

Insights on scaling of innovations from Agricultural Research for Development: views from practitioners

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Despite a growing body of literature on how to scale innovations to contribute to the Sustainable Development Goals, there has been little attention for how scientists and programme managers engage with the scaling process in practice. Through 36 interviews we found that the dominant understanding of scaling was output and beneficiary-focused, rather than outcome and society focused as the latest literature suggests. This has implications on how scaling is approached in projects on the ground, and on the role of an agricultural Research for Development (R4D) organization such as the International Maize and Wheat Improvement Center (CIMMYT) in bridging science and development. We recommend more reflection on the scaling process and make more use of scaling capacities and tools to better link scientific knowledge to results on the ground.

Keywords: R4D, CGIAR, interviews, scaling, practice, roles, principles

Introduction

Scaling of innovations, or the process of expanding the use of beneficial technologies or practices over geographies and across organizations to impact large numbers of people, is seen as a major pathway to contribute to the Sustainable Development Goals (SDGs). However, successful scaling of innovations is rare, for two major reasons. First, scaling innovations is a complex process; it is highly dependent on the local dynamic context (McLean and Gargani, 2019), and requires the right mix of technical, social and institutional innovations (Schut *et al.*, 2020) and time (Low and Thiele, 2020). Second, projects are often not set up to deal with this complexity (Woltering, *et al.*, 2019) and there is insufficient capacity of implementing actors to clearly understand and sufficiently engage with the scaling process (Shilomboleni and De Plaen, 2019). Although there is a growing body of literature and practical tools on how to deal with the complexity of scaling, we also observe that critical reflections on the scaling process itself (Wigboldus and Brouwers, 2016); its purpose (McLean and Gargani, 2019); and the extent to which single organizations can scale (Meehan and Jonker, 2018; Seelos and Mair, 2019) are lagging behind the speed at which new initiatives emerge that aim to scale innovations.

Research for Development (R4D) organizations have an important role to play to identify, develop, and support the scaling of innovations that can lead to impacts at scale. In the agricultural sector, R4D organizations have increasingly been under pressure to demonstrate impact at scale of their innovations (Schut *et al.*, 2020). However, their capacity to actually scale innovations depends on (local) implementing partners that can reach users at scale (Leeuwis *et al.*, 2018). Furthermore, the reporting frameworks of “scaling projects” focus on the numbers and outputs reached, and there is little documentation of, or attention placed on, the processes of scaling innovations in the messy real-life context (Gibbs *et al.*, 2020).

Our objective is to shift attention to the role of human agency (Barrett *et al.*, 2020) and understand how scientists and programme managers engage with the scaling process, as opposed what the theories on scaling may prescribe. We focus on how scaling is interpreted, how it is approached in practice, and what role an agricultural R4D organization such as the International Maize and Wheat Improvement Center (CIMMYT) plays in the scaling of innovations. These insights are important for CIMMYT but can equally contribute to the transition process currently underway in the CGIAR to become a key player in global food systems transformation.

Conceptual framework and research questions

Conceptual framework

The implementation of this study is guided by a conceptual framework that is based on the latest insights in scaling around four areas of interest: (1) goals (2) approaches, (3) guiding principles, and (4) roles and responsibilities in scaling initiatives. The survey questions focus on the experience and insight of practitioners in these four areas of interest.

1. Goals of scaling

McLean and Gargani (2019) state that most of what we understand today about scaling has been borrowed from 19th century industrial expansion, 20th century pharmaceutical regulation, and 21st century technology start-ups—all of which focus on expanding operational scale, growing market share, and achieving commercial success. The authors explain that such approaches, while not wrong, are incomplete when applied to development efforts where the goal is social impact and the public good. CIMMYT, as a largely publicly funded R4D organization, should not aim for maximum scale of use of “their” innovations to a target group, but for an optimal scale that balances the positive impacts for society and the environment beyond the target group and area. Furthermore, the goal of scaling should be **responsible** and **sustainable**. Responsible scaling (Wigboldus, 2018) means recognizing that changes resulting from scaling may have unintended consequences—positive or negative—

for the population, landscape, value chain, or society. This calls for setting aside scaling strategies that address “maximum potential scale” for a few in favour of “optimal” or “responsible scale” for many, considering the “do no harm” and “leave no one behind” principles (Woltering *et al.*, 2019; Jacobs *et al.*, 2021). Sustainable scaling of innovations refers to a sustained uptake of an innovation which lasts well beyond the lifetime of any intervention. Hence, scaling innovations is a means that contributes to the goal of scaling outcomes.

