11 Taking technologies to a greater scale

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Introduction

It is important to establish a strategy to take the key products of research to a greater scale if a significant contribution is to be made to increased and sustainable agricultural productivity, leading to enhanced food security and reduced poverty. This chapter presents a definition of 'scaling' and outlines the key elements for success based on the experiences gained from Africa RISING research and dissemination in East and Southern Africa (ESA). Three examples are presented: a) research and development partnerships; b) community-based scaling through seed systems; and c) outdoor advertising for orange-fleshed sweetpotato.

Key terms such as invention, technology, and innovation are often used interchangeably in development narratives. The following definitions are adopted largely from Ajayi *et al.* (2018):

- Invention: the act of creating, designing, or discovering a device, method, or process that has not existed before. In finer terms, it is a novel scientific idea conceived through research and experimentation that turns into a tangible object.
- Innovation: a new idea, product, service, and/or solution capable of facilitating impact through innovation systems involving multiple partners and enablers.
- Technology: a new product; an intervention or approach that has been tried and tested elsewhere, either within a country or in other countries, and that can be built upon and/or adapted (e.g., improved agricultural practices, crop varieties, inputs, and associated products such as crop insurance).

Definition of scaling

Scaling has multiple definitions, with some consensus on the three main dimensions, referred to as scaling out, scaling up, and scaling deep. Scaling out is horizontal, focusing on the geographical spread of successful technologies and knowledge to additional people and communities, with the same stakeholder group. It is associated with quantitative processes like replication, expansion, extension, adoption, dissemination, transfer of technology, mainstreaming, rollout, and multiplication (Wigboldus and Leeuwis, 2013). Scaling up adds a vertical dimension, whereby the successful technologies and knowledge are disseminated beyond the original intervention area with the involvement of additional stakeholders and institutions at different levels (e.g., from village to county, district, region, and national levels). Thus, scaling up is associated with qualitative processes like transition, institutionalization, transformation, integration, incorporation, and development (Wigboldus and Leeuwis, 2013). The third dimension of scaling deep deals with the notion that durable change is achieved

 Sustainable Agricultural Intensification (eds Mateete Bekunda, Irmgard Hoeschle-Zeledon and Jonathan Odhong)
DOI: 10.1079/9781800621602.0011

only "when peoples' hearts and minds, their values and cultural practices and the quality of relationships they have are transformed" (Moore *et al*., 2015).

In practice, scaling out, up, and deep go together, and there is a tendency among the research and development community to use the term scaling in a generic context. The definition of scaling adopted for this handbook is as suggested by the International Fund for Agricultural Development (IFAD, 2012) and endorsed by the United States Agency for International Development (USAID) in relation to its Feed the Future initiative (USAID, 2012). One important observation in this definition is that technologies and knowledge should be proven successfully on a small and controlled scale (pilot project) before being taken to scale, to maximize the chances of success.

The scaling process model proposed by Linn *et al*. (2010) is highly relevant to Africa RISING research since it emphasizes learning as well as organizational and institutional aspects of scaling. The model has three non-linear, dynamic, and interactive phases: innovation, learning, and actual scaling (Figure 11.1). During the innovation phase, a new technology is embedded in a pilot intervention or project, which by itself has limited impact and reach. The purpose of this phase is to test if it is worthwhile supporting at a larger scale, whether it works or not, and to test the context (e.g., collaborations and partnerships, and finance and market models required to scale the innovation beyond the pilot). During the learning phase, experience gained during the design and implementation of the technology is monitored and evaluated to provide information and lessons for subsequent scaling. In the actual scaling phase, the original technology is brought to scale, drawing on the internal and external knowledge base generated by the pilot, and on external knowledge, where appropriate. Scaling efforts should focus on all three phases.

Research and development partnerships

Research organizations generally lack sufficient local contacts to support successful scaling, and therefore need to build suitable partnerships for sustainable implementation. Partnerships can be formal or informal, but involve an agreement between partners to work together toward achieving a common goal, and with each partner mobilizing and contributing complementary resources.

