "facilitation for innovation," which was initially documented in 1995, but has since grown and expanded (Engel 1995). Facilitation for innovation is about extension playing a broader role in agricultural innovation systems, engaging with a wider range of stakeholders beyond research and farmers, and using knowledge and resources essential for problem-solving. The facilitation process enables varied actors within the agricultural innovation system to share knowledge and engage in collective and coordinated action to enable innovation and impact at scale, with extension serving as an agency for intermediation among these diverse and pluralistic actors.

Evolution and current trends in extension

Frame conditions: The enabling environment

Changes in extension paradigms affect the frame conditions—that is, the environment that supports or deters implementation of policies and programs. A number of key shifts have occurred in recent years. As a result of the rapid growth in digital tools, the number of global digital advisory services increased nearly 10 times between 2009 and 2019 (Phatty-Jobe et al. 2020), leading many donors and governments to consider how they can use these tools to cost-effectively scale extension services. A shift toward understanding and supporting "farming as a business" has led to interventions that provide farmers with marketing skills or enable them to connect to global value chains (Arulmanikandan et al. 2023). Catholic Relief Services, for instance, developed the Skills for Marketing and Rural Transformation set of manuals that outlines steps and provides guidance for farmers to market their produce (CRS and MEAS 2016). Nutrition, while part of (mainly women-focused) extension programs in the 1970s, was recognized as an important topic for extension to tackle again in the 2000s. IFPRI's work on nutrition and extension includes evidence on how to provide nutrition-sensitive school meals (Gelli and Bliznashka 2024) and how adoption of small-scale irrigation and water harvesting techniques is linked to nutritional outcomes (Balana et al. 2024). There is also a growing focus on including women and youth as extension clientele (Babu et al. 2021; Franzel et al. 2021).

A major paradigm shift has occurred in response to climate change, biodiversity loss, and natural resource degradation, with attention now on extension that can support farmers in adapting to and mitigating climate change

(see Chapter 5) (Sulaiman 2020). Extension and advisory platforms and international agencies, as well as farmers themselves, are increasingly focusing on environmental health and biodiversity, including through sustainable intensification, agroecological approaches (FAO 2022; Gliessman 2022; Sulaiman 2021), regenerative agriculture, and nature-based solutions.

For instance, the CGIAR Research Initiative Ukama Ustawi used various methods to disseminate climate-smart agriculture solutions—such as conservation agriculture, drought-tolerant maize varieties, crop rotation, and climate information—to help farmers in maize-based systems in East and Southern Africa sustainably intensify their agricultural production (CGIAR n.d.-a). The CGIAR Research Initiative on Nature-Positive Solutions worked with farmer groups in three continents to co-develop social, institutional, and technological community and agricultural innovations that include women and youth, provide livelihoods, and preserve the natural environment (CGIAR n.d.-b). Farmers around the globe are recognizing the shortfalls of industrial agriculture and turning to agroecological practices that work with nature to feed the planet (Thurow 2024).

As priorities shift, funding and policies help to provide an enabling environment to implement new paradigms. For instance, GFRAS received funding to support climate adaptation and mitigation (GFRAS n.d.-b) and agroecology (GFRAS 2023) in extension. The African Union has called for 30 percent of Africa's agricultural land to be managed sustainably in the Kampala Declaration on the Detailed Programme for the Development of Agriculture (Ulimwengu 2025). At the national level, for instance in Kenya, agroecological principles are being integrated into the constitution and various policies and laws (Awiti and Ndiwa 2024).

Governance and capacity

Pluralism is a major evolving factor in the governance of extension. In the 1970s, many LMICs solely employed public extension models. However, in response to liberalization policies and the perceived failure of government models in the 1980s, nongovernmental organizations, private companies, and farmer organizations increasingly began providing these services. Today we see many different public, private, and civil society actors providing and financing advisory services, a trend that also includes public–private partnerships (Bruce and Costa 2019) and multistakeholder platforms (Schut et al. 2019). Pluralism can lead to greater reach and enhanced focus on women, the environment, and financial sustainability, but it can also lead to coordination difficulties and duplicated efforts.

