Small Scale Seed Cleaning Unit and the creation of farmer cooperatives to enhance land productivity and rural income

An exploratory Scaling Readiness assessment

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ICARDA
Science for resilient livelihoods in dry areas

MEL
monitoring evaluation and learning

1. Background:

Source: WOCAT

The mobile seed cleaning machine improves the livelihoods of smallholder farmers in Tunisia by significantly enhancing seed quality, increasing crop production, reducing workload and costs, and promoting local value chains and social cohesion.

In Tunisia and Algeria, the agricultural system is characterized by low levels of mechanization, particularly among small and medium-sized farmers who cannot afford expensive imported machines. As a result, a substantial amount of manual labor is required to carry out various agricultural operations, such as seed cleaning, which is traditionally done by women and children. While seed production is often handled by large suppliers, this does not always meet the demand. Therefore, many smallholder farmers in Tunisia prefer to use their own seeds, despite the time-consuming manual cleaning process and the risk of lower quality.

To address these issues, the International Center for Agricultural Research in Dry Areas (ICARDA) collaborated with national partners to develop a mobile seed cleaning machine for small-scale farmers. The prototype, designed and tested with input from a local manufacturer, is suitable for primary field crops, such as wheat, barley, vetch, and faba beans, commonly grown in Tunisia. The machine sorts out damaged or undersized seeds and removes rocks or pebbles, while treating the remaining seeds to eliminate contamination or weeds, ensuring quality and longer shelf life.

The introduction of the mobile seed cleaning machine has several advantages, including a reduction in the workload for women and children, improved crop production and quality, increased land productivity, reduced dependence on imported seeds and machinery, and the promotion of local value chains and social cohesion through cooperative ownership and shared utilization of the machines.

However, there are still some challenges to overcome. For example, the initial prototype required heavy bags of seeds to be lifted to a height of two meters, leading to additional labor requirements and reduced efficiency. This challenge was addressed by equipping the machine with a conveyor screw, which can double its capacity but comes at an additional cost. Additionally, the cost of purchasing the machine can be a significant investment for individual farmers, but this obstacle can be overcome through collective buying and organizing themselves into cooperatives.

Scaling Readiness and Concepts

Scaling Readiness (SR) is a conceptual approach aimed at enhancing the scalability of an innovation package within a specific context. It helps users pinpoint the obstacles, often referred to as bottlenecks, that may hinder the scaling process. This is a dynamic process as innovation packages, bottlenecks, and SR scores can change over time and across different locations due to evolving contexts or the introduction of new innovations. The exploratory SR assessment involves two fundamental steps:

Characterization of the Innovation: This initial step involves defining and understanding the innovation itself. It includes identifying the core innovation, the scaling target or desired goal (aligned with SDGs), the complementary innovations (context-specific elements crucial for successful scaling), and the innovation package. Here are the key concepts related to this step:

- Core Innovation: The central innovation to be scaled, which is context-independent and broadly formulated.
- Scaling Ambition: The desired goal or outcome of scaling the innovation, often aligned with Sustainable Development Goals (SDGs).
- Complementary Innovations and solutions: These are co- or sub-innovations that are essential for successfully scaling the core innovation. They are context-specific and can be seen as the enabling environment for the core innovation.
- Innovation Package: A comprehensive description of how the core and complementary innovations interact, including the context (country and subnational level), the intended beneficiaries, and the targeted SDGs.

Diagnosis of Complementary Innovations: After characterizing the innovation, the next step is to diagnose its various components, specifically the complementary innovations. These are often classified into different types, including features, tools, products, principles, (institutional) arrangements, services, and techniques. Complementary innovations are closely linked to the following enabling aspects:

- *Awareness*: Strategies to inform relevant individuals about the innovation, like radio broadcasts.
- Funding: Ensuring adequate financial resources for research or improvement, often involving proposal frameworks and stakeholder collaborations.
- *Availability:* Guaranteeing a sufficient supply to meet demand, such as sufficient seedlings.
- *Accessibility*: Making the innovation accessible to users through means like a contact person or phone number.
- *Affordability*: Ensuring affordability through measures like subsidies, loans, or cost-effective designs.
- *User Friendliness*: Ensuring that the innovation is user-friendly, such as creating ploughs suitable for commonly used tractors.
- *Benefits for the Targeted Group*: Innovations designed to enhance benefits for the intended beneficiaries, for instance, seedlings that yield more fodder.
- *Trust*: Improving the trust in the (core) innovations and reduce risks.
- *Compatibility*: The ability of an innovation to fit in the existing systems.
- *Capacity*: The knowledge and skills to adequately use and maintain the innovations.
- *Gender*: Promoting inclusive design and diverse perspectives to ensure the responsible and equitable use of innovations.