2. *Approaches to scaling*

The approach towards scaling is described in literature in three directions, or a combination thereof (Riddell and Moore, 2015):

- **Scaling out:** Expanding geographical spread/reach of a technology/practice over time. This refers to reaching more people with an innovation through adoption, multiplication, dissemination, extension, replication, technology transfer, etc.
- **Scaling up:** Expanding beneficial institutional practices within and across organizations and levels. This refers to “changing the rules of the game”, transforming institutional conditions (policies, strategic partnerships, value chain development) to allow efficient scaling out through upgrading, transition, institutionalization, integration, evolution, and development.
- **Scaling deep:** Shifting mindsets of people, changing beliefs, values, and cultural practices, for example through awareness-raising and capacity development. It also refers to scientists, development practitioners, and value chain actors shifting their patterns of thinking that shape their actions—not only the end-users.

3. *Scaling principles in practice*

From the scaling literature, four guiding principles can be drawn that can be applied to any scaling intervention.

1. **Design for scaling from the beginning:** Projects designed for scale tend to reverse engineer what is required to achieve a vision of success. This requires early attention to collect evidence that is convincing for large-scale implementers and decision makers, assess unit costs, and integration of market and client feedback (WHO and EXPANDNET, 2011; Cooley and Howard, 2019). Rather than just piloting to test whether the innovation works in a specific context, one should also pilot the scaling, thus testing forms of collaboration, financing, and dissemination that can be sustained beyond the project (Hartmann & Linn, 2008).
2. **The entry strategy is the exit strategy:** With average project durations of two to four years, it is imperative that the development sector shift from seeing projects as complete efforts to framing them as individual building blocks towards achieving

long-term change (Linn & Cooley, 2014). To achieve this, projects should be explicit about exit strategies and the gradual transition from externally run efforts and resources to locally adopted ones.

3. **Collaboration as the key to sustainable change:** It is important that multi-stakeholder partnerships are built on a broader strategy to tackle social issues (Hall and Dijkman, 2019), not just as a collection of transactions to help the project achieve objectives and use up resources. Generally, local markets and governments can sustain and grow the changes achieved by donor-funded projects. Therefore, it is important to recognise and strengthen local leadership, ownership, collaboration, and management (Cooley and Howard, 2019).
4. **M&E&L to navigate complex systems:** Continuous monitoring, evaluation, and learning (M&E&L) of the scaling process and its actual impacts on people and the environment is critical for effective scaling (McLean and Gargani, 2019). M&E&L systems should focus not only on the outputs but endeavour to capture outcomes, unintended consequences, sustainability, and systems changes.

4. The roles and responsibilities for scaling

The CGIAR was founded to have an impact on development. However, the way scientific knowledge has been linked to results on the ground has always been a contested topic across its centres (Leeuwis *et al.*, 2018). CGIAR institutes have gradually moved to cover the entire research for development continuum. They are increasingly held accountable for the use of the international public goods they develop. More recently, with the ongoing One CGIAR transition, there are calls for the CGIAR to act as the custodian of an international science agenda to ensure the directionality of agri-food systems transformation (Hall and Dijkman, 2019). Covering this wide and dynamic spectrum of expectations poses challenges for CGIAR institutes, and their staff, in finding their value proposition (Baranski and Ollenburger, 2020). Wigboldus and Brouwers (2016) distinguish three types of engagement with scaling processes, these are 1) control (making things go to scale), 2) catalyse (helping things go to scale) and 3) creating conditions (seeing things go to scale). We expand this model with two additional roles that are more hands-off of the scaling process, resulting in the following five roles 1) to produce scalable innovations, 2) to understand scaling, 3) to advice others on scaling, 4) to catalyse scaling processes, and 5) to scale innovations.