In Malawi, Tanzania, and Zambia, Africa RISING initiated research to validate technologies developed for sustainable intensification (innovation phase) and then packaged them for scaling through partnerships with development actors such as USAID-funded projects, national government institutions, and non-governmental organizations (NGOs). Africa RISING scientists provided technical backstopping and other forms of support to their development partners through a strategy incorporating innovation, learning, and scaling components.

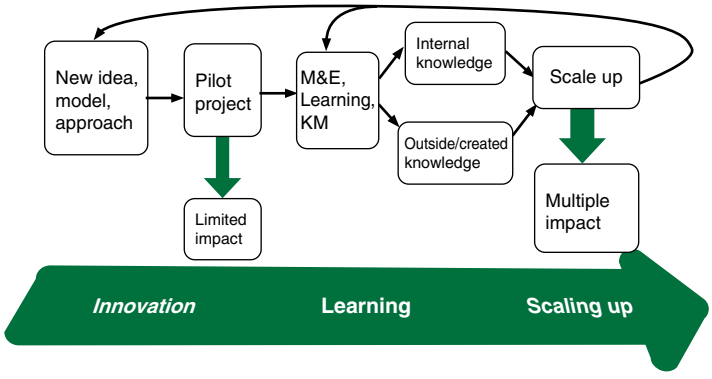

Figure 11.1. The links between innovation, learning, and scaling. The innovation phase encompasses the technologies described in this book. Adapted from Linn *et al*. (2010) with permission from the author. M&E = monitoring and evaluation; KM = knowledge management.

Figure 11.2 outlines the partnership structure in which Africa RISING partnered with the Tanzania Staple Value Chains (NAFAKA) Project led by Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance (ACDI/VOCA). In Malawi, Africa RISING partnered with Catholic Relief Services (CRS) and other partners to implement the Integrating Nutrition in Value Chains (INVC) project. In Malawi and Zambia, the partner was Total Land Care (TLC), with the project focusing on conservation agriculture.

Farmers' challenges were identified through baseline studies conducted by NAFAKA, after which the farmers were organized into producer groups with the support of the local government extension services. NAFAKA proposed broad technology options to address the challenges faced by farmers with different characteristics (typologies). Africa RISING strengthened the scaling role of NAFAKA by providing specific, validated sustainable intensification technologies, and by building the knowledge and technical capacity of the implementing partners through demonstrations. Cascading demonstrations for farmer learning were managed by NAFAKA with backstopping from Africa RISING. Information gathered through monitoring and evaluation was shared to inform necessary adaptations in response to identified challenges.

Experiences from Tanzania

In Tanzania, both Africa RISING and NAFAKA worked toward a common goal: reducing poverty and hunger through improved productivity and competitiveness of maize and rice value chains. Partnership activities focusing on scaling the technologies across these value chains started in 2014, with a focus on: a) improved crop varieties; b) good agricultural practices; c) household nutrition; and d) post-harvest management (IITA, 2014). Before establishing the partnership, Africa RISING research was reaching less than 1,000 smallholder farmers through hosting validation trials. The partnership with NAFAKA enabled the technologies to reach many more, by including a diverse development consortium (Figure 11.3). The partners included ACDI/VOCA (a United States-based contractor),

