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# Capacity development for scaling conservation agriculture in smallholder farming systems in Latin America, South Asia, and Southern Africa: exposing the hidden levels

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Capacity development is a major pathway for research for development projects to scale innovations. However, both successful scaling and capacity development are held back by a persistent simplistic focus on 'reaching more end-users' and training at the individual level, respectively. This study provides examples of the other levels of capacity development: the organizational, cooperation and enabling environment levels. Drawing on four projects implemented by the International Maize and Wheat Improvement Center (CIMMYT) to scale conservation agriculture practices to smallholder farmers, we discovered that these three other levels are less understood, appreciated and reported on than individual training. Trainings are popular to report on because they are simple to plan, quantify, verify, and budget, and success in most projects is measured by the number of individuals reached and trained. There is little awareness and guidance on how to intentionally design and implement projects to address the other capacity development levels. Using a modified framework with clear examples of various types of capacity development activities, project leaders were able to identify and uncover activities that pertain to each of the four levels of capacity development. We argue that project teams must be aware, able, and empowered to invest in the development of capacities of local organizations and the system they operate in. They must be more explicit about the different levels of capacity development, what they mean in their context, and how to create synergies between them. The framework proposed in this paper can serve as a model for initiatives that aim to identify and address capacities at all four levels in order to contribute to large-scale sustainable change.

**Keywords:** Capacity development; scaling; conservation agriculture; sustainability; projects; learning

# 1. Introduction

## 1.1 Capacity Development in agricultural research for development projects

Capacity Development is defined as the process by which individuals, organizations and the system as a whole create, strengthen and maintain their capacity over time (OECD, 2006). It is a core function of international development organizations, takes up a prominent part on all funds spent on technical cooperation (Pearson 2011), and is a core vehicle for achieving the Sustainable Development Goals (SDGs) (Vallejo and Wehn 2016). One CGIAR, the largest publicly funded agricultural research and development organization in the world, counts capacity development as one of its three main pathways for food system transformation. Posthumus and colleagues (2012) conclude that capacity development based on participatory capacity needs assessments, long-term learning and targeting multiple levels can yield considerable economic or social impact. But, capacity development is often supply-driven, focused on technology transfer and heavily skewed to only one aspect of it, the individual human capacity level, or training (TAP 2016; Woodhill 2010). Also, more often than not, there is an implicit assumption that strengthening the capacities of individuals will automatically enhance the performance of organizations, which in turn will contribute to the emergence of capacity of the system (TAP, 2016). An evaluation of capacity development activities at the CGIAR (2017) revealed that there was good evidence of the effectiveness of individual capacity development interventions and programs, but little evidence of cumulative effects to strengthen organizational and institutional capacity of collaborators in agricultural research and development. Similarly, Woodhill (2010) concluded that many capacity development interventions have been driven by the needs of technological innovation rather than the needs of institutional innovation. The evaluators found that organizational and institutional capacities are considered 'informal', not consistently planned or monitored and therefore go unnoticed despite making a major contribution to the organizations' long-term objectives.

## 1.2 Capacities to scale

Bringing the innovations from research into widespread use has become a key role for agricultural research for development (AR4D) organizations, (Leeuwis *et al.*, 2018). The focus has been on developing capacities of partners so that they can adapt innovations to local circumstances. Cooley and Howard (2019) state that the innovator is hardly the best scaler and there is need for a set of intermediary functions such as fundraising, investment packaging, coordinating stakeholders and change management, in between innovation and delivery at scale. Scaling of innovations requires multiple complementary organizations, projects and initiatives committed to this cause over a long period of time (Low and Thiele 2020). The strategy is to scale up to trigger scale out (Moore, *et al.*, 2015), hence supporting other organizations to reach

the target population during and after project lifetimes. However, for this indirect path to work, actors have to be willing and able to scale (van Lunenburg *et al.*, 2020; Banerjee, *et al*., 2017). Deiglmeier and Greco (2018) argue that skills and expertise need to evolve towards systems thinking, cross-sector collaboration and growth to navigate the scaling journey. Such process requires investing in the capacities of actors to manage complexity, learning collaboratively, engaging politically and being self-reflective (Blesh *et al.*, 2019; Woodhill, 2010). It also requires attention to 'scaling deep' (Moore *et al*., 2015), or, shifting norms and beliefs to make the innovation the 'new normal' which relies heavily on awareness raising and capacity development. After all, only local actors and structures can sustain and grow the changes achieved by donor-funded projects. But, very often local organizations and networks have insufficient capacities to lead the scaling process beyond the geographical and time boundaries of external funded interventions (Woltering *et al.*, 2019, Van Loon, *et al.*, 2020). AR4D have a critical role in strengthening systemic capacity development (Leeuwis *et al.*, 2018) to ensure the capacity and willingness of local actors to sustain impact at scale (McLean and Gargani, 2019).