The growing role of value chain approaches and the private sector in extension services is arguably the biggest shift in recent decades (Zhou and Babu 2015). This demand-driven development perspective focuses on product characteristics, and the production process is determined by perceived consumer demand and communicated to producers through value chains. Through this value-chain-driven process, capital, technology, and advisories flow upstream to farmers, with private extension services playing an important role. The relative importance of this model varies by commodity, institutions, infrastructure, and level of development. Hybrid models are common, in which the public, private, and civil society sectors fund and provide extension. For instance, the Agricultural Technology Management Agency in India is a mechanism at the district level created to provide decentralized extension services through a semi-autonomous registered society under government control (Swanson and Rajalahti 2010). In Uganda, the government has begun a scale-up effort designed to enhance the reach of its public extension service by training some 32,000 private village agents (Scheer and Okelai 2019).

Additionally, farmers and farmer organizations, who are also part of the private sector, provide services today. For example, the National Smallholder Farmers Association of Malawi is a smallholder-owned membership organization that provides information to members through radio, newsletters, and trainings on topics such as farming methods, literacy, and business skills (Makwenda 2010). Also in Malawi, we see examples of local farmer extensionists—"lead farmers"—who provide a link between the public extension system and farming communities, helping to translate public messages and demonstrate practices for their fellow farmers (Ragasa 2020).

Some private sector models, particularly those focused on specific commodities, risk some pitfalls. Private providers may focus only on crops of interest to the company, rather than holistically helping farmers who often have diversified operations, or on high-potential geographies, farmers, and crops, thus potentially excluding marginalized groups and locations (Muyanga and Jayne 2008; Feder et al. 2011).

Private sector extension is too diverse to draw general conclusions about its impact. A book synthesizing global lessons of private sector extension concludes that those programs implemented as part of value chains are effective in their areas but have limited coverage (Babu and Zhou 2015). It finds that the private sector cannot be a substitute for public sector extension and recommends developing public–private partnerships to increase the efficiency and effectiveness of both public and private extension. Further, it is important to

distinguish between extension from upstream actors such as input or service providers and downstream actors. Upstream providers will want to increase their market share without necessarily having farmers' interests at heart, while downstream actors have an interest in upgrading the quantity or quality of agricultural production, which is an objective more aligned with that of public extension services and farmers.

Decentralization of public services is another governance trend that is usually intended to provide more accountability to clientele (see Chapter 15). For instance, Kenya changed its constitution in 2010 to decentralize government services as part of a strategy for accelerating growth and increasing equality (World Bank 2015). However, decentralization has implications for organizational and management capacities of extension organizations. Many times, local-level extension offices and departments lack the individual and organizational capacity necessary for planning, monitoring, evaluating, and managing extension programs (World Bank 2019). Thus there is need for strengthening these capacities at the local level.

Other organizational and management capacity-building trends include focuses on adaptive management, leadership, alliance building and partnering, and mechanisms to incentivize performance (Davis and Sulaiman 2014). These organizational capacities are particularly important for addressing the crises and change seen today. In exploring extension's response to COVID-19, researchers noted that capacities for flexibility, collaboration, and partnerships were important for coping with change (Davis et al. 2021). In addition, to address risks and shocks and better link farmers to markets, further methods are needed to mobilize farmers into groups, strengthen their organizational and managerial capacities, and support community-managed services and community-based extension workers.