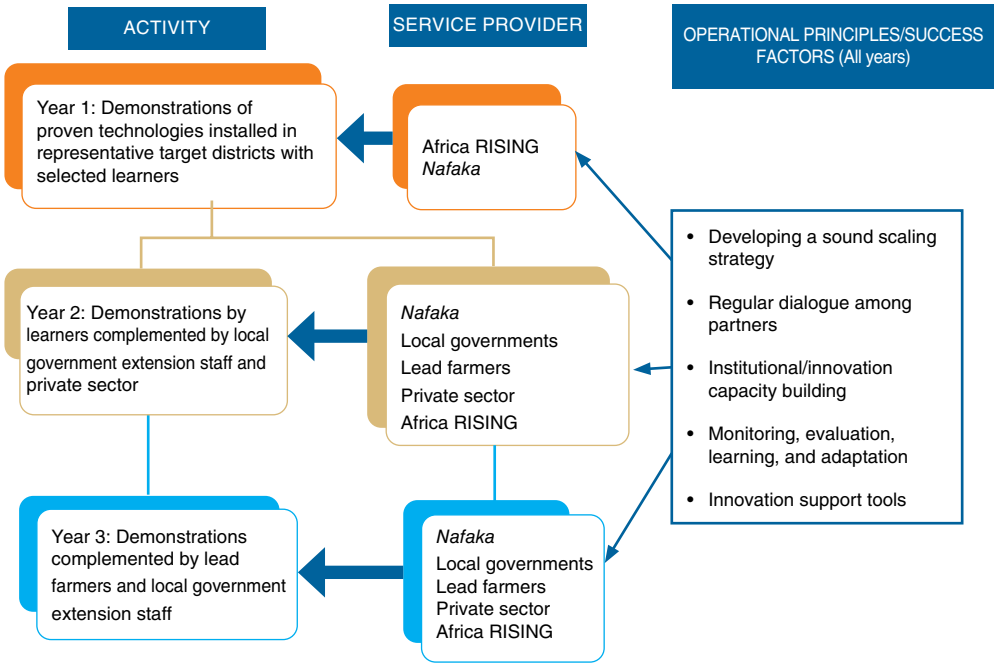

Figure 11.2. The Africa RISING–NAFAKA partnership scaling model in Tanzania.

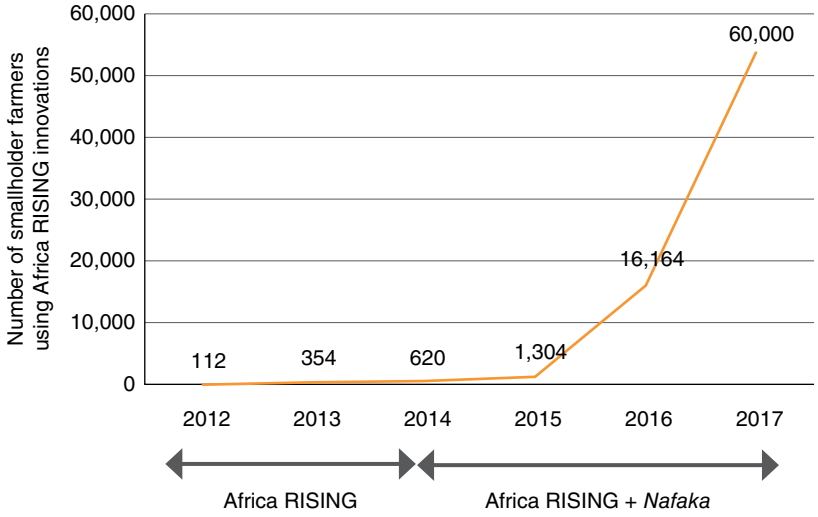

Figure 11.3. Scaling benefits arising from partnerships: the Africa RISING–NAFAKA case in Tanzania. Source: Africa RISING annual reports (2012–2017).

the International Fertilizer Development Center, local NGOs (including a national farmers' apex organization and a regional extension organization), Farm Input Promotions (FIPs)-Africa, private sector institutions (agro-input companies, grain processors, buyers of agricultural produce, and a credit provider), and government institutions (the Ministry of Agriculture research and development department, a seed certification institute, and district local governments).

Experiences from Malawi and Zambia

In Malawi and Zambia, the International Maize and Wheat Improvement Center (CIMMYT) joined the Africa RISING research consortium in 2013. This enabled the team to build on prior work by CIMMYT and TLC, which commenced in 2005. The collaboration was based on a common vision to expand sustainable agriculture systems with a long-term commitment. Working with farmers in selected target communities, the team identified the main challenges and constraints to the current farming system, selecting conservation agriculture — based on minimum soil disturbance, crop residue retention, and diversification — as the priority technological intervention.