### 1.3 Scaling conservation agriculture

In this study we focus on projects that aim to scale conservation agriculture to a large community of smallholder farmers. Conservation agriculture is a production system based on three principles: minimum mechanical soil disturbance, permanent soil organic cover, and crop rotation. These are applied simultaneously alongside other agricultural practices such as the use integrated management of pests, diseases and weeds and efficient fertilizer and water management (Thierfelder *et al.*, 2018; Kassam *et al.*, 2014). Benefits of conservation agriculture vary among crops, cropping systems, soil textures and rainfall conditions, as well as how and which conversation agriculture practices are used (Hermans *et al.*, 2020). However, when done right, there is overwhelming evidence on improvements in soil conditions, CO2-emission (O'Dell *et al.*, 2020) and, net economic returns (Gathala *et al.*, 2021).

Hermans and colleagues (2020) speak of the paradox of conservation agriculture, namely that despite positive biophysical results, adoption rates remain low, especially among smallholder farmers in low-income countries of Southern Africa. Adoption studies find constraints that are not inherent and not unique to conservation agriculture, but rather typical of why technological change in small scale agriculture in low-income countries is so challenging. They relate to availability, accessibility and affordability of quality inputs, equipment well as opportunity costs (Gassner *et al.*, 2019; Harris, 2019) and availability of labor (Jew *et al.*, 2020). An adoption constraint very specific to conservation agriculture is that it may require a fundamental change to farmers in terms of management and behavior (Kassam *et al.*, 2014). Conservation agriculture is a complex innovation, it involves the integration and coordination of technical, social and

environmental components (Brown *et al.*, 2018; Glover *et al.*, 2019) which requires robust capacity development investments at individual, organizational and systems levels (Jew *et al.*, 2020; Kassam *et al.*, 2014). The high level of knowledge required to do conservation agriculture raises questions on project dependency (inputs and trainings) (Brown *et al.*, 2018) and its suitability for the poorest segment of farmers (Jew *et al.*, 2020; Andersson and D Souza 2014).

### 1.4 Research question and scope

The research question is if, and how, AR4D projects that aim to scale innovations, plan, and implement capacity development activities at different levels. In this paper we focus on the largest center of the global agricultural innovation network CGIAR, the International Maize and Wheat Improvement Center (CIMMYT), which aims to improve livelihoods through scientific excellence, partnerships, and capacity development. Since the early 1980s, CIMMYT has been researching and promoting conservation agriculture, a set of practices that promote sustainable use of natural resources for primary production. CIMMYT has been involved in dozens of projects around the world promoting conservation agriculture adoption by farmers (Kassam *et al.*, 2014). This study gives recognition to activities and learning at four levels of capacity development and their links in support of scaling innovations. We draw from literature and give voice to the challenges, ideas and motivations of project leadership staff dealing with innovation, scaling, capacity development, and project management on a daily basis. This study is part of a wider investigation of the perspectives, roles and responsibilities of scientists in AR4D oganizations on scaling and systems change for sustainable and resilient agri-food systems (Woltering and Boa-Alvarado, 2021).

## 2. Methodology

### 2.1 Information collection

The authors selected projects led by CIMMYT in Latin America, South Asia, and Southern Africa where capacity development is a dominant pathway to scale conservation agriculture. A conceptual framework was drafted based on literature and enriched with categories and examples by the authors. It served as an important orientation to identify and provide a clear distinction and examples of the different actors, topics and activities involved at the different levels of capacity development in the projects. Project leaders were asked to complete and elaborate the conceptual framework, indicate what and who is targeted and prioritized and then elaborate on specific capacity development activities and examples. This was done through a series of interviews and follow ups with the project leaders between May and July 2020. Project documents, such as proposals and reports, were analyzed to assess the extent to which the different levels of capacity development were planned, implemented, and reported on.