This systematic approach helps stakeholders identify key components, barriers, and opportunities related to the scaling of an innovation, ultimately facilitating its successful implementation within a specific context.

Diagnosing

The complementary innovations are diagnosed so that the bottleneck hindering scalability is revealed. Diagnosing consists of calculating the Scaling Readiness Score – the product of multiplying the *Innovation Readiness Score* and the *Innovation Use Score*. These two concepts are defined and scored as follows:

Innovation Use is a metric used to assess the extent to which an innovation is already being used, by which type of users, and under which conditions, with a scale ranging from no use (lowest level – 0) to common use (highest level – 9). (source: MELCOP/ PRMF Glossary).

Innovation Readiness is a metric used to assess the maturity of an innovation (its preparedness for scaling) with a scale ranging from the idea (lowest level – 0) to validated under uncontrolled conditions (highest level – 9). (source: MELCOP/ PRMF Glossary).

Score	Innovation Use		Innovation Readiness	
	Generic level label	*Generic level description*	*Generic level label*	*Generic level description*
9	*End-users/ beneficiaries (common)*	The innovation is commonly used by end-users or beneficiaries who were not involved in the initial innovation development	*Proven innovation*	The innovation is validated for its ability to achieve a specific impact under uncontrolled conditions
8	*End-users/ beneficiaries (rare)*	The innovation is used by some end-users or beneficiaries who were not involved in the initial innovation development	*Uncontrolled testing*	The innovation is being tested for its ability to achieve a specific impact under uncontrolled conditions
7	*Unconnected next-user (common)*	The innovation is commonly used by organizations not connected to partners involved in the initial innovation development	*Prototype*	The innovation is validated for its ability to achieve a specific impact under semi-controlled conditions
6	*Unconnected next-user (rare)*	The innovation is used by organizations not connected to partners involved in the initial innovation development	*Semi-controlled testing*	The innovation is being tested for its ability to achieve a specific impact under semi-controlled conditions
5	*Connected next-user (common)*	The innovation is commonly used by organizations connected to partners involved in the initial innovation development	*Model/ early prototype*	The innovation is validated for its ability to achieve a specific impact under fully-controlled conditions
4	*Connected next-user (rare)*	The innovation is used by some organizations connected to partners involved in the initial innovation development	*Controlled testing*	The innovation is being tested for its ability to achieve a specific impact under fully-controlled conditions
3	*Partners (common)*	The innovation is commonly used by partners involved in the initial innovation development	*Proof of concept*	The innovation's key concepts have been validated for their ability to achieve a specific impact
2	*Partners (rare)*	The innovation is used by some partners involved in the initial innovation development	*Formulation*	The innovation's key concepts are being formulated or designed
1	*Project lead*	The innovation is used by the organization(s) leading the innovation development	*Basic research*	The innovation's basic principles are being researched for their ability to achieve a specific impact
0	*No use*	The innovation is not used	*Idea*	The innovation is at idea stage

In the process of Scaling Readiness assessment, a key aspect is Diagnosing, identifying the bottleneck within the complementary innovations. The bottleneck is essentially the complementary innovation that receives the lowest Scaling Readiness Score. This concept aligns with Liebig's law of the Minimum, which asserts that growth is limited by the scarcest resource or factor. This is illustrated in Figure 3 (Sartas, et al., 2020).

Understanding and addressing the bottleneck is crucial for achieving sustainable and impactful outcomes when scaling innovations. It ensures that all aspects of the innovation package are optimized for the specific context, allowing for a focused allocation of resources and efforts. This ultimately increases the likelihood of successful scalability and positive impact on the intended beneficiaries and Sustainable Development Goals (SDGs).