The scaling approach involved setting up experimental plots in the form of six on-farm trial replicates per community, with different conservation agriculture technologies on display. In Malawi, CIMMYT and TLC used these experimental plots as reference points, and demonstration and learning sites. Over the years, the trials evolved from simply displaying the three main components of conservation agriculture (2005–2011) to adding a full maize–legume rotation (2011–2014), stress-tolerant maize varieties (2014–2017), and introducing an agroforestry component with doubled-up legumes (2017–2020). In 2011, the initiative was expanded to eastern Zambia.

The high standards of scientific excellence and increased yields (among other things) attracted additional communities and farmers, who were brought to the original trial sites for exchange visits and learning days. TLC also used the trial sites in their lead farmer approach to extension, in which one lead farmer per community is trained and supported with inputs for establishing the trial site, and 20 other farmers in the community follow and learn from the lead farmer. Later, TLC adjusted their extension approach to include farmer field schools. The partnership has reached about 140,000 beneficiaries and brought over 45,000 ha of land under conservation agriculture in Malawi and Zambia (Figure 11.4).

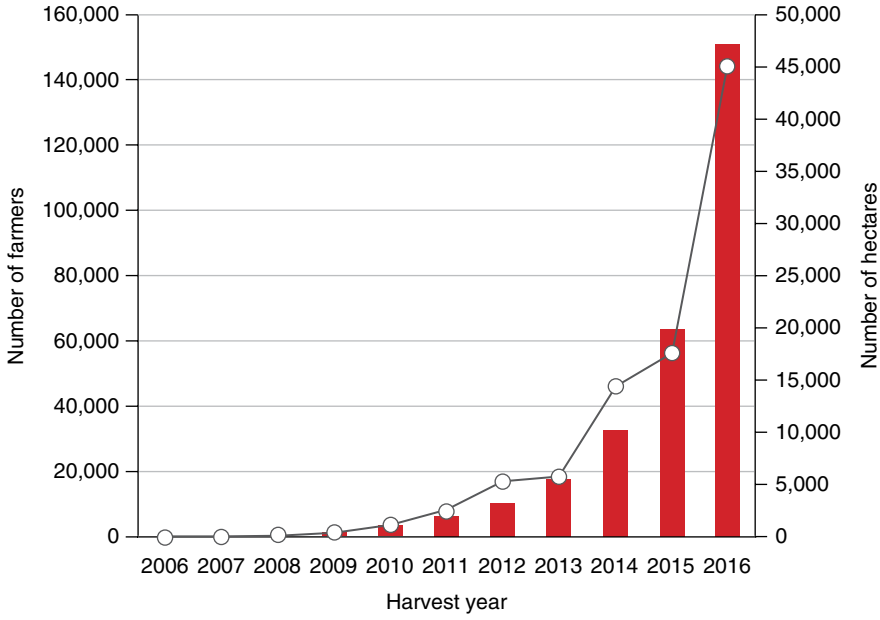

Figure 11.4. Scaling of conservation agriculture systems with the support of Total Land Care, from 2006 to 2016. The curve represents the cumulative number of farmers reached over time in Malawi and Zambia, and the bars represent the cumulative land area under conservation agriculture.

Also in Malawi, Africa RISING led the INVC Bridging project (funded by USAID) to increase its scale during 2016/17. The project built on the achievements of a previous four-year INVC project (2012—2015) implemented by another consortium. The Bridging project focused on legumes (soybean and groundnuts) and aimed to enhance value chain competitiveness through: a) increased access to business development, financial, and extension services; b) transforming the relationships between value chain actors; and c) developing farmer-market linkages. The project also aimed to improve the productivity of the targeted value chains through efficient use of natural resources (land and water), and increased adoption of improved varieties and recommended agronomic practices, while also minimizing negative impacts on the environment. The partners in the INVC consortium included Catholic Relief Services (CRS), the Farmers Union of Malawi, Agricultural Commodity Exchange for Africa, Catholic Development Commission of Malawi, and We Effect. Other partners included the Malawi Improved Seed Systems and Technologies Program (funded by USAID), the district agricultural extension service, and Michigan State University.