**Table 1: Selected CIMMYT-led projects that aim to scale conservation agriculture (CA) through capacity development (CD)[1]**

| Description | MasAgro Productor | MasAgro Guanajuato | Africa RISING | SRFSI |
|---|---|---|---|---|
| Full name | *Programa Modernización de la Agricultura Tradicional - Componente Productor* | *Programa Modernización de la Agricultura Tradicional Guanajuato* | *Africa RISING** | *Sustainable and Resilient Farming Systems Intensification (SRFSI) in the Eastern Gangetic Plains (EGP)* |
| Area | National – Mexico | State – Guanajuato, Mexico | Regional – Southern Africa | Regional – Bangladesh, India, Nepal |
| Project objective | Seek higher and stable yields, higher net income for farmers and the adoption of a culture of conservation of natural resources through a coordinated effort of actors in the production chain of maize, wheat, and associated crops, integrated for innovation, dissemination, and adoption of sustainable solutions. | Support the technological improvement of traditional agri-food production units to implement actions of diagnosis, design, validation, demonstration, and induction to the use of technological innovations. | Increase food security and incomes for the resource poor and women farmers by increasing the productivity, market access and resilience of selected maize-legume systems in eastern province of Zambia and central and southern Malawi | Reduce poverty in the Eastern Gangetic Plains (EGP) by improving the productivity, profitability and sustainability of smallholder farmers while safeguarding the environment and empowering women |
| CD Target(s) ** | [1] Key actors in the productive chain of maize, wheat and associated crops production systems develop capacities and their competencies are certified; and [2] Design, co-development, consolidation, validation and / or continuous improvement of prototypes, instruments and decision-making tools, technical support, and dissemination available to the actors | [1] Develop and manage a comprehensive training and monitoring strategy for change agents or managers of sustainable agriculture innovation; [2] Manage the development of key players in the innovation network, through specific training and specialized courses; [3] CD of farmers from the different productive strata and agroecosystems of the state. | [1] Set up demonstration and learning sites in target ESA communities; [2] Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies; [3] Leverage/link and integrate with existent initiatives including Government extension systems to support and encourage the delivery pathways; and [4] Support the Ministry of Agriculture and NGO Extension in scaling Eastern Zambia and Malawi. | [1] To train key stakeholders such that then can create policy changes that permeate across their jurisdiction that enable farmer uptake of CASI; and [2] create community awareness and uptake through local CD initiatives. |
| Types of performance indicators *** | Increase maize and wheat production in rainfed areas by 85% and 10% respectively; use of sustainable agricultural practices; and the generation of a genetic footprint of maize and wheat varieties available to the scientific community. | Yield and Yield variation rate of participating farmers in relation to the control; Income and Variation rate of the income of participating farmers in relation to the control: Adoption area in areas served by the MasAgro Guanajuato Program. | Innovations that increase productivity of farming systems and of availability and consumption of safe and nutritious food are adopted; No. of households growing and consuming seed varieties; No. of farmers trained; Feed the Future. | 1.2 million farm households and other actors along the value chain adopting at least one CA innovation; Number of service providers available to support adoption; Amount of investments of the private sector in CA; Changes at strategy, policy, and regulatory level. |
| Period | 2010-2020 | 2013-2024 | 2009-2021 | 2014-2021 |

### 2.2 CIMMYT project cases

The study focuses on capacity development as a major pathway to reach projects objectives and scale Conservation Agriculture. These projects are implemented in three geographies: Mexico in Latin America, Zambia and Malawi in Southern Africa, and the Eastern Gangetic Plains (EGP) of India, Nepal, and Bangladesh in South Asia (Table 1).

## 3. Results

### 3.1 Finding 1: There is no off-the-shelf conceptual framework to systematically plan and assess capacity development to scale innovations

FAO (2010) proposes a capacity development framework composed of three dimensions (individual, organizational and enabling environment), four functional capacities and a set of technical capacities. GIZ (2015) propose a more practical framework with an individual, organizational as well as a cooperation and enabling environments as the third and fourth level. Whereas there are ample examples of what constitutes individual capacity development, we had to investigate and iterate with peers and several sources (FAO 2010; GIZ 2015; TAP 2016, CGIAR, 2017) to identify project activities that promote organizational, cooperation and enabling environment capacity development, or the interaction between those. This was done for a context of adoption of specific innovations to improve smallholder farming. For the project teams to recognize and recall examples of capacity development from their own work, the framework needed to be clear on the who, what and how:

- The Who? Actors whose capacity is being developed, which can be farmers, organizations, public-private partners and on civil/public/private entities' interactions as examples of each of the four levels;
- The What? Capacities to be developed, such as agronomic practices, resource mobilization, collaboration methods and advocacy;
- The How? Activities, or specific actions to develop capacities of actors such as organizing class-room trainings, providing advisory services, facilitating platforms of exchange like discussion fora and engaging in public awareness campaigns.

Furthermore, existing frameworks focus a lot on the tangible and structural capacities required with little attention for the role of mindsets, power relations and culture of people and communities in wanting and sustaining change at scale (Woltering, Boa-Alvarado and San Juan, 2021; Moore, et al., 2015; Gardeazabal, et al., 2021).