Using participatory approaches is a key capacity for extension staff and organizations. Many extension programs have been designed and implemented with little farmer participation (Lampach et al. 2021). Traditional extension approaches often deliver generic, regionwide advice, missing opportunities to provide farm-specific insights. These usually prioritize yield maximization, often based on controlled experimental data from test plots, rather than addressing the economic realities faced by small-scale farmers. Farmers do not necessarily aim to maximize yields; they need to consider both the costs and productivity of recommended practices and technologies. Risk-neutral farmers will want to maximize profits rather than yields, while risk-averse farmers, who face a trade-off between increasing profitability and reducing risk, may find that profitable investments expose them to more risk

than they are willing to accept. The tendency of extension systems to recommend an innovation if it improves yields, without considering costs and risks, has become even more problematic given recent challenges related to climate change. Thus, the emphasis on yields has limited the effectiveness of extension programs because this emphasis does not correspond with farmers' actual preferences and undermines their trust, adoption rates, and overall results. It is critical to have skills to better understand farmers' needs and involve them in program design and evaluation to make extension relevant to farmers.

Digital tools

Extension methods are typically classified into individual (farm visits, phone calls), group (demonstrations, tours, trainings), and mass (bulletins, leaflets, radio, television) communications (van den Ban and Hawkins 1988). Since 1975, extension outreach methods have evolved substantially in the digital space, from radio to the rise of mobile phones, big data, and artificial intelligence (AI). Despite the digital evolution, radio remains an important tool for extension, providing information that is inclusive, accessible, and affordable. A relatively high percentage of rural dwellers, including women, own radios, allowing for extensive reach and social inclusion, and evidence shows farmers prefer listening to advisory messages rather than reading them (Gorman et al. 2018). With availability in local languages, radio programs have potential to reach vulnerable groups and to include feedback and monitoring through call-in (or text-in) numbers or discussion in local study groups. Radio's impacts can be maximized when it is integrated into wider agricultural extension programs and is locally relevant. EFarm Radio International, The Mediae Company, and BBC Media Action have worked to scale up radio programs by collaborating with existing national extension services and training radio stations to produce quality programs (Rao 2015).

Today, digital applications (apps), social media, videos, television, smartphones, and micro-projectors can all provide extension information. In Kenya, for instance, digital information and advisory services are rapidly penetrating agricultural systems, with 46 percent of farmers recently reporting their use (60 Decibels 2024). Digital extension tools abound in Kenya thanks to the importance of agriculture, high connectivity levels, use of mobile phones and mobile money, and data transparency (CTA 2019). In this rapidly growing space, some digital tools have been rigorously evaluated, while many have not.

Television has become a tool to deliver "edutainment"—educational content presented in an entertaining format. For instance, The Mediae Company

BOX 8.2 Democratizing and localizing extension through artificial intelligence

Artificial intelligence (AI) may reshape extension services by moving services to greater levels of personalization and site-specificity. Digital Green's Farmer.Chat AI assistant exemplifies the ways in which agentic AI can localize extension by offering increasingly precise and personalized support to smallholder farmers (Digital Green n.d.). This multilingual chatbot is accessible through text, voice, and images and can deliver advice in multiple underrepresented local languages such as Hausa, Kiswahili, and Odia. It can combine complex scientific research with dynamic weather and market data to help farmers make more informed decisions on crop management, pest control, and sales. For instance, Farmer.Chat helped Annred Gakii, a smallholder farmer in Kenya, treat a sick cow and provided tailored advice to her on crop diversification, leading to increased yields and reduced costs (Digital Green 2024). Drawing on more than 350,000 farmer queries, Farmer.Chat also highlights patterns in the challenges faced by farmers, enabling extension services to adapt to evolving needs and creating new pathways to co-design solutions with farming communities. Tools like Farmer.Chat also provide opportunities to explore and measure these effects at scale, thereby demonstrating not only the benefits from agentic AI services but also the heterogeneity in benefits across different farmers and contexts and AI's cost-effectiveness as a complement or substitute to traditional in-person extension services. Digital Green and IFPRI collaborate in several countries to examine these research topics.

has reached millions of smallholder farmers through its farm makeover reality programs "Shamba Shape Up" (in Kenya and Uganda) and "Munda Makeover" (in Zambia), as well as through a farming contest for young farmers, "Don't Lose the Plot?" (VOA 2018). Globally, the reach of digital tools is growing quickly, especially among youth (71 percent of young people use the internet) (UNICEF 2017). However, as with any extension method, constraints to access and participation of marginalized groups and areas must be considered.