Research questions

The conceptual framework informed the following research questions (Figure 1):

- a) Goals: What do scientists and project managers want to achieve with scaling?
- b) Approaches: What approaches to scaling (scaling out, up or out) are the most dominant among scientists and project managers?
- c) Principles: How do scientists and project managers operationalize important principles of scaling?
- d) Roles and responsibilities: How do scientists and project managers see their role and responsibility in scaling in terms of the engagement models?

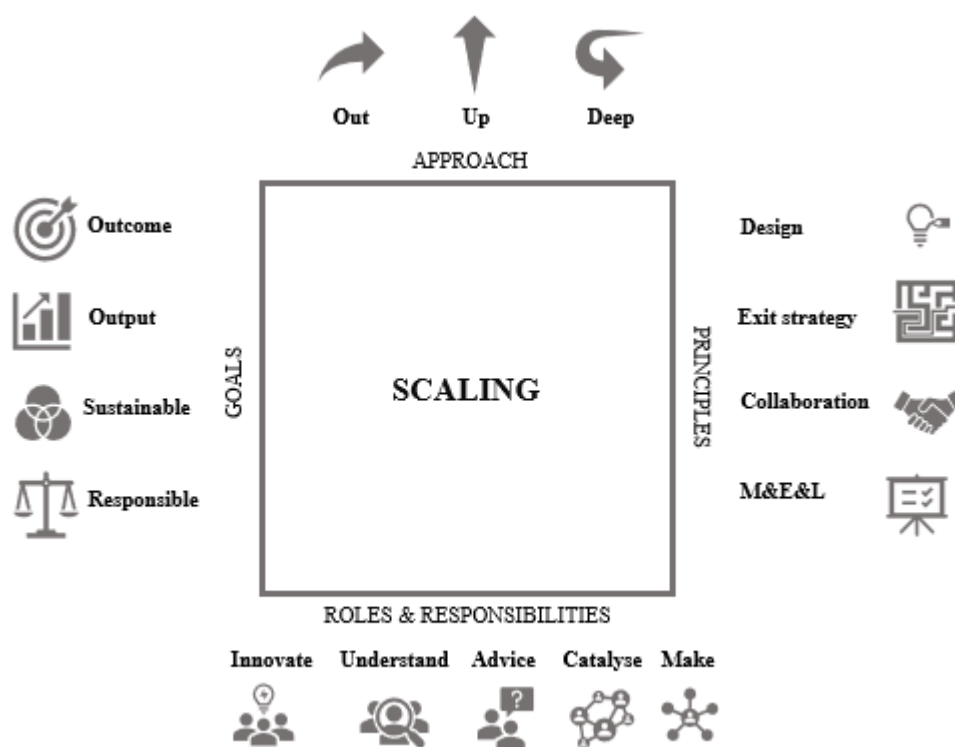


Figure 1. Graphical abstract of the conceptual framework that informed the research questions, the interview questions and their coding.

Methodology

Case study: CIMMYT

This study focuses on CIMMYT, one of the first of the 15 agricultural research centres that form the CGIAR. Through its mission—maize and wheat science for improved livelihoods—CIMMYT aims to achieve its vision of contributing to the development of a world with healthier and more prosperous people, free from the threat of global food crises, and with

more resilient agri-food systems (CIMMYT, 2016). The strategic plan 2017–2022 further outlines CIMMYT’s contribution to 10 of the 17 SDGs, as well as how it aims to achieve impact through scientific excellence, partnerships, and capacity development. CIMMYT leads the CGIAR Research Programs on Wheat (CRP WHEAT) and Maize (CRP MAIZE) and hosts the CGIAR Excellence in Breeding Platform (EiB). In addition, CIMMYT has research programs on Socioeconomics (SEP), Sustainable Intensification (SIP), Integrated Development (IDP), and Genetic Resources (GRP). CIMMYT has 13 country offices (three in Africa, eight in Asia, and two in Latin America) and 1,675 staff members. CIMMYT is very active at the global stage in scaling; it chairs the Agriculture and Rural Development working group of the international scaling community of practice¹, is an important contributor to the science of scaling (Schut *et al.*, 2020), and co- developed the Scaling Scan tool (Jacobs *et al.*, 2021).