The proposed conceptual framework (Table 2) aims to consider the willingness and capacity to scale and differentiates more clearly between four distinct levels of capacity development, for whom, what and how, to enable a systematic assessment of practical experience, at the

1. Individual level: competence development by improving personal and professional performance of people;
2. Organizational level: raising the performance of an organization by establishing or strengthening processes, procedures and/or structures;
3. Cooperation level: improvement of relationships between organizations in order to increase their performance and cooperation;;
4. Enabling environment level: improvement of enabling legal, political, socioeconomic, and cultural environment so that individuals, organizations, cooperation and societies can develop and raise their performance.

The four levels of capacity development are connected (see Figure 1).


**Figure 1: Four levels of capacity development (CD), their interactions and what they aim to improve** (adapted from FAO, 2010).

This conceptual framework with four different levels and the examples of who, what and how is involved, proved instrumental in facilitating discussions and enrich what projects address at which level.

**Table 2. Framework of capacity development (CD) for scaling complex innovations in smallholder farming systems**

| CD Level | Actors (Who?) | Capacities (What?) | Categories of project activities (How?) |
|---|---|---|---|
| Individual | Individuals such as a:<br>• Farmer (F)<br>• Extension agent (public, private, NGO) (EA)<br>• Researcher or student (R/S)<br>• Entrepreneur (i.e., service or input provider) (E)when<br>• Manager or decision maker (i.e., policy maker, NGO management) (M/D) | Strengthening knowledge, skills, and behaviours:<br>• Technical<br>o Agronomic practices/technologies (adapt, use, and promote)<br>o On-farm research (design, implement and monitor)<br>• Management<br>o M&E&L<br>o Marketing and entrepreneurship<br>o Acquisition and resource mobilization<br>o Leadership and management<br>• Social<br>o Scaling<br>o Gender and social inclusion<br>o Communication, storytelling and writing skills<br>o Advisory skills<br>o Adult learning (train-the-trainer)<br>o Lobby and advocate (influence changes in policy/regulations/standards)<br>o Influence public opinion | Short term support- theoretical<br>• Training (physical and virtual)<br>• Conferences and seminars (physical and virtual)<br>Short term support- experience<br>• Field visits and demonstrations<br>• Workshops (physical and virtual)<br>• Experience sharing and discussions (physical and virtual)<br>Long term support<br>• Graduate programs and advanced courses<br>• Coaching and mentorship of individuals or groups<br>• Visiting scientists, internships, research visits or stays<br>• Community of Practice (CoP) |
| Organizational | Organizations such as a:<br>• Farmers' organization (FO)<br>• National Agricultural Extension Service (NAES)<br>• Research center and university (N/U)<br>• Non-governmental organization (NGO)<br>• Private company (service or input organization) (Co)<br>• Government organization (local, national, regional departments and programs) (Go) | Processes, procedures, and structures within organizations to:<br>• Adapt, use, promote and/or deliver technologies<br>• Manage knowledge and learning, including use of data/tool for decision support<br>• Communicate and raise awareness<br>• Design, acquire, implement, and monitor projects and programs<br>• Mobilize resources<br>• Improve administrative and financial processes and procedures<br>• Collaborate with individuals, other organizations, and networks<br>• Engage in strategic and political processes | Strengthen capacities of organizations through:<br>• Advisory services or technical assistance<br>• Providing data and analytics<br>• Support establishment of new processes, procedures, and units<br>• Facilitating exchange (physical/virtual) |

| CD Level | Actors (Who?) | Capacities (What?) | Categories of project activities (How?) |
|---|---|---|---|
| Cooperation | Platforms and networks between organizations such as a:<br>• Farmers' association or network (FN)<br>• Research/Innovation platform (IP)<br>• Public alliance (PA)<br>• Public-Private-Partnership (PPP)<br>• Business-to-Business (B2B) | *Processes, procedures, structures between organizations to:*<br>• Collaborate, coordinate, and manage multi-stakeholder processes<br>• Adapt, use, promote and/or deliver technologies<br>• Manage knowledge, sharing and learning<br>• Communicate and raise awareness<br>• Design, acquire, implement, and monitor projects and programs<br>• Mobilize resources<br>• Improve administrative and financial processes and procedures<br>• Research alignment and/or harmonization of practices<br>• Engage in strategic and political processes | Strengthen capacities of cooperating organizations through:<br>• Advisory services or technical assistance<br>• Providing data and analytics<br>• Support establishment of new processes, procedures, and units<br>• Facilitating exchange (physical/virtual)<br>• (Co) funding or (co)-investing resources |
| Enabling environment | • Family and community (FC)<br>• Local/(sub)-national/regional political institutions (Ins) | Capacities of public and civil society organizations to:<br>• Create/improve legal and political frameworks<br>• Create/improve guidelines, standards, and policy frameworks<br>• Create/improve financial mechanisms and incentives<br>• Engage in strategic and political processes<br>• Engage in public behavior change processes | Strengthen capacities of political and civil society organizations through:<br>• Advisory services or technical assistance<br>• Providing data and analytics<br>• Support establishment of new processes, procedures, and units<br>• Facilitating exchange (physical/virtual)<br>• Lobby and advocacy (e.g., videos and policy briefs)<br>• Relationship building and brokering<br>• Consensus building (e.g., through sector, prioritization, and agreement on drivers for change) |