The digital revolution has helped to democratize extension by allowing information and innovation to flow not just in one direction from researchers to farmers via extension, but in multiple directions to multiple actors and at a low cost to large audiences. Big data and AI, such as large language models, have great potential for delivering scientific information to farmers and extension staff and for responding to and aggregating information and requests

from farmer. Coupling these tools with innovative delivery channels can help providers tailor advice to local contexts and allow them to increase their reach (Box 8.2).

IFPRI has contributed to extension methods through content and knowledge management and sharing as well as big data and open access policies that support extension. IFPRI co-founded the CGIAR Platform for Big Data in Agriculture and spearheaded CGIAR's work on open access and open data, making data comply with FAIR (findable, accessible, interoperable, and reusable) standards. IFPRI research underpins several initiatives on building open-source models and data frameworks to enhance AI-driven agricultural advisory services and support global digital public goods. The Institute is also leveraging its AI expertise to design a range of pilot studies exploring how AI can enhance agricultural advisory services. For example, IFPRI developed a pilot study in Uganda, led by the CGIAR Research Initiative on Digital Innovation, to help Farm Radio International process farmers' voice messages in a local Bantu language by using AI tools to automate transcription, reducing the need for manual effort (Mganga et al. 2023). However, while digital tools and advancements have facilitated much greater access to information, they have also created a digital divide affecting marginalized groups, who are also affected by elements of intersectionality (Gillwald and Partridge 2022) and geography (Saha et al. 2024). Despite promising adoption trends, digital extension providers struggle to reach and benefit populations, particularly women, with low literacy and limited digital skills, highlighting persistent gaps in accessibility for these groups (60 Decibels 2024).

A growing body of evidence suggests that not all digitally enabled extension approaches are equally effective in improving adoption, productivity, income, or welfare outcomes (Spielman et al. 2021). While digital tools can increase the effectiveness and decrease the costs of information delivery to small-scale farmers, with more personalization to fit marginalized farmers' unique conditions, the design attributes of such approaches matter, and it is important to consider these to make digital tools inclusive (Van Campenhout et al. 2020). While digital tools can provide tailored advice (Box 8.2), scholars still recommend the continued input of human experts (Tzachor et al. 2023). Combining virtual approaches with face-to-face interventions and multidirectional communication can make the provision of information and advisory services much more effective. For instance, Digital Green, working with the agriculture ministries of India, Ethiopia, and Kenya, created nearly 8,000 farmer-to-farmer videos in more than 50 languages, enabling extension agents to provide timely, locally relevant information to more farmers. Randomized

BOX 8.3 Bundling insurance and advisory services

Farmers face risks of weather extremes but often cannot afford crop insurance that could mitigate these risks (see Chapter 10). Picture-based insurance (PBI) delivers affordable, comprehensive, and easy-to-understand crop insurance. The PBI tool uses farmers' smartphone pictures to cheaply verify farmers' claims, making crop insurance more attractive and accessible to small-scale farmers (Ceballos et al. 2019). By relying on pictures showing crop characteristics, PBI minimizes the costs of loss verification and detects damage at the plot level. This instrument lends itself to natural synergies with site-specific, picture-based agro-advisories that recommend better (climate-smart) technologies and practices (IFPRI. n.d.). Yet, research on the impacts of picture-based advisories found that they did not have larger effects on farmer knowledge or practices than generic advisories; effects of advisories were driven by engagement with the advisories, regardless of whether these were generic or personalized (Ceballos et al. 2024).

controlled trials have shown that the community video approach leads to 18–22 percent increases in yields and up to a 24 percent increase in farmers' profits relative to traditional extension.

