

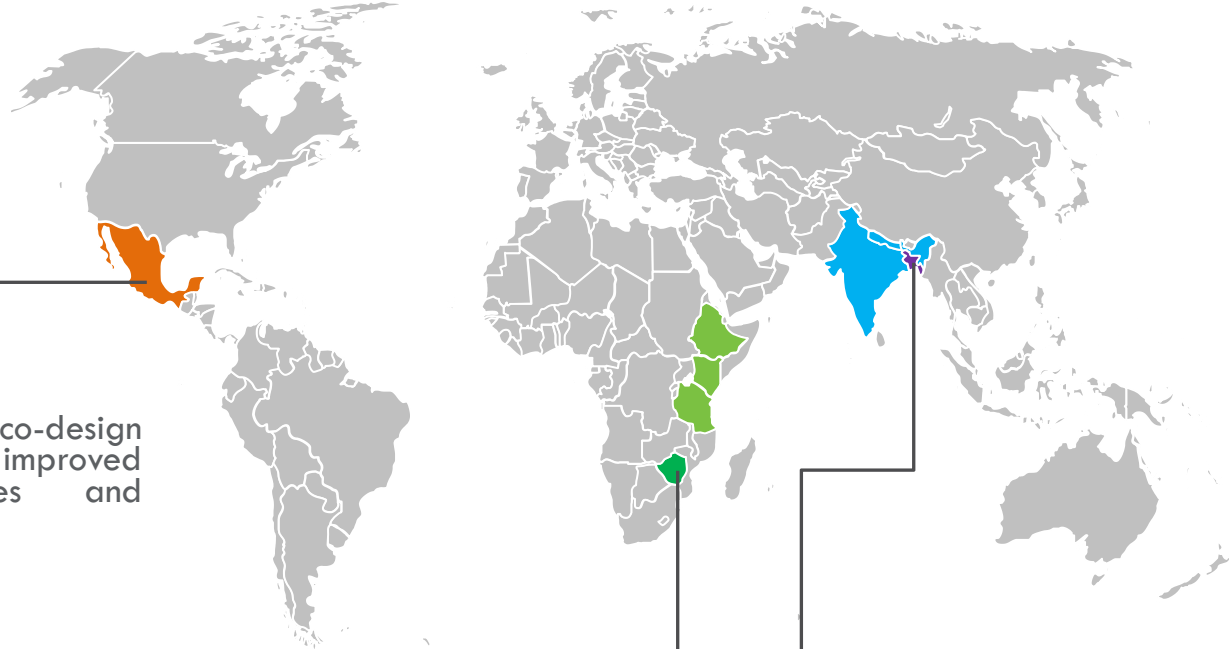


SCALING AGRICULTURAL MECHANIZATION SERVICES IN SMALLHOLDER FARMING SYSTEMS

CASE STUDIES FROM SUB-SAHARAN AFRICA, SOUTH ASIA, AND LATIN
AMERICA

Jelle Van Loon

CROSS-REGIONAL WORK ON MECHANIZATION CONSERVATION AGRICULTURE AND SUSTAINABLE INTENSIFICATION



MasAgro

'Innovations hubs' to co-design and co-implement improved agricultural practices and technologies

RURAL21 Focus

A round tour of mechanisation

What is mechanisation like in different world regions? Which challenges do farmers face in Latin America, sub-Saharan Africa and South Asia? Jelle Van Loon, Frédéric Baudron and Timothy Krupnik, working for the Global Conservation Programme, headed by Bruce Gerard, at the International Maize and Wheat Improvement Center (CIMMYT), give accounts of their experiences.



Jelle Van Loon is based in CIMMYT Mexico. He leads the machinery and mechanisation unit based on agricultural analysis of farm machinery and tools. It involves the evaluation of new or better machinery, construction and operation of motor, multifunctional equipment required to various farmer's needs.



Frédéric Baudron is working for CIMMYT in East and Southern Africa, based in Ethiopia. He got into mechanisation field from a farming system project, realising that people were not using tools to the productivity of many farms in Africa, as much as good seeds and feeders.



Timothy Krupnik leads CIMMYT's research on agricultural mechanisation in Bangladesh and contributes to mechanisation research and a strong work in Indonesia.