### 3.2 Finding 2: Capacity development in the projects focuses on the transfer of technical knowledge and skills to extension agents and researchers to reach more farmers with locally adapted solutions

Across the projects, most of the capacity development efforts focus on transfer of knowledge and research on Conservation Agriculture to extension agents. In Southern Africa these were mostly government and NGO extension staff, while in Mexico these were commercial extension agents from seed, machinery, or farm advisory companies. In the SFRSI project in South Asia, farmers and their farmer organizations were primarily targeted. In the other projects, only a relatively small portion of farmers, such as lead or demonstration farmers were targeted. Lead farmers are trained on how to use and adapt the conservation agriculture principles and participate in setting up, monitoring, and evaluating research trials on their farms.

Researchers and students are also important targets of capacity development in the projects, mostly for joint development and management of on-station and on-farm research trials that have clear scientific output and specific data capturing needs. This includes skills and protocols to do participatory on-farm research in Southern Africa with farmers. MasAgro Productor actively integrates graduate students and scholars in the project implementation. With the projects designed to increase farmer adoption of conservation agriculture and with a strong research component the focus on farmers, extension agents and researchers is critical to achieve the project targets. After all, the predominant indicator of performance is the number of farmers adopting conversation agriculture practices by the end of the funding period or the area cultivated under conservation agriculture. This is then supported by the numbers of trainings and the number of attendees.

Although less prominent than the technical skills, attention is given to leadership, management and lobbying skills of, especially extension agents, and the national extension and research services to raise awareness and develop their own initiatives to promote conservation agriculture. Noticeable, MasAgro Guanajuato has a strong focus on strengthening the capacities of public extension agents to develop their communication, management and lobbying skills to become innovation brokers (CIMMYT, 2018).

### 3.3 Finding 3: Activities at organizational, cooperation and enabling environment level are not systematically planned or explicitly reported on

The case projects give the individual level the greatest consideration out of the four different capacity development levels. These are the tangible activities that were planned in the project proposals and work plans, and consequently communicated to the funders and donors. The

reports include information on the number of workshops, demonstration events, and trainee numbers and types. Fewer examples from the projects could be given for the type of capacity development at organizational, cooperation and enabling environment that were pre-identified in the conceptual framework (Table 2). For example, the capacities of partner organizations to communicate, collaborate, increase administrative efficiency, or act politically were rarely addressed. However, it should be noted that activities at these higher levels are more difficult to identify as capacity development initiatives than activities at the individual level, and their reporting may have been included in a section of the report devoted to sustainability, for example. This does not mean that no activities occur or do not intersect with other levels (see Finding 4). Moreover, the projects have far less influence over their execution and impact and are more of a supporting and consultative role.

## 3.4 Finding 4: The case projects have good examples of activities to develop capacity at individual, organizational, cooperation and enabling environment level

### *3.4.1 Example at individual level*

The projects perform a range of activities to develop capacities, ranging from theoretical to practice-oriented trainings in the field, classrooms, or virtually. In Southern Africa for example, most trainings are on farmers' fields where extension agents, researchers and farmers come together, choose the conservation agriculture practices, collect data, and evaluate results. These sites are used for regional cross-site visits and joint learning apart from demonstration technologies to primary actors to learn from. Annual study tours and WhatsApp groups turned out to be important vehicles to keep momentum for learning.

In South Asia, SRFSI supported the Bihar Agricultural University to deliver a Massive Open Online Course (MOOC) on conservation agriculture practices and business models to farmers, extension agents, students, researchers, entrepreneurs and policy makers. The course, which is available in Hindi and English, was attended by more than 7,000 participants. Importantly, this was deployed during the first wave of COVID-19 in South Asia which likely provided learning opportunities for those who were otherwise unengaged with their usual agricultural capacity development activities. Additionally, since 2011, CIMMYT has been implementing an Advanced Conversation Agriculture course at the Borlaug Institute of South Asia, India, for professionals from South Asia.