Additionally, many digital tools are not scaled at a significant level. Investments in digital tools for extension are generally low, with a focus on specific enterprises, and are primarily fueled by donors, with private investment lagging (CTA 2019). Some services have been discontinued when the implementing projects ended, perhaps due to the lack of digital infrastructure. For instance, a project may provide smartphones to village extension service providers to deliver advisories to farmers (who do not have access to smartphones or extension platforms themselves), but these smartphones may get damaged or stolen over time. Thus, although the project may set up a system for creating and disseminating content, the system may not be sustainable, and the content may stop reaching the end user if there is no plan to invest in and maintain the necessary digital infrastructure once the project ends. For AI, the challenges for scaling also include accuracy, data limitations, performance, and costs.

Methods discussed so far have focused mainly on the dissemination of information. However, information is just one extension service that farmers need to take up innovations. Bundling information with credit or insurance could strengthen both information dissemination and uptake of financial services (Box 8.3) (Timu et al. 2024).

BOX 8.4 Methods for evaluating extension

Evaluations of extension programs are systematic and objective assessments of projects, programs, or policies, and their results. Evaluation methods include performance indicators, formal surveys, participatory methods, public expenditure tracking surveys, and impact evaluations (which establish a causal relationship between an intervention and observed outcomes). Evaluations examine the relationship between activities and outputs of an extension program and intended outcomes and impacts. The relevance, efficiency, effectiveness, impact, and sustainability of extension can be measured using various indicators related to knowledge, attitudes, perceptions, practices, and downstream impacts such as farm productivity or profitability (Christoplos et al. 2012).

Effectiveness of extension and financing strategies

Globally, evidence on the effectiveness of agricultural extension programs remains uneven, with outcomes varying significantly by context, crop type, and target group. Generally, public research and extension programs have shown high rates of return, although conclusions may depend on methods used (Alston et al. 2000). Extension research and evaluation (see Box 8.4) are complicated by the diversity of delivery methods, which range from traditional in-person training to digital-enabled platforms, combined with the inherent complexity of agriculture and its socio-ecological setting. Methodological challenges such as selection bias, limited baseline data, and resource constraints further impede the ability to assess impacts rigorously. Not surprisingly, the existing evidence on the impacts of extension is mixed. A meta-analysis found that while some interventions achieved substantial yield increases, many showed limited or no effects (Ogundari 2022). Similarly, a review of 41 analyzed programs with rigorous evaluation methods found that only 12 delivered significant improvements in farmer yields or profits (J-PAL 2023). These findings highlight the need for better-designed, evidence-based extension strategies that account for contextual diversity and address systemic barriers to effectiveness.

IFPRI is known for its work on assessments of the design and impact of extension and advisory services in LMICs. This includes conceptual work (the best-fit framework), global measurements of extension systems (Davis et al. 2020; Davis, Makhija, and Spielman 2021), and in-depth reviews of the evolution of the practice and performance of extension systems across countries and programs (Nakasone and Torero 2016; Spielman et al. 2021). Other

IFPRI research covers topics such as digital innovations in extension services for a picture-based advisory system piloted in Haryana, India, and seven counties in Kenya (Ceballos et al. 2024); the "edutainment" reality TV show in Zambia; bottom-up approaches and decentralized extension structures to improve access to and quality of extension services in Malawi (Ragasa et al. 2024); digital extension strategies that consider men's and women's needs in Uganda (Lecoutere et al. 2023; Van Campenhout et al. 2023); and video-mediated extension approaches in Africa and South Asia (Abate et al. 2023; Ringler et al. 2023; Van Campenhout et al. 2020).