Round the globe, Frédéric and Timothy, you work in very different regions throughout the world. What is the level of agricultural mechanisation like in these regions, and what impact does it have on day-to-day farm work?
Jelle Van Loon: Mechanisation levels vary a lot within Mexican borders. In rough terms, the northern states are dominated by big farms with highly advanced machinery and irrigation systems, moving southwards, the gradually changes and farms less advanced farming with traditional hand tools in the most southern states. In between, there is a mix of medium-sized farmers using small two-wheel tractor and smallholder farmers using animal-drawn tools

or working with hand ploughs. Large farmers look for high-precision tools for large fields, while medium and smallholder farmers are stuck between the choice of investing in machines or hiring services. Service providers to medium and smallholder farmers usually lack modern equipment, and so those farmers have limited access to appropriate services. Small tools are in high demand in those farmer groups and include manual equipment, animal drawn implements and small motorised machines, including two-wheel tractor. Substantial farmers rely greatly on non-motorised tools, and here attention should be on functional design and ergonomics, but most importantly on durable solutions.

Frédéric Baudron: In the past decades, both the number of tractors and the number of draught animals have been stagnating – or even declining – in sub-Saharan Africa (SSA). The reason that SSA smallholder agriculture is increasingly relying on labour – that is human muscle power. We see labour shortage becoming an issue. This stems from rural-urban migration, an ageing rural population, off-farm income opportunities and the consequences of climate change. Today, more than 50 per cent of the cropland in East and Southern Africa is cultivated by hand. Tractors are only used on 20 to 25 per cent of the cropland, and on less than 10 per cent in Western and Central Africa. The history of mechanisation in Africa has been dominated by 'tractorisation' – that is the promotion of tractors with four wheels and two axes – through government-run lending schemes, since the 1950s or 1960s. Most of these schemes collapsed in the 1990s. Appropriate mechanisation was an interesting alternative movement during the 1970s and 1980s. Small machines are probably more appropriate in the small and fragmented fields of most African farmers and more affordable than large ones. The main problem was that these machines were developed without understanding the demand – no involvement of farmers during the R&D – and with no consideration of their contribution – i.e. no involvement of the private sector during the R&D.

Timothy Krupnik: Much of South Asia is already highly mechanised, with over 500,000 two-wheel tractor in Bangladesh alone (although they are used primarily for tillage), 1.6 million irrigation pumps, and over 250,000 threshers. This makes a great platform to build on as farmers are quite familiar with mechanisation. We focus on more efficient and effective use of machines, especially with respect to agronomic aims like introducing line sowing by seeders that can be attached to two-wheel tractor, or conservation agriculture practices. In South Asia, we are witnessing a transition

FACASI

'Markets for the poor' approach to stimulate small-scale farm mechanization, improving farm power balance

CSISA-MI

'Joint venture agreements' supporting emerging service providers to scale out farmers' access to surface water irrigation and appropriate agricultural machinery

Rural 21 – 2015
<https://bit.ly/3jFBHof>



PURDUE SCALE-UP CONFERENCE 2018

INNOVATIONS IN AGRICULTURE SCALING UP TO REACH MILLIONS

Scaling appropriate agricultural mechanization worldwide: two-wheel tractors and smallholder farmers

Large-scale adoption of the technology can aid smallholder farmers to become more **competitive** and more **responsive** to changing environment

- Professionalize farming through skilled labor, value chain integration and tailored financial services

Adaptable business models and value chain facilitation to generate **push and pull** towards movement for adoption

- Tensions between groups and need to align business cases

Two-wheel tractor smallholder farmers can become **scale-catalysts** offering mechanized and affordable services enabling rural transformation

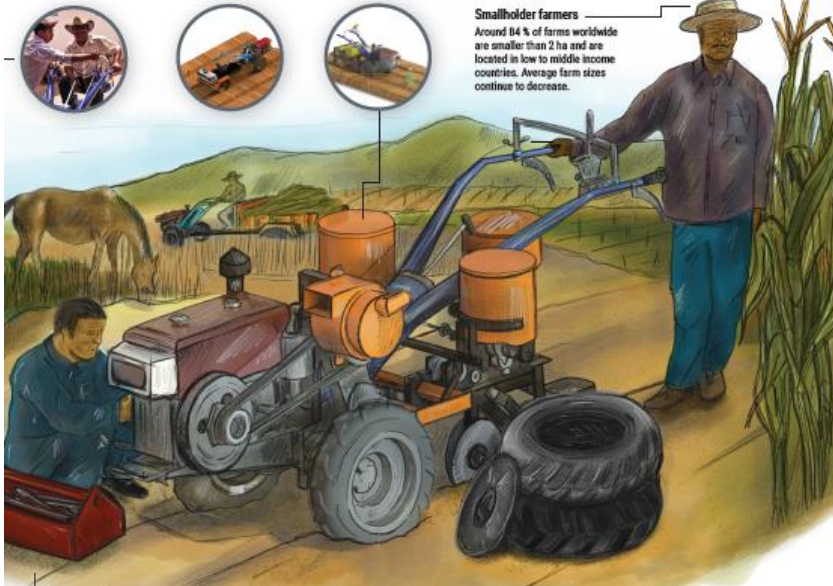
- Critical role of strategic collaboration and position brokers to reach optimal scale