Selection of participants

The survey participants came from all of CIMMYT’s research programs, as well as the Project Management Unit (PMU). We reached out to the six program directors and the leaders of the EiB and PMU. Additional CIMMYT colleagues were proposed for interviews by program leaders, or selected by the authors of this work. Additionally, all members of CIMMYT’s scaling task force were invited to participate through an online questionnaire. In total, we invited 58 colleagues, of which 36 participated in individual interviews (5 participated online) between 4 July and 22 August 2019.

Data collection and analysis methods

Qualitative data was collected through face-to-face meetings, virtual semi-structured interviews, and online questionnaires. Face-to-face meetings were conducted with staff based at CIMMYT headquarters in Mexico, while virtual semi-structured interviews were implemented with staff at regional offices. The interviewers listened, asked for clarifications but did not discuss with the participants. Each respondent was assigned an alphanumeric code to indicate their roles as a leader (A), researcher (B) or manager/support (C), while the number identifies the individual. The interviews lasted between 30 and 85 minutes, with an average duration of 50 minutes. Quotes and interpretations included in the internal final report were verified with the participants. Results were validated at a workshop attended by 40 colleagues, including interview participants. A final internal report was presented to all the participants and CIMMYT leadership. This article summarizes insights and lessons for potential global application.

¹ www.scalingcommunityofpractice.com

Interview structure, questions and coding

The interview posed 10 open-ended questions (Table 1) designed to address important scaling challenges for R4D organizations, as described in the conceptual framework. Firstly, on goals of scaling (Block I); secondly, on approaches to scaling (Block II); thirdly, on scaling principles in practice related to the design, implementation, and learning components around scaling (Block III); and finally, on the perceived roles and responsibilities for scaling (Block IV). The questions focus not on “the what” (innovation or project) or “the how many” (number of end-users) of scaling, but rather on how participants dealt with the scaling process itself. The responses were transcribed and coded based on an inductive approach to find patterns in the interviews. The results were categorised on themes according to the research questions and considered their frequency of occurrence.

Research question	Interview question	Coding of responses
Block I: Goals of scaling		
1) What do scientists and project managers want to achieve with scaling?	1. How do you interpret the term “scaling”? 2. How would you define successful scaling?	Interpret and organize open responses associated with the four goals of scaling we defined.
Block II: Approaches to scaling		
2) What approaches to scaling (scaling out, up or out) are the most dominant among scientists and project managers?	3. What are the factors that propel/hinder the success of scaling efforts?	Interpret and organize open responses associated with definitions of scaling approaches: out, up and deep.
Block III: Scaling principles in practice		
3) How do scientists and project managers operationalize important principles of scaling?	4. In your project(s), how do you plan for scaling from the beginning?	Interpret and organize open responses associated with design of scaling process.
	5. In your project(s), what do you consider critical elements in an exit strategy?	Interpret and organize open responses associated with key characteristics for sustainable scaling.
	6. Can you give examples of how you work with collaborators in a way that ensures the continuation of positive outcomes after the CIMMYT-led project ends?	Interpret and organize examples of collaborations.
	7. Are you monitoring factors that have an impact beyond the project (in terms of geography, target group, project period)? If so, how?	Interpret and organize forms and factors for monitoring scaling of innovations.

Block IV: Roles and responsibilities for scaling		
4) How do scientists and project managers see their role and responsibility in scaling in terms of the engagement models proposed?	8. What is the competitive advantage of CIMMYT in successful scaling? What should its role be? 9. What does CIMMYT need to do better to be more successful in scaling? 10. What service should a scaling unit at CIMMYT provide to add value to your work?	Interpret and organize open responses according to roles and responsibilities for scaling

Table 1. Relation of research question, interview question and coding of responses

Results

Scaling goals and approaches

Participants spent from 10 to 15 minutes answering the questions about what (successful) scaling is and how it is achieved. From the interviews, we assessed which dimensions of the goals and approaches to scaling were explicitly or implicitly included in the responses to the questions (Figure 2 **Error! Reference source not found.**).