Evaluations of extension impact have evolved from straightforward adoption studies focused on uptake of technologies in relation to farmers' attributes to approaches that account for the frame conditions—that is, the enabling environment and agricultural innovation system. IFPRI and partners are increasingly using experimental methods, such as randomized controlled trials, that can identify the effects of extension alone by controlling for other factors. For instance, in Ethiopia, researchers assessed the impacts of video-mediated agricultural extension provision on farmers' adoption of improved agricultural technologies and practices. Results showed that video-mediated extension significantly increased uptake of recommended technologies and practices by improving extension access and farmer knowledge (Abate et al. 2023). Similarly, for IFPRI's picture-based advisory study in India and Kenya (Box 8.3), a comparison of users and matched non-users would have led to the conclusion that the advisories had an impact, but comparing outcomes with a randomized control group showed that the personalized advisories did not affect knowledge or practices more than generic advisories. Even in the case of a national television show, to which access cannot be restricted, it is possible to conduct a rigorous evaluation of the intervention using encouragement designs, which introduce exogenous variation in the probability of accessing an innovation (such as the television show) by randomizing an encouragement to access it (such as text reminders to watch the show), as IFPRI did for an edutainment assessment in Zambia (Aggarwal et al. 2024).

Randomized controlled trials are often seen as the gold standard because of their rigor and capacity to attribute observed differences between treatment and control groups to the intervention using straightforward data analysis methods. They can be complicated and expensive to deploy, but the major cost in these trials is often the implementation and monitoring of the intervention that is being evaluated. If implementers and researchers coordinate from the start and commit to a randomized rollout of the intervention, and there is no duplication of implementation or monitoring efforts, costs can be reduced

substantially. Another advantage of randomized trials is that, while baseline data are helpful to have, this data is not absolutely required, given that there is no need to control for a wide range of potential confounding factors, unlike for many quasi-experimental methods. Baseline data are mainly used to test for balance between treatment and control groups, which can also be done using secondary or administrative data. Also, sample sizes in these trials can be smaller than sample sizes in well-designed quasi-experimental evaluations because control observations will be more comparable to the treated sample by design. As such, randomized trials may offer greater value for money than quasi-experimental methods.

Evidence on who benefits and to what extent from different types of extension is also important for determining how to finance it. Traditionally, extension—like many public goods—has been publicly financed. Farmers are willing to pay for digital information, but only small amounts, with lower willingness to pay among women than men (Hidrobo et al. 2022). As a result, financing extension through fee-based advisories or extension services could introduce inequities and high administrative costs relative to fees collected from farmers. More sustainable models for financing extension would involve vertical or horizontal coordination, whereby farmer groups, private sector, or other value chain actors with an interest in promoting their products and services or increasing the quantity or quality of agricultural produce fund advisory services for smallholder farmers. Public funding for extension will remain crucial, though, to avoid extension becoming primarily a marketing tool.

Future of extension: New research directions

Looking to 2050 and beyond, we can expect continued challenges to food and nutrition security and livelihoods amid rising demand for food and fuel (Gotor and Masso 2024). These ongoing issues will require the continued evolution of extension's governance, capacities, and methods. Further research is needed to understand how national extension systems can support smallholder farmers, other rural actors, and our food systems through 2050 and beyond. Over the past 50 years, extension has largely been supply-driven, focused on priorities of donors, researchers, and governments. Several national governments have made substantial effort to strengthening extension, including Brazil, China, Rwanda, and Uganda,[3] and IFPRI

3 See Bergamasco et al. (2016) on Brazil; Yonggong (1998) on China; Davis et al. (2010) on Ethiopia; MacNairn and Davis (2018) on Rwanda; and Rwamigisa et al. (2019) on Uganda.

has helped to evaluate several of these programs and to transfer lessons from one system to another (Ambler et al. 2016). However, we now need to better trace the pathway from policy and funding decisions to deployment and assessment of national extension services. Going forward, we need research on LMIC extension governance, organizational capacities and management, and methods, particularly digitally enabled methods, to help achieve sustainable impact at scale.