Scaling ambition

Precision and fee-for-services
Small scaled equipment can reduce drudgery and create opportunities for entrepreneurship within the farming system. Two-wheel tractors can in this sense enable rural transformation.



Large-scale adoption of 2WTs can aid smallholders farmers globally to become more competitive. The technology can enable more precise farm operations and can be used in combination with resilient crop management practices. 2WTs also provides business opportunities in rural areas through mechanized service provision. CIMMYT's Sustainable Intensification program focuses on these issues across Latin America, East and Southern Africa, and South and South East Asia.



Smallholder farmers
Around 84 % of farms worldwide are smaller than 2 ha and are located in low to middle income countries. Average farm sizes continue to decrease.

What does impact look like?



Anticipated positive impact and potential benefits

Anticipated negative impact and potential risks

PURDUE SCALE-UP CONFERENCE 2018

INNOVATIONS IN AGRICULTURE SCALING UP TO REACH MILLIONS

Understanding mechanization in the perspective of scaling efforts

Technology: What are challenges and opportunities for scaling multifunctional innovations?

Finance: What are challenges and opportunities for scaling innovations that require a shift from low investment- high operational costs to high investment- low operational cost?

Policy: What are challenges and opportunities for scaling innovations that are popular to benefit from subsidies?

➤ Scaling spatially and temporally-defined packages to achieve outcome at scale

Mechanization options,
adapted to local conditions

➤ Bottlenecks for scaling often non-technological nature



SCALING AGRICULTURAL MECHANIZATION SERVICES

CASE STUDIES FROM MEXICO, ZIMBABWE AND BANGLADESH

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Scaling agricultural mechanization services in smallholder farming systems:
Case studies from sub-Saharan Africa, South Asia, and Latin America



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Agricultural Systems Special Issue: Science of Scaling

- connecting the pathways of agricultural research and development for improved food, income and nutrition security
- study scaling of agricultural innovation retrospectively as part of long-term transition processes and as part of short-term scaling interventions, while introducing methodologies and tools that can support more impactful scaling of innovations

Mechanization Service Provider Models to improve smallholder farmers' access to appropriate mechanization

- *Understand sustainability and transformative nature of interventions*
- *Assessment of scaling success to understand impact of project design and environment and context of interventions areas*
- *Do interventions fit with needs of environment to enable sustained use of machinery by farmers at a large scale ?*
- *How can apparent success at an intermediate, on-going point in a projects lifetime be assessed to identify critical aspects of needed exit strategies ?*

Van Loon, J., Woltering, L., Krupnik, T.J., Baudron, F., Boa, M. and Govaerts, B.
2020. Scaling Agricultural Mechanization Services in Smallholder Farming Systems:
Case Studies from Sub-Saharan Africa, South Asia, and Latin America. *Agricultural
Systems* 180: 102792. [<https://doi.org/10.1016/j.agsy.2020.102792>]

MECHANIZATION SERVICE PROVIDER MODELS

CASE STUDIES FROM MEXICO, ZIMBABWE AND BANGLADESH

Mexico

Machine Hire Centers

- Farmers association representatives, farm advisors, rural entrepreneurs
- Small to medium scale cereal-based farmers (~0-20 ha)
- Minimum infrastructure, logistics capability, initial client base
- Accessories for four-wheeled and two-wheeled tractors, animal-drawn and manual equipment including seed drills, fertilizer, and land preparation equipment
- Machines are provided and owned by *MasAgro* without direct ownership by service providers

Zimbabwe

Complementary income service providers

- Medium-sized farmers, rural entrepreneurs
- Smallholders farmers (~0-10 ha)
- Initial purchase power, no initial infrastructure or equipment required, no client base
- Machine services as complementary income for existing service providers
- Two-wheel tractors and accessories and/or shellers of various sizes
- Owned by individual or group, pay 10% and remaining 40-90% over 3 years