For more than a decade, MasAgro Productor has provided one-year conservation agriculture courses to primarily public and private extension agents in order to develop their technical, management, and social skills. Successful participants receive a nationally recognized certificate

(in Spanish, *Técnico Certificado en Agricultura de Conservación*). Graduates can become part of the hub-trainers pool (*formadores*) who undergo continuous intensive training to support extension agents within and beyond hub innovation platforms in Mexico. This approach is a hands-on method to support scaling efforts and is therefore a more practical training than the international training course on conservation agriculture that CIMMYT has been offering to scientists from partner countries. The primary objective of the international training course is to prepare motivated scientists from around the world to become conservation agriculture champions in their respective regions, in accordance with the cooperation and enabling environment level capacity development. Notably, no projects reported supporting formal training centers where extension agents obtain their basic education.

### *3.4.2 Example at organizational level*

In Mexico, Bangladesh, and India, CIMMYT supports manufacturing companies with quality standards for machinery and equipment that respond better to farmer and market needs. For example, MasAgro Productor helps set norms and then develops detailed standardized construction plans of scale-appropriate farm machinery and post-harvest equipment to enable local manufacturers replicate and commercialize equipment compliant with the quality norms. The SRFSI project in South Asia focuses on farmers that are part of farmer organizations, and those that are part of larger associations, showing a clear link between the individual, organizational and cooperation level. These farmers use their knowledge to subsequently train extension agents. SRFSI supports policy and development decision-makers with joint implementation plans and protocols to unite national agriculture development programs. This enables farmer organizations and other stakeholders enhance their capacity to cooperate and coordinate efficient scaling of conservation agriculture beyond singular projects.

In Africa RISING, the project mentors and coaches partner organizations to foster leadership, advocacy, and implementation of conservation agriculture. Partners adapt and adopt CIMMYT protocols for knowledge management and data collection within their organizations and make data available on research repositories such as Harvard Dataverse.

### *3.4.3 Example at cooperation level*

National Agricultural Research and Extension Systems (NARS/NAES) and universities are important partners for locally tailored research and adaptation of innovations. In all the cases CIMMYT actively brokers partnerships with public and/or private organizations. CIMMYT initiates, facilitates, or supports the development of several multi-stakeholder platforms, for example with the Conservation Agriculture Regional Working Group (CARWG) and national CA task forces (NCATF) in Southern Africa that were originally led by FAO. The NCATF in

Zambia, Zimbabwe, and Malawi coordinates stakeholders within the country to promote the adoption of conservation agriculture. Examples from Mexico are seed, fertilizer or machinery-oriented Public-Private Partnerships and organization of hub meetings with a diverse set of actors for local and regional sector consultations. In the case of South Asia, there are a lot of cross-border exchange and more importantly, these efforts are based on innovation platforms and the establishment of the agronomy protocols as mentioned previously. SRFSI linked networks of farmers organizations with national research centers and international organizations which not existed before. Also, SRFSI created online platforms for knowledge exchange and learning, like the knowledge repository of training materials and monitoring data.[2]

MasAgro Guanajuato works with different input and service providers companies such as fertilizer distributers. In this case, they are partnering with local companies, farmer organizations and local governments to create fertility maps of municipalities which generate tactical recommendations to apply the right source and amount of fertilizer in the right spot at the right time as an important component of conservation agriculture. At the same time local government officials are trained in soil fertility, fertilizer needs and the impact of fertilizer subsidy and distribution programs on over- and under fertilization. They are critical partners to promote localized fertilizer application, fertilizer distribution and coordinate capacity development activities across the value chain. In addition, the cooperation with fertilizer suppliers and farm advisors to interpret the soil fertility maps or take the soil samples is critical to develop, deliver and scale site specific fertilizer formulas.

### *3.4.4 Example at enabling environment level*

CIMMYT invested in developing scientific agronomy and data collection protocols, and standardized participatory trials across Latin America (Mexico and Colombia), East and Southern Africa (Zimbabwe, Ethiopia, Kenya, Malawi, Mozambique, and Zambia) and South Asia (India, Bangladesh, and Nepal). These are public goods that can be used by any organization or network to conduct research on conservation agriculture using best practices and up to the standard used by, for example, Departments of Agriculture and universities. This allows for cooperation among organizations abiding by the same standards and creates an enabling environment for professional implementation and scientific research on conservation agriculture. Moreover, in all the cases, social media tools like YouTube videos and Twitter are supporting the mainstreaming of conservation agriculture by the endorsement of political or social leaders like ministers of agriculture or farmer leaders' accounts.