Adapting governance to pluralistic systems. Better understanding is needed of how governments can best facilitate innovation and coordinate and regulate pluralistic extension providers, including supporting extension in private value chains. Evidence is needed to determine how to best combine novel and traditional approaches and to coordinate multiple providers of information and advisory services. Research should focus on identifying which mechanisms work for effective coordination of pluralistic services, and how public, private, and public–private partnership extension models can become more financially sustainable, without losing focus on socially inclusive models that help farmers transition toward environmentally sustainable agricultural practices. Inclusion and environmental sustainability goals may not be in the primary interest of profit-maximizing private sector advisory providers, but they are important objectives for the public sector to incentivize. Relatedly, further research is needed on new models for extension, including on private sector and value-chain-based extension, as well as on hybrid models and models seeking to extend reach by supplementing public systems with lead farmers. These models should be evaluated for impact and approaches to scaling them up.

Building capacity for extension. Research on the best ways to enhance capacities in extension services at both the individual and organizational levels for problem solving, digital literacy, and adaptive management is needed. In addition, it is important to identify the capacities that public and private extension staff need to effectively use digital tools. Further research is also needed on organizational capacities to provide gender- and nutrition-sensitive adaptation and mitigation strategies and strategies to conserve natural resources. With the diverse demands now placed on extension, finding the right balance of skills and expertise within an extension organization and within a pluralistic system should be examined.

Improving metrics, tracking, and data. In terms of management, there is also a clear need for improved metrics to track and measure impact in extension delivery (USAID and Agrilinks 2019). Efforts have been made toward this goal, including the development of frameworks (Sulaiman et al. 2022) and

indicators to assess performance and outcomes (Davis 2020). However, these have not been implemented at scale. For agricultural research, the Agricultural Science and Technology Indicators (ASTI) program provides open-source data on financial, human, and institutional resources in agricultural research systems (both public and private sector) across LMICs (ASTI n.d.). Extension proponents have discussed establishing an ASTI-style collection of metrics for extension systems. However, the complexity and pluralistic nature of extension, especially in decentralized systems, make the task of tracking resources daunting. It is critical to have national or state government ownership in such efforts: deeper engagement at the country or state level will be needed to develop a better understanding of countries' experiences with extension implementation and metrics generation and use, as well as potential opportunities for specific partners to collaborate with the public sector to facilitate cost and time efficiencies by incorporating digital tools. National pluralistic extension platforms that are part of GFRAS could be a possible option for national-level monitoring (GFRAS n.d.-a). Relatedly, data quality is an important consideration as extension relies increasingly on big data and digital advisories. Extension needs capacity to source, use, and evaluate data used in advisories, and feedback loops are critical to ensure that data underlying localized advisories on weather, markets, and practices are accurate.

Informing extension methods. To build the evidence base on methods, we need to explore how bundling of extension services with complementary products can help lower costs of distribution, reduce and manage risk, and increase technology adoption and agricultural incomes, while being responsive to different user groups, including women, youth, and those with limited literacy. Given the many barriers to technology adoption, addressing solely information constraints will not ensure uptake of innovation. We need holistic solutions that address risk and liquidity constraints, high transportation costs, and limited access to output markets, among other barriers. With the changing nature of extension, impact evaluations of bundled products and services that include advisories are needed to quantify the added value of the extension services and identify complementarities and synergies, if any, with the bundle components. If there are no clear synergies, then extension should not be included as a bundled product but instead offered separately to facilitate choice.

The appropriate roles of government and other actors are of interest here: some methods are controlled by public authorities (such as radio) and some by the private sector. This can affect efficiency, access, and quality of services. For digital extension methods, evidence is needed regarding what digital

infrastructure can facilitate these services and how barriers to use can be reduced. Further questions remain about how AI can be harnessed to provide relevant tailored solutions that use human-centered design. Finally, research is needed on how extension outreach methods can be inclusive, reaching marginalized populations and providing high-quality content as extention's reach expands through the use of digital tools. Extension has adapted its governance, capacities, and methods in response to the changing environment or frame conditions. While many approaches have come and gone, extension will remain an important institution for supporting smallholders, including marginalized populations, in managing risk and improving their livelihoods and nutrition while protecting the environment. Over the next decades, we urgently need more evidence on how extension can more efficiently and effectively facilitate innovation to provide sustainable impact at scale.

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