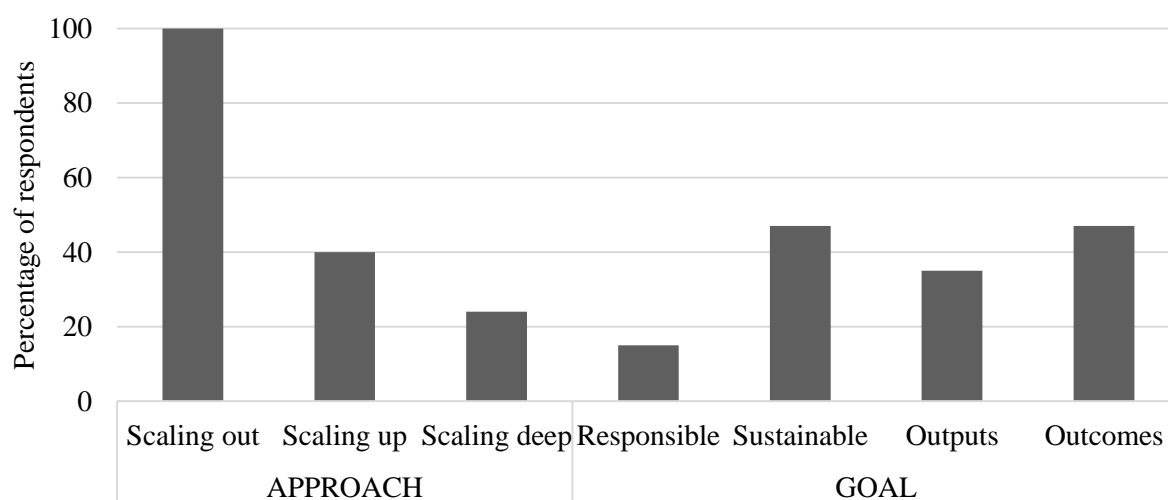


Figure 2 Percentage of respondents referring to specific scaling approaches and goals (n=36)

All respondents referred to the scaling out dimension—getting more of something—while 40% mentioned elements of scaling up and only about a quarter of respondents described the importance of shifting mindsets as an approach for achieving large-scale impact. Nineteen per cent of respondents warned about the potential side effects of scaling, mentioning issues around sustainability, responsibility, and “do no harm”. Almost half of the respondents saw projects as a way to kick-start scaling processes and explicitly defined the ultimate objective of scaling as improved livelihoods and changed systems rather than innovation adoption.

Over the series of interviews, we noticed a pattern in how respondents who work in wheat, maize, or cross-cutting programs talked about scaling (Table 2). Respondents who work on wheat seeds were primarily concerned about developing improved varieties that the public sector can scale further. After all, wheat is self-pollinated and farmers can replant their own seeds relatively easily year after year; wheat research is also largely government supported (Lantican *et al.*, 2016). CIMMYT work on maize generally goes further and includes support to local businesses so that they can commercialise and efficiently scale within their market segment. This is because hybrid maize possesses “heterosis” or “hybrid vigour”—that is, a dramatic increase in yield and performance for other traits, compared with inbred parents. There is significant economic advantage for farmers to repurchase—and for businesses to sell—hybrid maize seeds every year. Respondents from the Sustainable Intensification, Integrated Development, and Socioeconomics Programs, which generally focus on cross-cutting innovations, tended to describe all three dimensions of scaling, especially leading demonstrations for technology dissemination, convincing public and private sector actors to support scaling and shifting mindsets along the value chain to change routines and include the innovation in their ways of working. For this last group of colleagues, it was important to deal with all three dimensions to transform agriculture and reach sustainable outcomes.