Bangladesh

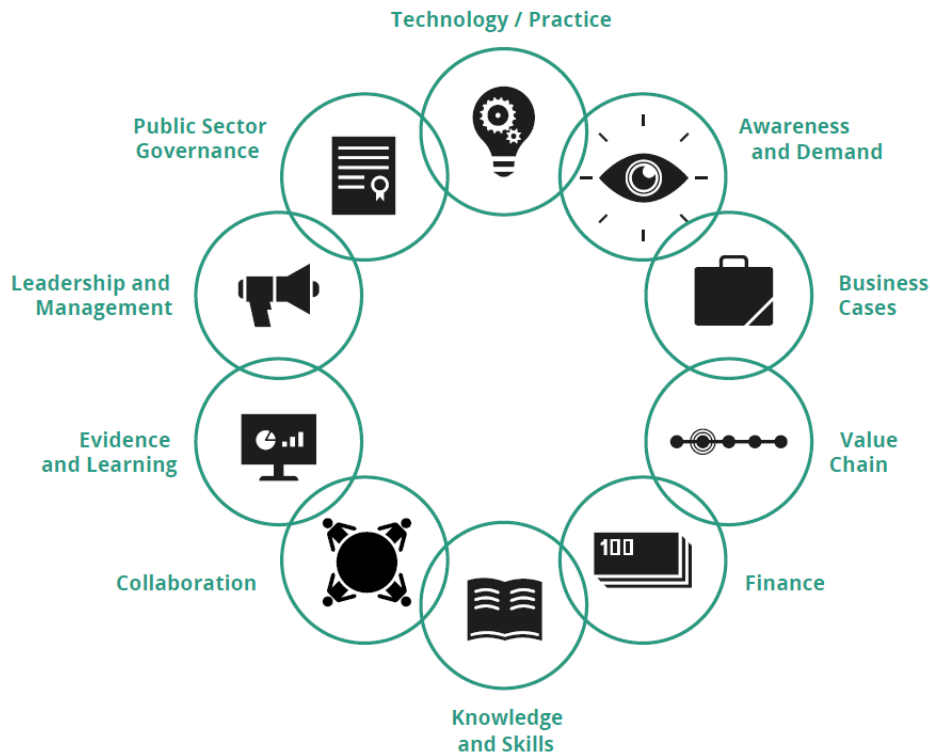
Expansion of service provider businesses

- Individual farmers with experience and/or ownership of two-wheel tractors or multipurpose engines
- Smallholder farmers (< 1 ha on average)
- Initial purchase power, credit worthiness, potential to serve smallholder farmer clients
- Two-wheel tractor seed and fertilizer drill attachments, attachable and self-propelled reapers, axial and mixed flow irrigation pumps, small multi-crop reaper-binders and combines
- Owned by individual service providers



SCALING SCAN

SCALABILITY ASSESSMENT TOOL



Ten scaling “ingredients” and 4 tactical questions per ingredient

- Semi-quantitative assessment to ‘gaps’ with reality on the ground
- Enables to identify bottlenecks and potential leverage points to reach scale and sustained adoption of the innovation

Technology/Practice - The Mechanization Service Provider Model should be relevant, compatible, easy to adopt, and better than alternatives that address the problem of the target population

Awareness & Demand - Farmers, service providers, and machinery companies should be aware of the technologies and service provider arrangements and demand their use

Business Cases - Attractive financial/economic propositions for companies, service providers, and other actors should be in place to respond to the demand for mechanization service providers

Value Chain – Effective links between value actors should exist for them to pursue the business cases for mechanization and service providers

Finance – Effective and low-risk financing options for users and other value chain actors should be available

Knowledge & Skills - Individual- and institutional-level capacity should be sufficient to use, adapt, and promote the innovation

Collaboration - Strategic collaboration within and beyond the sector is required to scale machinery and service provider businesses beyond the project context

Evidence & Learning - Evidence and facts (data, scientific insights) are available to underpin and help gain support for the pursuit of the scaling ambition