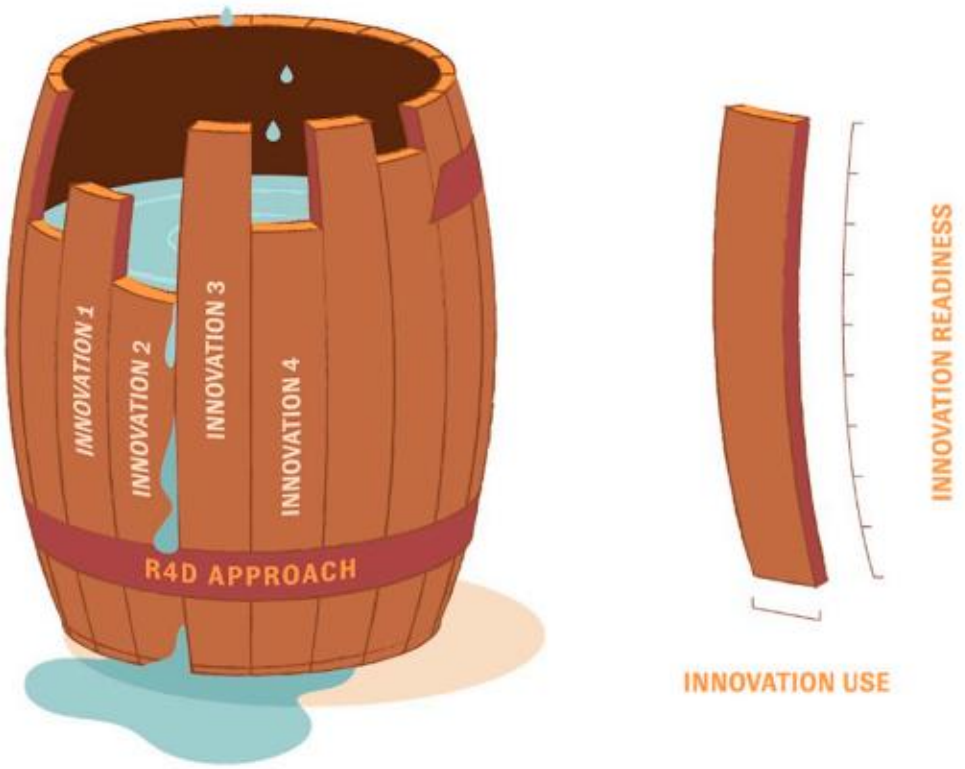

FIGURE 1: LIEBIG'S BARREL ANALOGY OF THE LAW OF THE MINIMUM DEPICTED HERE IN THE CONTEXT OF SCALING READINESS

Scaling Readiness Assessment of the Innovation

Characterizing

Scaling Ambition:

To enhance farm productivity through increased farm mechanization with the small seed cleaning unit, on small to medium sized farms in North Africa.

Core innovation:

A mechanical intervention to decrease workload and improve seed production and crop yields.

Complementary innovations and solutions:

- The small-scale seed cleaning unit
  A machine that cleans and treats the seeds with fungicides, making manual cleaning unnecessary.

- Farmer cooperations
  An arrangement between farmers to use the machine jointly and share costs.

- Scaling and knowledge hubs
  A self-sustaining and self-learning location where farmer cooperatives learn to use and maintain the machine and share the knowledge, together with other stakeholders (such as ICARDA, the manufacturer, OEP, INRAT).

- Local manufactory
  The machine is locally produced to improve local value chain and make after-sales services easier.

- After sales services
  Process of improving the machine, but also to perform repair and maintenance services.

- Access to credit
  As the seed cleaning unit is relatively expensive (about 7,000 US$) for small scale farmers and their associations, credit access provided by MFI are necessary.

- Governmental subsidies for machine purchase
  Expensive machines need to be subsidized by governmental programs to enable poor farmers to purchase the machine.

- Sensitization

Farmers in the countries need to be sensitized about this technology and the existence of such machines and manufacturers.

- Schooling through inclusion in national curricula
  National agricultural training institutions should include this technology in their specific mechanization curricula.

The innovation package:

To increase farm productivity and decrease workload for small to medium sized farms in North Africa, through the introduction of small-scale cleaning machines and the creation of farmer cooperatives.

Diagnosing

The following tables show the complementary innovations, the rationale for their use and readiness, their scoring within the context of the innovation package, and the evidence that supports their scoring.