Despite being only an 18-month activity, the achievements were noteworthy, due largely to the soundness of the technologies and the presence of a functional partnership. The average yields of project beneficiaries were reported to be 1.34 tons/ha for soybean and 1.0 ton/ha for groundnuts in 2016/17, compared with 0.67 ton/ha for soybean and 0.58 ton/ha for groundnut for the same farmers the previous year. The project also aimed to increase household incomes and assets for smallholder farmers by increasing access to market information and financial services; enhancing commercial linkages in the soybean and groundnut value chains, including vertical coordination of smallholders through producers' groups and small and medium enterprises; and developing marketing opportunities for soybean and groundnuts through better market competitiveness and increased transparency. As a result of group marketing efforts, the average sale price achieved was US$ 0.23/kg for soybean and US$ 0.41/kg for groundnuts, compared with US$ 0.19/kg for

soybean and US$ 0.3/kg for groundnuts offered to farmers selling individually (IITA, 2018).

Lessons learned

- The partnerships included actors with complementary strengths. Africa RISING research contributed new technologies, management practices, and capacity-building ability, with NAFAKA, INVC, and TLC providing expertise in community empowerment and policy engagement. Additional partners, including government institutions and seed suppliers, enabled long-term sustainability by providing human resources to reach smallholder farmers, multiply the technologies, provide policy support, and facilitate market linkages.
- Continuous open dialogue clarified the roles and responsibilities of each partner and minimized the potential for conflict.
- Joint planning enabled equitable apportioning of financial resources, with joint mobilization of additional resources to facilitate continued scaling activities.
- It was important to continually adapt scaling activities to existing conditions and needs, with changing roles for the partners. For instance, Africa RISING researchers were responsible for introducing improved varieties and new agricultural machinery. Over time, as the new varieties and machinery became popular, the private sector took a more prominent role and the Africa RISING research team was concerned mostly with technical backstopping. Similarly, with TLC, demonstrations were modified over time to cater for evolving stakeholder needs.
- Innovation support tools were useful to ensure the technologies were targeted to suitable agroecosystems and the socioeconomic conditions of the beneficiaries (see Box 11.1).

Community-based scaling through seed systems

In Tanzania and Malawi, community-based seed systems have proven vital in ensuring farmers have access to quality seeds of new crop varieties, especially legumes and rice. Private sector seed companies have yet to make substantial investments in these commodities, due partly to limited demand. Africa RISING and partners selected experienced farmers and, working with the national seed certification institutions, provided them with basic seed for planting and trained them how to produce certified seed. District seed certification staff supervised the fields throughout the cropping season to ensure the seed would meet the required standards. After harvest, the producers sold the certified seed to fellow farmers as quality declared seed (QDS). Some of the producers also signed up to seed production contracts.

The community-based seed system model could enhance access to quality legume and rice seed across many African countries. The model is most successful with self-pollinated crops (e.g., soybean, Figure 11.6), since cross-pollinated crops like maize are subject to good levels of private sector investment. In Tanzania, 223 community-based producers of QDS for rice and legumes were supported by the national seed certification institution, producing over 400 tons of seed (362 tons for rice variety SARO5, and 41 tons for common bean varieties Jesca, Njano, and Uyole) for planting in the 2020 cropping season (IITA, 2019). For every ton of quality seed produced, about 300 farmers benefited, each accessing about 3 kg. In Malawi, 300 producers harvested about 66 tons of QDS for soybean and groundnuts in 2019.

Lessons learned

- Farmers growing new varieties through planting quality seed also need to apply good agronomic practices to obtain maximum yields and benefits. Training in agronomy should therefore be offered as part of the strategy to scale up sustainable intensification.
- Producers of QDS will also need capacity-building to improve their skills in post-harvest management (sorting, drying, storage), record keeping, and marketing to ensure the sustainability of community-based seed systems.