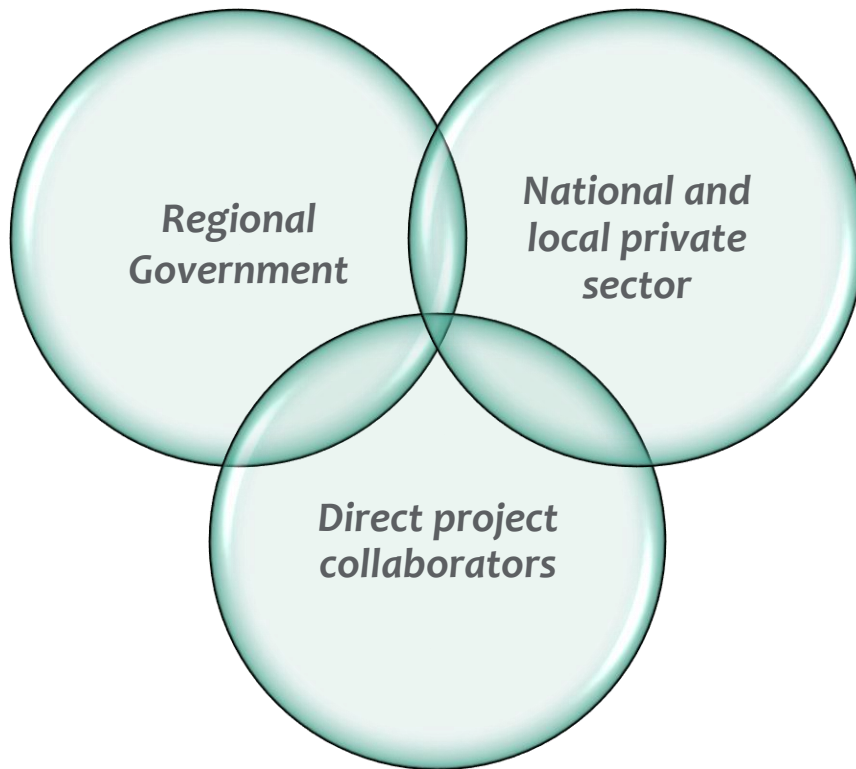
Leadership & Management- Effective coordination and navigation of the scaling process by machinery and service provider “champions” and brokers help propel scaling forward

Public Sector Governance - Government support and/or lack of prohibitive policies are necessary to achieve the scaling ambition

Jacobs, F., Ubels, J., Woltering, L., 2018. The scaling scan: A practical tool to determine the strengths and weaknesses of your scaling ambition. <https://bit.ly/34ubWS4>

SCALING SCAN

REPRESENTATIVE STAKEHOLDER SAMPLE GROUP



Workshop per region minimum 3 representatives per stakeholders group

Country level vs. Sample group scaling assessment

*No farmers or service providers included**

- *Zimbabwe evaluated mechanization service businesses offering **planting** or **shelling**, due to inherent different dynamics and perceived progress*
- *Project leaders answers are reference benchmark*

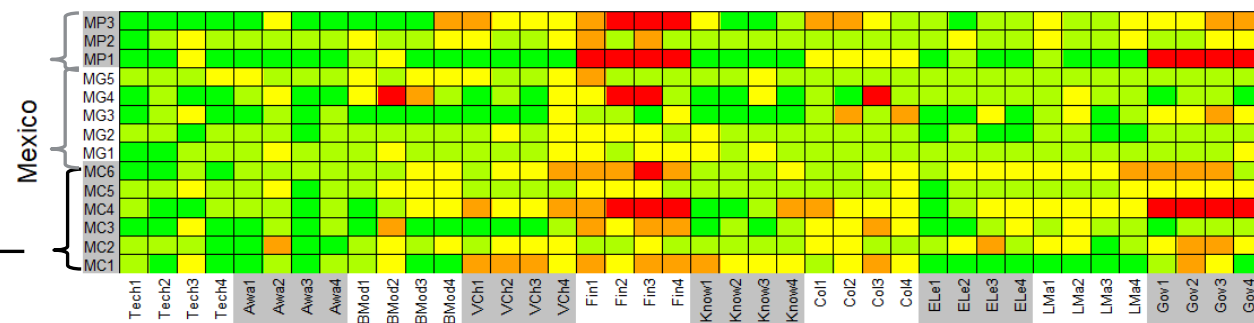
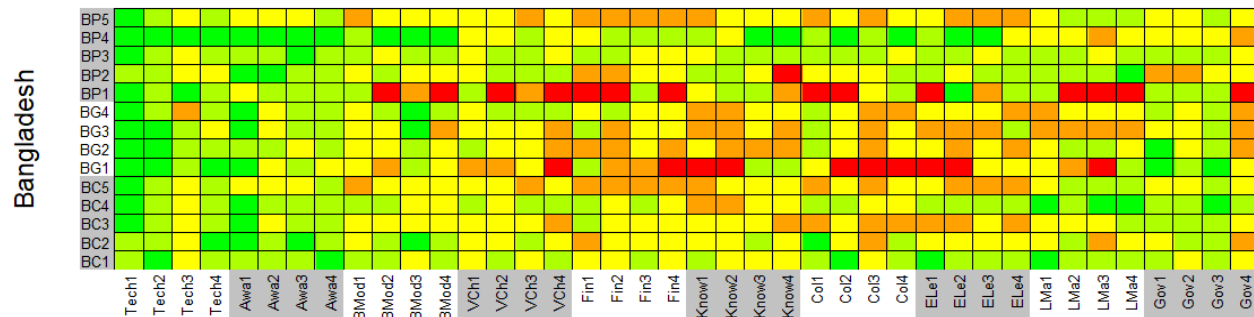