MasAgro Productor's outcomes made it possible for the State of Guanajuato to fund their own initiative, MasAgro Guanajuato. By working closely with the Secretary of Agri-food and Rural

Development, MasAgro Guanajuato contributes to implementation of state development plans, such as campaigns promoting the non-combustion of crop residue across the state. This led to further collaborations with the Secretary of Environment and Territorial Planning on issues of clean air and with private sector actors on water conservation. As the region's established technical advisor, the MasAgro Guanajuato team coordinates, leverages, and exerts influence. Furthermore, MasAgro through its enabling stakeholder engagements at multiple locations provided the springboard to work on an integrated Maize for Mexico strategy to improve coordinated articulation of the maize value chain on a national level. It used science-based scenario analysis and sector consultations to co-develop with national and state governments, private companies, and industry associations value propositions for investments in the maize sector and pitch them in selected windows of opportunity (Govaerts *et al.*, 2021). In turn, this opened new opportunities for MasAgro Productor and Guanajuato.

#### *3.4.5 Example of integration of levels*

There are links between the different capacity development levels. For example, CIMMYT projects share digital monitoring systems with partnering organizations to expand reach and impact. As a result, these organizations improve their capacity to monitor data and make better-informed decisions within and outside a collaborative agreement. This performance improvement is considered organizational capacity development. Finally, when data insights from this shared monitoring approach allow creating consensus between and beyond both organizations in terms of prioritization and aligning research agendas in other projects, this reaches the level of cooperation. These findings are integrated into the discussions with other stakeholders like public organizations to help create a better enabling environment.

## 4. Discussion

### 4.1 Missing or hidden capacity development

This study shows that in four large CIMMYT-led projects aimed at scaling conservation agriculture in farmers' fields, capacity development activities at organizational, cooperation and enabling environmental level are implemented but they are not systematically designed for or explicitly reported on. These sample projects focus on individual level, on extension agents and researchers on their capacity to deliver and innovate. Hence, the case projects tend to implement trainings to transfer knowledge and technology from projects and innovators to beneficiaries primarily to achieve the project objectives. However, we find that such a statement may obscure that the other capacity development levels are less understood, less tangible, and less reported on. In the project cases, activities at organizational, cooperation and enabling environment are

reported on but not necessarily as capacity development activities. In that sense, they are not missing but hidden.

### 4.2 Practical application of the capacity development framework

The challenge of gaining attention for capacity development beyond individual trainings is consistent with the literature of the past several decades. We discovered that the absence of practical capacity development frameworks that permit a deliberate assessment of which activities fall under which level may be a significant contributor to this persistent problem. The conceptual framework proposed for this study helped greatly in steering the interviews with the project leaders, allowing them to systematically go through the table to see which actors and what activities were most important for capacity development. In doing so, the conceptual framework was enriched with actors and activities, often not thought of as beneficiaries and project actions per se. It was observed that a lot of activities on the organizational, cooperation and enabling environment level were not recognized as capacity development activities until the framework and examples were presented. Although the study primarily focuses on four projects and the perspectives of their leadership teams, the projects have a strong track record over the long term and serve as a model for similar initiatives undertaken by CIMMYT on scaling innovations. In addition, the projects provided capacity development that was not always driven by need but aimed to advance project objectives and potential future collaboration with CIMMYT. For example, a partner organization may have a significant dependence on the project funding and be willing to accept assistance with research methods, however assistance with administrative or financial procedures may be more crucial for their development (Van Loon *et al*., 2020)... To enable projects to be truly needs-based at different levels of capacity development, funders must modify their accountability frameworks and give implementers the freedom to engage in less controlled capacity development efforts that may not guarantee the desired results within the specified timeframe. However, evaluating the impact of capacity development activities on individual behavior, organizational competencies, the performance of cooperation systems, and the enabling environment and ensuring value for money is difficult (Thornton *et al.*, 2017 and Vallejo and Wehn, 2016). Evaluation of the effect of the capacity development activities was beyond the scope of the projects and the present study.

### 4.3 Integration across the capacity development levels

The projects provide some inspiring examples of what capacity development at various levels means, but the most promising examples are those in which the link between different levels of capacity development is strong. Systemic capacity development is defined by Leeuwis (et al., 2018) as the linking of trained individuals, national agendas, policies, partnerships, and development initiatives. For example, national research and/or extension centers and local NGOs

that mobilize resources for further research support the training of local researchers on on-farm experiments according to standard international research protocols. These protocols produce strong evidence for informed decision-making and advocate for more high-quality science. However, the integration of the different levels is often not intentionally designed nor pursued. It is necessary to develop and use new practical frameworks and tools to prevent capacity development from becoming fragmented across levels.