Box 11.1. Geospatial tools for increasing the scale of adoption

Africa RISING used geospatial tools to generate recommendation domains largely from climatic and topographic data obtained through remote sensing. Using these domains helps reduce the risk of failure, focuses limited resources, maximizes potential impact, and increases the probability of adoption. The team developed two complementary spatial indices to guide technology targeting and applied them in the USAID Zone of Influence for Tanzania (Muthoni *et al*., 2017a and b).

1. The extrapolation suitability index (ESI) map was based on spatially explicit biophysical attributes and helped to visualize the risk associated with increased scale of dissemination of a validated technology package (SC719 maize with YaraMila CEREAL and YaraBela SULFAN fertilizers) beyond the biophysical conditions encountered in the original demonstration sites. ESI values ranged from 1 to 25, with lower values indicating greater suitability and therefore lower risk.
2. The impact-based spatial targeting index (IBSTI) map overlays spatially explicit socioeconomic attributes onto the ESI map, to identify potential high-impact zones for the specific technology package. This helps to maximize the benefits from investment of limited resources and can be extrapolated to the whole ESA region.

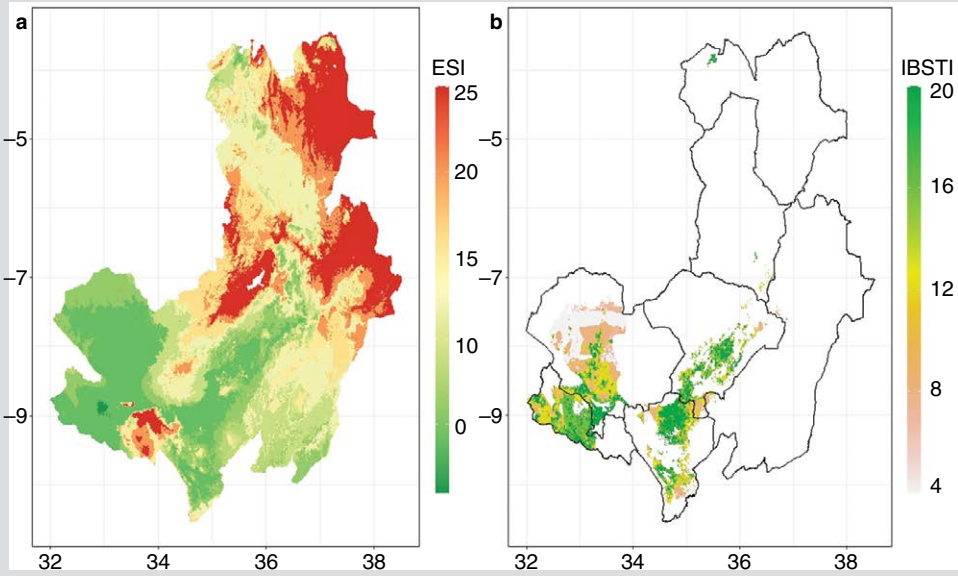

Figure 11.5. ESI (left) and IBSTI for the area where ESI is 4 (right) for a technology package comprising SC719 maize grown with YaraMila CEREAL and YaraBelaSULFAN fertilizers in Tanzania. YaraMila CEREAL fertilizer contains 23% nitrogen, 20% phosphate, 5% potassium, 3% magnesium oxide, 3% sulfur, and 0.3% zinc. YaraBela SULFAN fertilizer contains 24% nitrogen and 6% sulfur.

- QDS producers should be organized into groups, and existing groups should be strengthened, to ensure continued access to such services as certified seed, inspection, and post-harvest management technologies after individual projects (e.g., Africa RISING) end. Savings and credit cooperatives can mobilize resources for external services, including buying certified seed from approved sources.