Innovation Use

Complementary innovation	Rationale	Sources	Use Score
Seed Cleaning Unit	Machine is used by cooperations that are directly related to the project. According to the producer the machine is also sold to people outside the project, implying score of 8.	(Rudiger, et al., 2021) (Rudiger & Zaiem, 2020) (Frija A. , et al., 2022) (Idoudi, et al., 2020)	8
Farmer cooperations	Cooperations for the use of the machine were established during the project. Outside the project, farmer cooperations with other purposes, are formed with support of national organization.	(Rudiger, et al., 2021) (Frija A. , et al., 2022)	8
Scaling and knowledge hubs	This approach is used within the project, but also in other projects, but only in ICARDA projects.	(Frija & Idoudi, 2020) (Rekik, et al., 2020) (Frija A. , et al., 2022) (Idoudi, et al., 2020)	4
Local manufactory	Seed cleaning unit is locally produced, and local manufactories also make other machines. The machine is on the market, available for all potential end users, outside the project.	(Rudiger, et al., 2021)	8
After sales service	This is performed by local manufacturers. As an example, a conveyor screw was added to the machine as enhancement.	(Rudiger, et al., 2021) (Rudiger & Zaiem, 2020)	8
Access to credit	Outside the project, there is no access to credits for farmers to create cooperation, hubs, and purchase machines. However, in general there are e.g., micro finance schemes available. Since there is access to credit but not specifically for agricultural machinery, a score of 6 is given.	(Dhraief, et al., 2018) (OECD, 2012)	6
Machine subsidies	There are no governmental subsidies for the agricultural machine investments, but not along with investments for forming farmer cooperations.	(Rudiger, et al., 2021) (APIA, 2022)	5
Sensitization	The conscious of relevant stakeholders and actors about the innovation package. Now, only some direct users/partners are aware.	(Dhraief, et al., 2018)	2
Schooling (for capacity building)	Capacity is built through trainings within the project, but for sustainable and large-scale uptake, it would be good if this technology is included in national curricula, but this is not the case.	(Rudiger & Zaiem, 2020) (Workshop with beneficiaries, 2020) (Dhraief, et al., 2018)	1

Innovation Readiness

Complementary innovation	Rationale	Sources	Readiness Score
Seed Cleaning Unit	Machine has shown to be beneficial and economically viable, although there are some (ongoing) modifications made (e.g., the conveyor screw).	(Rudiger, et al., 2021) (Rudiger & Zaiem, 2020) (Frija A. et al., 2022)	8
Farmer cooperations	Farmer cooperations are working, but with support from the project. However, cooperatives (for other purposes) are introduced and trained outside the project.	(Rudiger, et al., 2021) (Frija A. et al., 2022) (AVFA, 2022)	7
Scaling and knowledge hubs	The approach makes impact, but its sustainability still needs to be validated.	(Frija & Idoudi, 2020) (Rekik, et al., 2020) (Frija A. , et al., 2022)	4
Local manufactory	The machines are produced locally and currently with minimal support from the project.	(Rudiger, et al., 2021)	8
After sales service	After sales have proven to work (e.g., conveyor screw)	(Rudiger, et al., 2021) (Rudiger & Zaiem, 2020)	9
Access to credit	Access to credit is crucial for investments in this innovation consequently its adoption, and this (e.g., micro-finance) is available in Tunisia. However, not specifically related to seed cleaning unit along with hubs and farmer cooperations.	(Dhraief, et al., 2018) (APIA, 2022)	7
Machine subsidies	In the project, farmer cooperatives had to pay half of the machine and the other half was paid by the project. This showed that subsidies were effective, however for sustainable grow and scaling, subsidies outside the project are needed (e.g., governmental).	(Rudiger, et al., 2021)	8
Sensitization	The project has undertaken activities to sensitize, but it was in a controlled environment and not validated.	(Dhraief, et al., 2018)	3
Schooling (for capacity building)	Capacity is effectively being built within the project. However, to be effective outside the project, farmers (or people in general) should be informed which can be done through schooling. This is not yet the case.	(Rudiger & Zaiem, 2020) (Workshop with beneficiaries, 2020) (Dhraief, et al., 2018)	2

Scaling Readiness Scores

Figure 5 shows a scatter plot of Innovation Use and Innovation Readiness for the complementary innovation. When the Innovation Use and Innovation Readiness scores are multiplied, the Scaling Readiness Score is calculated. This is summarized in figure 6.