Respondent focus:	Out	Up	Deep	Scaling is about...
Wheat seed	Multiply	NM*	NM	Multiplication
Maize seed	Multiply	Commercialize	NM	Marketing
Cross-cutting	Disseminate (demonstrate)	Public and private sector promotion	Shifting mindsets	Transformation

*NM, not mentioned

Table 2. The interpretation of scaling depends on what innovation you work with at CIMMYT

Scaling principles

Plan for scaling from the beginning

Thirty per cent of respondents mentioned the Theory of Change (ToC) and impact pathway approach as the most popular models to plan for scaling from the beginning: “Incorporating scaling into the Theory of Change is fundamentally important” (C8). Nevertheless, many of these respondents recognised the suboptimal use of a ToC in practice when there is limited participation of local stakeholders in its design; when the use is more theoretical than practical; and when the assumptions are vague. Additionally, it was recognized that “frameworks for design, implementation, and monitoring of scaling are lacking” (C5).

Exit strategy

The critical elements of a project exit strategy mentioned most frequently by respondents included: (1) a focused effort on collecting enough evidence for partners to justify further scaling beyond the project; (2) support to individual and organisational capacity development; and (3) the setting up of viable business models for the private sector. On the other hand, “an exit strategy is no reality [not a real option] for CIMMYT global strategic breeding work, as we have to keep our pipeline going and adapt to new situations” (B13), such as the climate crisis. Furthermore, one respondent stated: “All projects I do are building blocks towards my personal vision of what I want to achieve in Sub-Saharan Africa over 10–15 years, so there is no beginning or end” (B4).

Collaboration

Working with collaborators in a strategic and respectful manner is important to ensure that the positive outcomes of CIMMYT-led projects continue after the project ends. Eighty-three per cent of respondents mentioned collaboration as one of the main drivers for scaling impact of research, either by co-creating new knowledge or technology, fostering innovation processes, or facilitating the delivery of research outputs to users. For the respondents, strategic collaboration meant mapping and engaging the right stakeholders from the beginning and being conscious about their financial, political, personal, and/or idealistic motivations for supporting the initiative. Respondents identified a need for being more systematic about partner engagement plans for scaling and “partner capacity assessment and criteria to determine [suitable] partners” (C2). Satisfactory results are achieved through long-term organizational capacity development, though focusing on the technical skills of individuals is still the norm.

Respondents described the difficulty of moving beyond “a transactional nature” of collaborations due to commitments to donors who require delivery within set budgets and methods: “Donors impose things on us, and we impose them on our partners and then we all impose them on farmers” (A4). Facilitation of scientific and non-scientific networks and platforms, especially South-South—such as the International Maize and Wheat Improvement Networks—were found to have a high impact. It is important to create spaces to provide and exchange relevant information to stakeholders, and to share decision-making processes to foster co-investment, co-design, and co-implementation. As one respondent noted: “For scaling, we should focus much more on the partners than on the farmers” (B16). While the multidisciplinary nature of CIMMYT staff is recognized as a competitive advantage, there is “little time for staff to work together to fulfil longer-term plans” (B13). Staff are committed to “their” projects, after all, 80% of CIMMYT funding is project-specific. There is potential to incentivise and support researchers to better collaborate between disciplines, programmes, and regions.

Monitoring, evaluation, and learning

Monitoring in projects “too often serves reporting purposes and not learning” (B17) because learning is often limited to the project boundaries. This is regarded by many as a missed opportunity; however, a “willingness to pay and demand for impact assessment are unfortunately not always balanced” (A5). Positive exceptions include the recurrent impact studies conducted by CIMMYT since 1994 (Lantican *et al.*, 2016), as well as projects funded by the Australian Centre for International Agricultural Research (ACIAR), which are selected for impact assessments five years after ending, as 5% of the budget is reserved for ex-post monitoring and evaluation (M&E). Attribution to project activities promoting CIMMYT varieties is becoming easier due to advances in molecular phenotyping, DNA fingerprinting, and varietal indicator numbering. Regardless, this is more difficult for complex innovations such as Conservation Agriculture. Furthermore, “it is challenging to assess impacts within the project, let alone assess impacts outside the project areas and on institutions we may have influenced” (A4). An important finding is the need to “focus on the human element . . . We need to measure outcomes, [although] finding a correlation between your intervention and reaching an outcome is difficult, due to many other interventions that we are not even aware of” (B8). This “requires a hybrid of using: (1) secondary data (statistics bureau, earth observation, household livelihood indicators, etc.) which capture big changes at outcome level, and (2) ground-truthing of data (interviews, household surveys, adoption)” (B18). One of CIMMYT’s flagship projects in Latin America, Sustainable Modernization of the Traditional Agriculture (MasAgro), monitors its progress with an indicator toolbox containing three categories: “(1) Respond to contractual obligations (number of farmers, etc.), (2) respond to [the] broader agenda of the donor (e.g., SDG reporting), and (3) respond to CIMMYT research agenda and strategy” (A3). Participants identified cross-program and