INDICATOR SCORES PER INGREDIENT

MECHANIZATION SERVICE PROVIDER MODELS

➤ Individual score vs. average indicators score per ingredient

➤ Fluctuations across countries and participants are expected, objective is to reveal **critical issues** that need to be dealt to induce a favorable scaling environment



Sample groups

Technology/Practice

Scaling Ingredient Questions

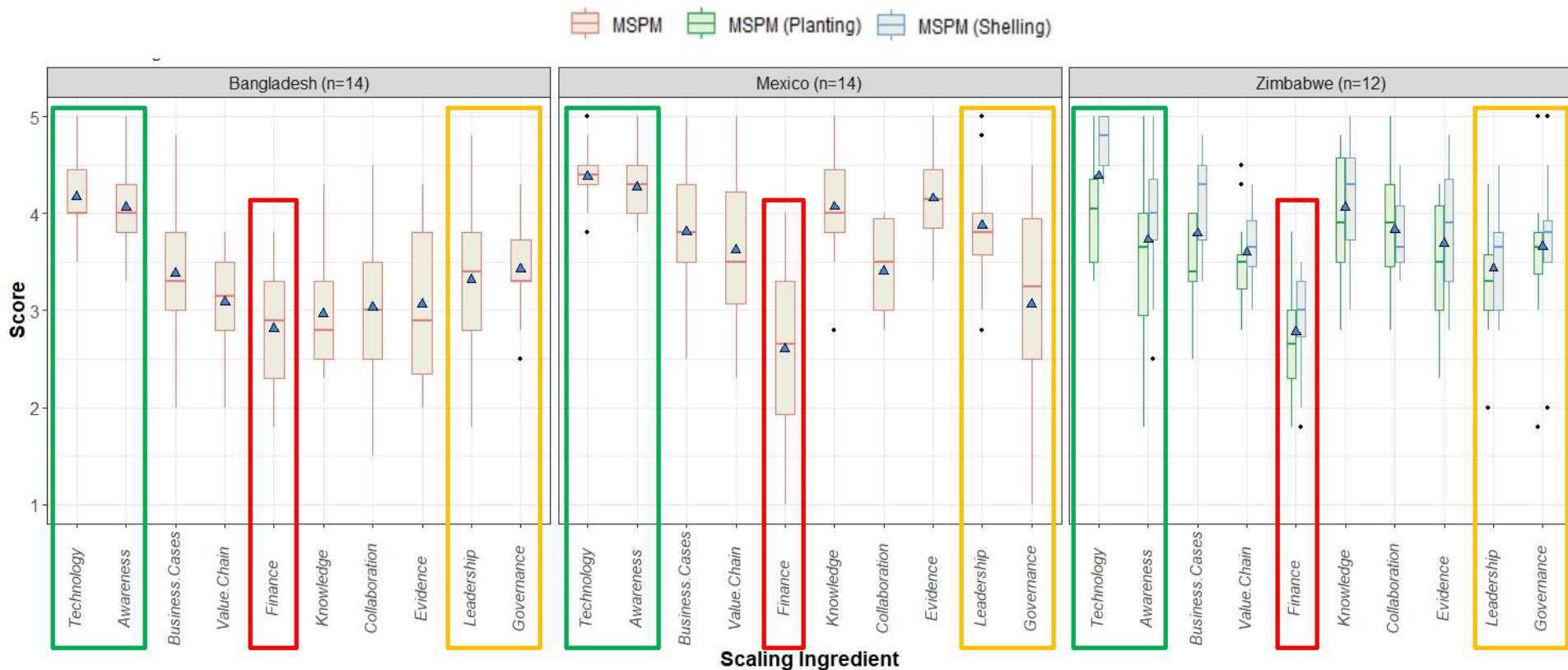


1 = poor status (red)
5 = very conducive to scaling (green)