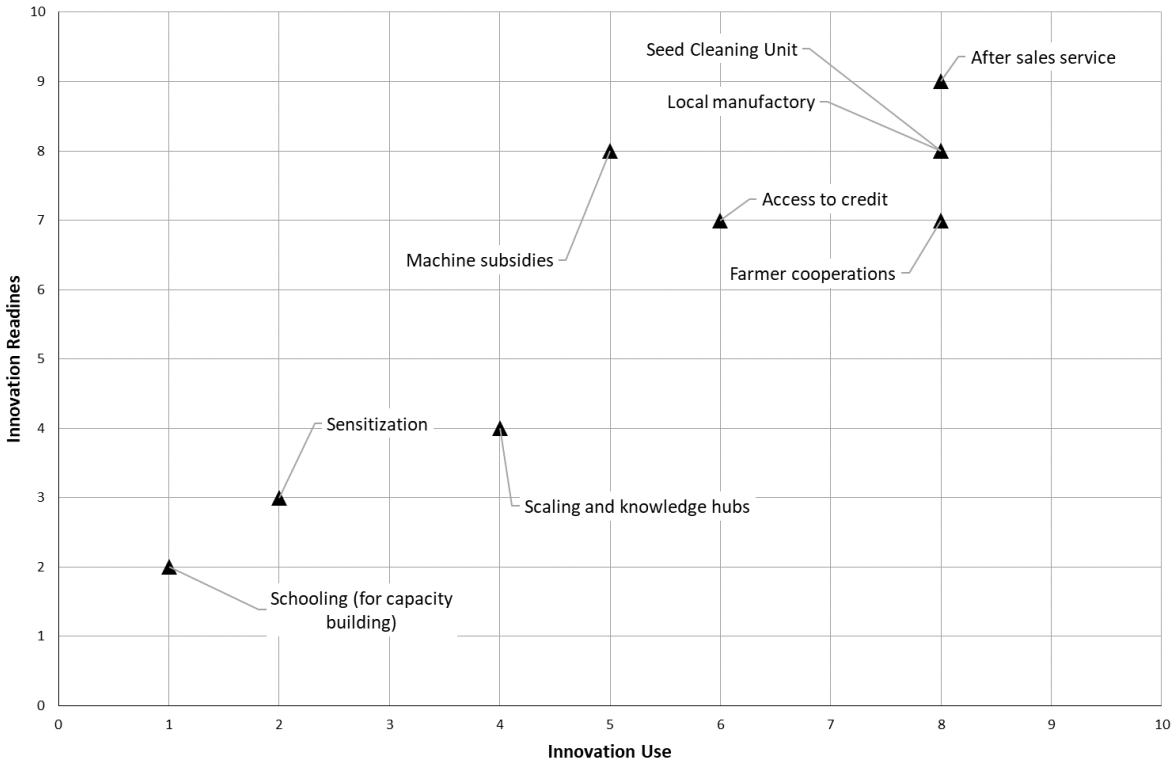

FIGURE 2: SCATTER OF DIAGNOSIS SHOWING THE INNOVATION USE SCORES PLOTTED AGAINST INNOVATION READINESS

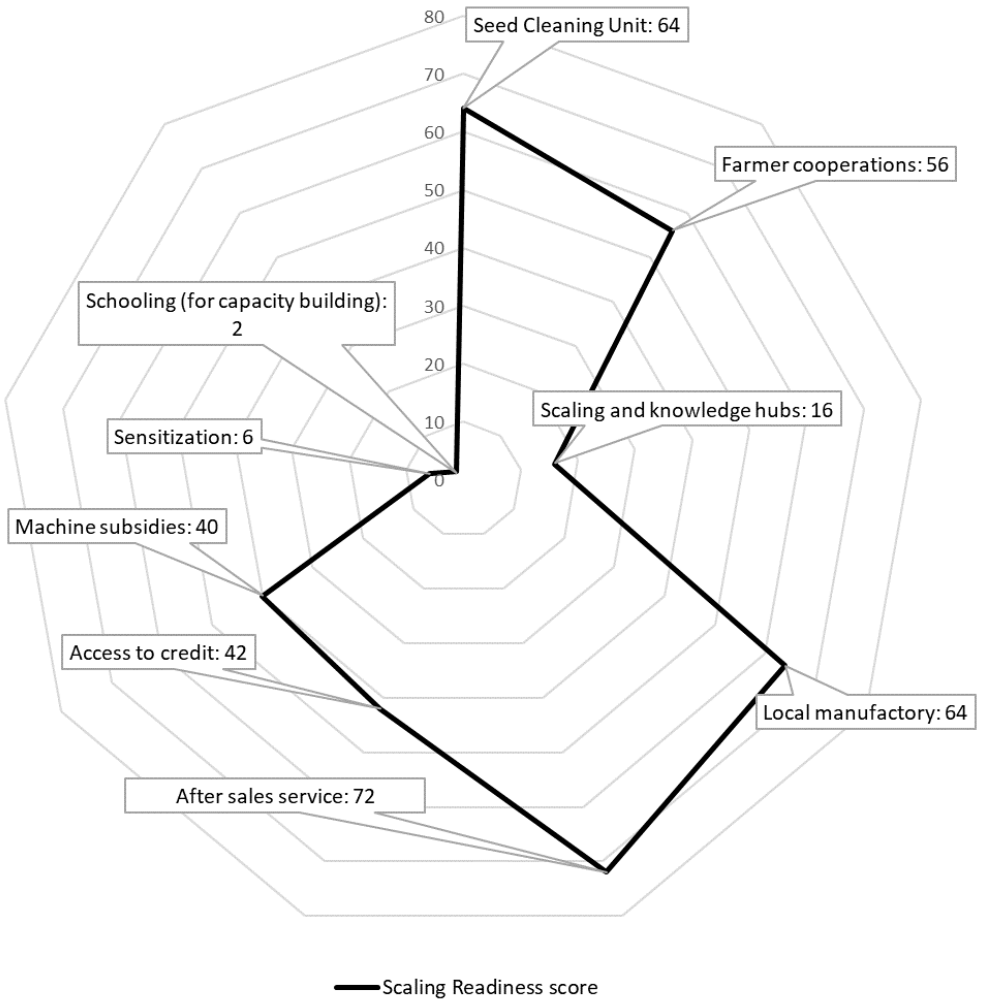

FIGURE 3: RADAR GRAPH OF THE SCALING READINESS SCORES OF EACH COMPLEMENTARY INNOVATION

Discussion and Recommendations

This document presents an exploratory Scaling Readiness assessment and valuable observations and recommendations can be drawn from this assessment:

- Looking at the complementary innovations, there is a strong foundation on the technical side, which includes local manufacturing, the seed cleaning unit, and after-sales service. This technical side is well established due to past successful projects and partnerships.
- However, less included in these projects were, for example, the use of (governmental) subsidies to purchase the machines, improving access to credit, and the schooling of farmers. This has resulted in lower levels of Innovation Use and Innovation Readiness. Farmer cooperatives, scaling, and knowledge hubs are moderately established but still require validation and wider use. Improving these complementary innovations could enhance scalability of the innovation package.
- Increasing the Innovation Readiness of the farmer cooperatives and the hubs is more challenging and is related to its low Innovation Readiness due to factors such as machine subsidies, schooling, and access to credit. To increase Innovation Use, unrelated end-users need to be aware of the innovation, and it must become accessible and affordable for them.
- Schooling could be crucial in this scenario; thus, improving schooling will likely improve overall use. However, this is not validated and proven (low Innovation Readiness), so when investing in schooling, this should be kept in mind. In parallel, alternatives can be considered, such as advertising over radio, Social Media, farmer field schools, or advertising in existing market channels (e.g., at tractor sales or seed markets).
- Furthermore, the machines are too expensive for a single farmer or small farmers' cooperative; hence, machine subsidies are needed to make them affordable. These subsidies have proven successful in past projects, but outside of the projects, subsidies for the seed cleaning unit are non-existent. This low use could be caused by the fact that the government is not aware of the innovation. Therefore, governmental sensitization would be necessary. Alternatively, access to credit by farmer cooperatives can be improved to enhance affordability. This may be less effective than subsidies but is also less costly, which might explain the current higher use. A combination of subsidies and access to credit is also an option.

To conclude, the foundation of the innovation package (the machine, local manufacturing, and after-sales service) has been well established. The task now is to improve the management side of the package, such as establishing farmer cooperatives (or linking existing cooperatives to the technology) and knowledge and scaling hubs. Once these have been well established and validated, similar to the machine and local manufacturing, resources can be invested in improving awareness, accessibility, and affordability through (potentially) schooling, access to machine subsidies, and credit. Sensitization activities via Social Media / Mass Media and field days could also help in scaling this technology. Shared documented business cases could show the benefit of this technology for farmer organizations.

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