cross-regional collaboration within CIMMYT as a clear opportunity: “We have to explore more our competitive advantage of working in different regions and having several disciplines within the institution” (B7).

Roles and responsibilities for scaling

One of the key insights emerging from the study was how the questions around scaling triggered respondents to reflect more deeply about what it means to be working in a R4D organization. Most participants revealed that they struggle to identify what lies within and outside their scope of work, and what is the right balance between the “R” and the “D”. “We do not go into development although we are often judged on that basis” (A1). All expressed their desire for the research to have a practical application, which requires some to “do action research with farmers to make sure innovations are suitable and adaptable to their conditions” (B4); and others stated that “we should do [more] research on scaling, and not do the scaling itself” (A2) and support local structures, processes and organizations.

Asked about the competitive advantage and role of CIMMYT in successful scaling and its role the responses were interpreted and grouped in five categories; being 1) to produce scalable innovations, 2) to understand scaling, 3) to advice others on scaling, 4) to catalyse scaling processes, and 5) to scale innovations (Table 3). Fifty-six per cent of respondents were explicit in their response that CIMMYT’s role in scaling is creating excellent scientific outputs with potential to benefit the livelihoods of farming households. As one respondent described: “We have always assumed that if we produce good technologies, seeds, and papers, they will scale automatically; now we know it doesn’t work like that” (B13). Another said: “We prove it, you scale it. But the reality is different: It’s not just about [the] creation of scientific outputs; it is about supporting the scaling process as well” (B2).

To produce scalable innovations	To understand scaling	To advice on scaling	To catalyse scaling processes	To scale innovations
56%	64%	53%	42%	0%

Table 3. Summary of CIMMYT’s roles in scaling as interpreted from the interviews

Sixty-four per cent of the participants agreed that CIMMYT's role in scaling is to understand scaling, particularly on the conditions under which the innovations are scalable. This involves responsibilities such as "assessing what innovations are scalable" (A5) depending on the context and acting as a "clearing house" (A3) to determine scalability and market potential.

Fifty-three per cent of the respondents went further and indicated that CIMMYT's role is to provide advice, by making available and accessible learnings on the conditions for scaling of promising innovations and provide guidance to different stakeholders who lead the scaling process. One respondent summarized what a balanced space could be on the R4D spectrum: "CIMMYT shouldn't do the scaling, but do the research on scaling and give guidance to partners on the how and what of scaling" (A2). Being recognised as an "honest independent broker" (B13) puts CIMMYT in a strong position to enable others to scale. The role of catalyser of an enabling environment for the scaling of a range of innovations was recognized by forty-two per cent of the participants. An important experience is to "make sure that you can link up with what the government is investing in" (B15). It also demands that staff "create scaling capacities among intermediaries, help them apply suitable methods, and learn from the process" (A5), as well as play a catalytic role for a network of partners "who do the actual scaling" (A4). This has implications on how CIMMYT attributes success: "Scaling means letting go, and success is impossible to attribute to one intervention or one intervener" (A3). The fifth scaling role, implies that CIMMYT "does" the "development work" of directly reaching out to the millions of end users, was not suggested by any respondent (0%). On the contrary twenty-five per cent (data not shown in Table) of respondents explicitly mentioned that CIMMYT should not "do" the scaling out and instead focus on elements of scaling up and deep. Respondents see an important role for scaling experts to develop scaling capacities across the institution because scaling should be an integral part of the project, not something that can be "outsourced".