Outdoor advertising for orange-fleshed sweetpotato

In Zambia, the Ministry of Agriculture, Zambia Agricultural Research Institute, and International Potato Centre (CIP), developed and released four improved varieties of orange-fleshed sweetpotato in 2014. In addition to providing high yields, these varieties have been proved in trials to

Figure 11.6. A well-maintained field of quality declared soybean seed in Mangochi, Malawi. (Photo courtesy of Regis Chikowo, 2017.)

provide beneficial nutrition (they are rich in vitamin A) as well as meeting consumer preferences and farmers' preferred agronomic characteristics. The varieties were not validated by Africa RISING but were taken to scale by the project to promote increased food security and nutrition. The research and scaling teams developed an accelerated, systematic, and sustainable delivery system for sweetpotato planting materials (vines), which involved participatory multiplication and deployment of disease-free vines of the high-yielding, nutritious varieties. The initiative strengthened the capacities of the participating communities in vine multiplication (increased and timely availability, and ease of access to high quality and disease-free planting material), thereby enhancing the adoption of the new varieties.

Outdoor advertising provided a useful tool to increase awareness and adoption of the new varieties (Figure 11.7), with 42 billboards erected at key points along the main road (Great East Road) and village feeder roads in eastern Zambia. Billboards promoting the nutritional benefits and where to obtain planting materials were also located strategically at a large market. In addition, local volunteer farmers selected from among the beneficiary communities received training in orange-fleshed sweetpotato production and were linked with sources of vines. These farmers played an important role in dissemination among their peers as well as ensuring sustainability of the production system. Although the effectiveness of the approach was not formally assessed, anecdotal evidence reported an increased demand for the vines.

Lessons learned

- Novel approaches to marketing can complement traditional tools to provide

Figure 11.7. An example of the billboard advertising campaign. (Photos: Felistus Chipungu, 2017.)

information to beneficiaries and enhance the scale of adoption of new technologies.

- It is important to build the capacity and involve local technology adoption champions.

Monitoring, evaluation, and learning

Monitoring, evaluation, and learning are necessary for successful scaling and require systematic use of evidence to guide the process and incorporate new learning. A system must be in place to collect and process information on the various aspects of the sustainable intensification domains that affect scaling. Using the innovation platform or any other multi-stakeholder approach, actors need to meet periodically to review progress and address emerging issues (e.g., new pests and diseases, input markets, research results, and progress toward set goals), as well as generating new research.

To assess the efficacy of the scaling process, Africa RISING compiled data on the number of project beneficiaries, smallholder farmers reached, area planted with improved varieties, number of farmers adopting, and productivity. These data are processed and shared in different ways, including reports sent to donors and other stakeholders, professional meetings, and stakeholder review and planning meetings. Regular feedback to beneficiaries (farmers' meetings) and partners (stakeholders' review and planning meetings held at least once a year) has been a cornerstone of the Africa RISING activities.

Procedures in the scaling process

Capacity-building for stakeholders is important for success. Stakeholders include farmers and farmers' organizations, researchers, development agencies, policymakers, and the private sector (input dealers, credit institutions, and buyers). Government institutions, and the staff who take a leading role after projects end, are of particular importance to ensure scaling efforts are sustainable.

Conducting capacity needs assessments for the selected institutions and individuals is critical to ensure capacity-building activities are targeted. To reach more beneficiaries, scaling efforts need to be responsive to the needs, capacities, and interests of all farmers, both women and men. It is important to pay attention to the specific constraints faced by women, such as lack of access to inputs or socio-cultural barriers to full participation in agriculture. Needs assessments should also assess the demand for capacity development in gender-accommodating or gender-transformative approaches to extension. See Chapter 1 of this book; see ILRI (2017) for methods that can be used to conduct the assessments, and FAO (2015) for capacity-building guidelines relevant to agricultural interventions.

Participating farmers need to be well organized, mostly through groups and associations (Tsusaka *et al*., 2017). Emphasis should be put on promoting the participation of women and youth, as well as ensuring that they also play a role in leadership. Lead farmers can act as 'champions' for scaling interventions. In addition to ensuring equitable involvement of the various community members, capacity-building activities should focus on bookkeeping and accounting, marketing (negotiation and lobbying skills, vertical linkages to prime markets), and continued support from other actors in the scaling system (research, extension, policy, private sector).