During project implementation, the framework proposed in this paper could serve as a valuable g uide for increasing awareness of the different levels and how to work with them.
Notably, while capacity development focuses on the process of developing capacities, knowledge management is concerned with their management and consolidation. Therefore, the capacity of individuals, organizations and networks to acquire, apply, and share knowledge is a key enabler or disabler of the effectiveness of capacity development measures and their potential integration across levels.

### 4.4 Capacities to scale

There is growing understanding about the important role of local stakeholders wanting and owning scaling processes. This requires international research and development organizations shift from ‘doing the scaling’ to ‘enabling others to scale’ (Wigboldus, 2016). In order for local stakeholders to take over projects and manage the process on their own terms, it is important to strengthen their capacities (Thornton *et al.*, 2017). However, there is scant literature on what capacity to scale entails, let alone what capacities project leaders must have in order to develop the capacity of partners to scale. A more systematic integration of scaling capacities for project leaders, partners, and local stakeholders could be part of the capacity development framework’s future development. Further, projects are often designed to deliver an appealing new technology to end-users as quickly as possible (Cooley and Howard, 2019) with few incentives for staff to invest in slower, less visible capacity development that goes beyond training those end-users to use that new technology. In contrast, the case projects are an exception because they have been active for more than ten years. This allowed for a greater emphasis on sustainability, trustworthy relationships, and influencing public opinion, which become indispensable at higher levels of capacity development. Given that most projects last three or fewer years, it is not surprising that few projects progress beyond the individual capacity development level.

## 5. Conclusions

Projects should focus on higher level capacity development as this is where strong organizations that are able to support and direct investments and interventions in their respective countries are

developed. Strong organizations form strong coalitions that can influence policies and culture to create an enabling environment for the numerous innovations and initiatives that are so difficult to maintain and grow to a scale where they contribute meaningfully to the SDGs. However, many colleagues have long concluded that capacity development in research and development projects rarely exceeds individual level. First because the majority of projects are designed and rewarded according to the number of individuals reached or trained. Trainings are popular to report on because they are simple to plan, quantify, verify, and budget. Activities at the organizational, cooperation and enabling environment levels are far more difficult to plan, implement, and monitor because they rely on other organizations' willingness and ability to accept and adopt new capacities. Second, there is little awareness and guidance on how to intentionally design and implement projects to address the other capacity development levels. Project teams need to be aware, able and enabled to invest resources in the development of capacities of local organizations and the system they operate in. They must be more explicit about the different levels of capacity development, what they mean in their context, and how to create synergies between them. This study demonstrates that existing frameworks can be used as a starting point but they will require adaptation and research to be practically applicable for project teams to identify systematically the types of activities performed at each of the various levels of capacity development. This paper demonstrates a capacity development framework for scaling conservation agriculture to smallholder farmers in low-income countries. This can serve as a model for other initiatives that seek and promote concrete examples of what the various levels of capacity development entail for their intended audience.

We derive a few lessons from the creation and use of the framework. First, raise awareness and demand within the research and development community that capacity development should be addressed at all four proposed levels. As demonstrated by this study, recognizing the various levels in ongoing work is an effective way to raise awareness. Second, capacity needs assessments in projects must go beyond the individual level to actively identify gaps and needs of organizations, networks, and institutions that must be addressed in accordance with the project theory of change to achieve short and long-term goals. According to Leeuwis and colleagues (2018), this calls for consideration of incentives, funding regulations, and organizational models as well, including understanding the power dynamics between local actors (Gardeazabal, et al., 2021). Going beyond the individual level, has implications on the human and financial resources of projects which raises questions if projects are able, or willing, to address capacity development more systematically. Third, plan for and actively promote activity alignment across capacity development levels to increase the likelihood that project activities will be sustainable and scalable beyond the project lifespan. We encourage other initiatives to use the proposed capacity development framework to make capacity development at various levels more visible and

actionable as it assists in the systematic planning, implementation, and monitoring activities that support the sustainable scaling of innovations such as conservation agriculture.

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[1] CIMMYT and partners have conducted long-term AR4D on conservation agriculture in Southern Africa. It is important to recognize project predecessors: Sustainable Intensification of Maize-Legume Systems for the Eastern Province of Zambia (SIMLEZA) and Facilitating the Adoption of CA by Resource-Poor Smallholder Farmers in Southern Africa (IFAD CA). Data was gathered from project proposals, plans and progress reports.
[2] https://srfsi.cimmyt.org/