Discussion and conclusion

The road is the goal

The interviews with CIMMYT colleagues brought to light many examples and challenges around designing for scale, exit strategies, collaboration, and monitoring and learning that help understand how practitioners engage with the scaling process. Scaling is interpreted differently depending on the innovation of interest and whether one works on the basic (upstream) or adaptive (downstream) side of research. Respondents' dominant view on scaling was output and beneficiary focused. This suggests that scaling is regarding as an end and not as a process, confirming the point that Shilomboleni and De Plaen (2019) make about the need for improved capacities to engage with the scaling process. This is arguably the result of researchers being directly accountable to donors who incentivise short-term (annual) quantitative demonstrations of impact that (Leeuwis *et al.*, 2017), paradoxically, may actually

reduce the long-term impact of a project (Baranski and Ollenburger, 2020). More reflection on the goals of scaling process and its implications (Glover *et al.*, 2019) is required.

Scaling out as a dominant approach

Historically, CGIAR institutes have defined their mandate around specific commodities, thematic areas or innovations risking strong path dependency and selection bias (Schut *et al.* 2020) resonating strongly with the phrase mentioned by two respondents “the hammer looking for a nail” (B8/B19). Results show only few respondents mentioning scaling up and deep as integral parts of successful scaling. Kohl (2021) calls this traditional, or industrial, scaling and McLean and Gargani (2019) state that while not wrong, that type of scaling is incomplete when applied to development efforts where the goal is social impact and the public good. A broad-based, more sophisticated understanding and integrated approach to scaling is necessary, where scaling out is a natural result of investments in scaling up and deep.

Collaboration as a key principle for scaling

In addition to providing scalable innovations around maize and wheat, CIMMYT is serving those at the front-line of scaling with decision-making tools and evidence around pathways to reach impact at scale. The international public goods nature of the CGIAR helps to act as the “honest independent broker” (B13) across geographies and a wide range of stakeholders which is a unique position to bring clarity, guidance, and evidence into the discussions around scaling. The expectation exists for CIMMYT and other CGIAR Centers to increasingly form partnerships rather than lead larger projects that address system-wide problems and seek impacts on livelihoods, poverty, and overarching objectives such as the SDGs. CIMMYT’s and partners’ capacity to collaborate will, to a large degree, determine the ability to scale (K. Pixley, Personal communication, 2020). Put more simply, while CIMMYT provides excellence in applied science, successful strategic collaboration is what ultimately generates impact, relying on (local) stakeholders that can reach users at scale (Leeuwis *et al.*, 2018). Thereby going beyond the “usual suspects” is advised, such as other research institutes and national extension programs, and work more with private sector actors, community initiatives, investors and non-agriculture organization.

Supporting scaling processes

R4D organizations such as CIMMYT have a strategic role supporting scaling processes, or as one respondent formulated it: “We should not do the scaling, but do the research on scaling

and give guidance to partners on the how and what of scaling” (A2). Multidisciplinary teams, guidance from scaling experts, and the use of scaling tools such as the Scaling Scan (Van Loon *et al.*, 2020; Jacobs *et al.*, 2021), and the Scaling Readiness (Sartas *et al.*, 2020), can help support scaling processes that consider the different approaches, goals, principles and roles and responsibilities presented in the conceptual framework. Actively asking questions from a scaling perspective can uncover a lot of issues that would otherwise go unnoticed. Exposing these, often hidden, mindsets (Woltering *et al.*, 2021) about what scaling is and how it works, allows a more nuanced and diverse view on the role of research in and for development to better link scientific knowledge to results on the ground.

Meaningful scaling in practice for R4D organizations

This study shows that reflecting on how individuals and organizations engage with the scaling process is important to recognize and examine patterns in approaches of what to scale, how to scale, and who will scale. The challenge remains as to *how* to make these issues more visible during the scaling process itself when scaling is largely regarded as an end, and not a means. This study drew insights from a subset of staff at CIMMYT that reflected on a conceptual model about scaling that will be useful for other R4D organizations as well to reveal scaling gaps. We encourage further research with diverse set of actors of the CGIAR community and beyond. Critical self-reflection and engagement into meaningful scaling are crucial for R4D organizations, including the entire CGIAR, to continue to contribute to the SDGs at a time where reaching numbers is not going to be enough and demands for transformation and systems change are putting new challenges to R4D organizations.

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