Efforts to promote buy-in by beneficiary institutions and partners are critical for sustained implementation of the activities resulting from capacity-building efforts. In addition, regular monitoring to provide for feedback, learning, and adaptation is important for successful capacity-building.

Africa RISING results

A good scaling strategy should abide by the scaling principles cited in the literature (Simmons *et al*., 2007; World Bank, 2012); such a strategy should exhibit the characteristics listed in Table 11.1. The table also shows the successes and challenges resulting from the experience of Africa RISING scaling activities.

Africa RISING's experience of successful scaling highlights the importance of partnerships, joint review, learning, and adaptation. In Tanzania, scaling efforts among Africa RISING, NAFAKA, the private sector, and public institutions reached 62,000 smallholder farmers in 2017, compared with fewer than 2,000 in the pilot stages in 2014. Yields of maize increased from an average of 1 t/ha to 2.1 t/ha and rice from 2 t/ha to 3.3 t/ha by 2017. Agro-input suppliers reported increased sales of improved seeds and fertilizers, from about 150 t/year to about 600 t/year for seed, and from about 500 t/year to 7,000 t/year for fertilizers. In Malawi, the INVC bridging project helped increase yields of legumes (soybean and groundnuts) by over 40%, benefiting about 33,000 smallholder farmers. In Malawi and Zambia, the conservation agriculture scaling partnership benefited about 140,000 smallholder farmers in 2016 compared with about 20,000 in 2013. Enhanced capacities for extension staff, seed producers, and local institutions supported continued scaling after the project closed. Monitoring, evaluation, and learning sessions ensured that timely actions and adaptations were implemented in such a way that the scaling efforts stayed on track.

However, these achievements were not devoid of challenges, especially with respect to maintaining the relevance of the partnerships, meeting the capacity needs of partners (since both the needs and partners are diverse), and being able to address new challenges as they emerged (flexibility and adaptability); for example, the need to address the credit and market demands of increased agricultural productivity. In most cases, the new challenges meant bringing new partners on board or dedicating extra effort to new activities.

Table 11.1. Africa RISING scaling approaches in Malawi, Tanzania, and Zambia

Characteristic	Successes	Challenges
Clear messages on the advantages of the innovation	Demonstration sites for the technologies complemented by leaflets, pamphlets, brochures, and training manuals helped to popularize the technologies	Timely implementation of all demonstration activities required meticulous planning, with delays potentially leading to poor demonstrations. Materials needed to be translated into local languages.
Early involvement of all members of the scaling team	Projects involved the research team, government and NGO extension staff, and community leaders right from the start	Aligning the mandates and interests of all partners is a critical challenge. Further, although some partners were willing to invest in scaling of technologies, limited financial resources constrained their efforts.
Technical assistance and a supportive approach	Africa RISING staff guided the scaling effort input from partner institutions	Local government resources may be limited and not all communities have access to extension staff.
Different communication channels and messages for different target audiences (men, women, youth) and varying levels of education	Channels included field days, mobile phone messages, local radio, farm visits, and outdoor advertising. GIS-based recommendation domains provided information for identifying suitable target farmers.	Capacity building may be needed for partners to ensure adequate skills for identifying target farmers, and this requires additional resources.
Training designed specifically for different groups (men, women, and youth)	Extension staff received extra training. The community-based seed systems targeted youth and women	Participation of women and youth may be limited by cultural norms and access to resources.
Systematic collection and use of evidence on the process and outcomes of scaling	Studies tracked numbers of farmers applying technologies, hectares under improved technologies, and changes in yields and incomes	Tracking has resource implications
A robust monitoring, learning, and evaluation system that considers sex-disaggregated data and has gender indicators	Monitoring, learning, and evaluation provides accountability results to donors and parent institutions	Developing an MLE system that is compatible with the mandates of the different partners is not easy

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