CROSS-REGIONAL SCALING ASSESSMENT

MECHANIZATION SERVICE PROVIDER MODELS



1 = poor status
5 = very conducive to scaling



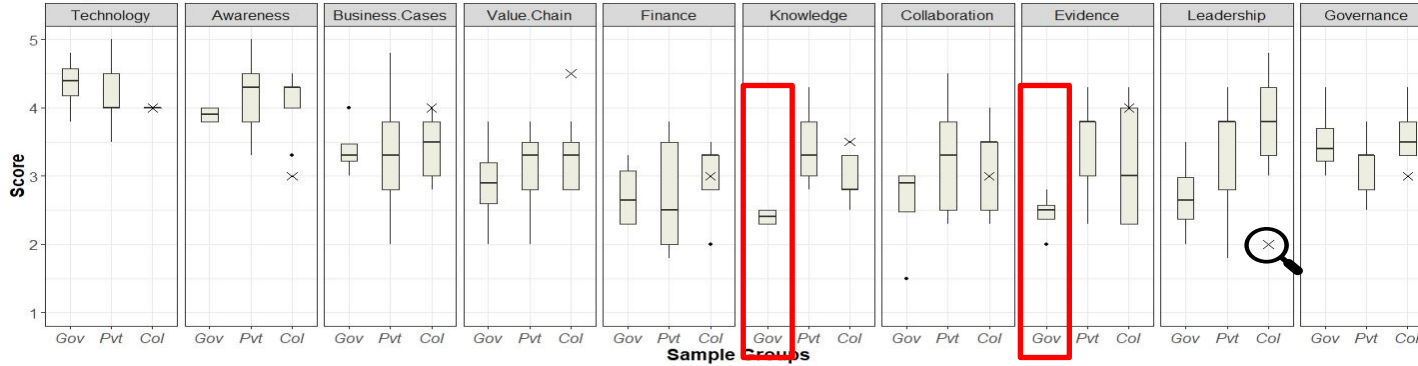
Averages ingredients scores are indicative values to understand **overall tendencies** and **address motivations between different perceptions** among sample groups



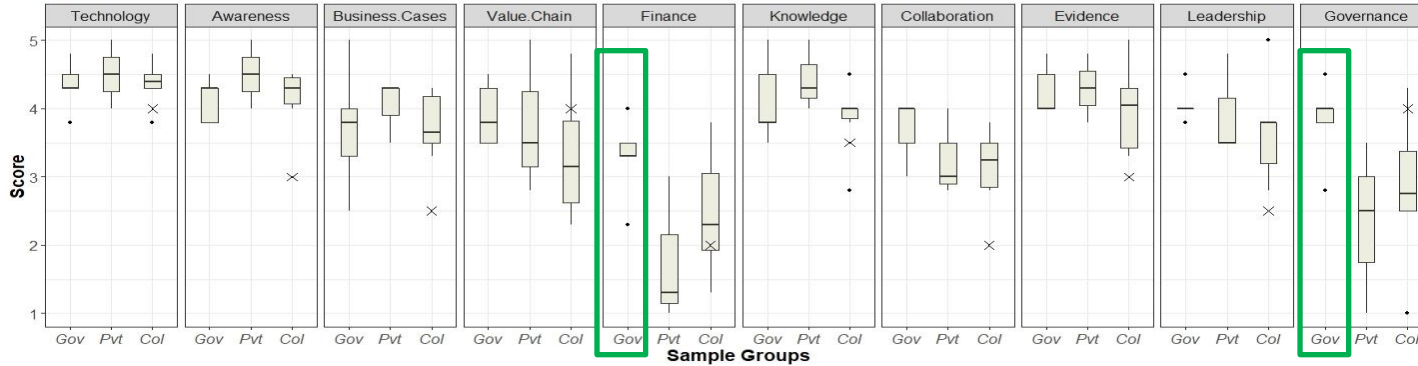
SAMPLE GROUP RESPONSES

MECHANIZATION SERVICE PROVIDER MODELS

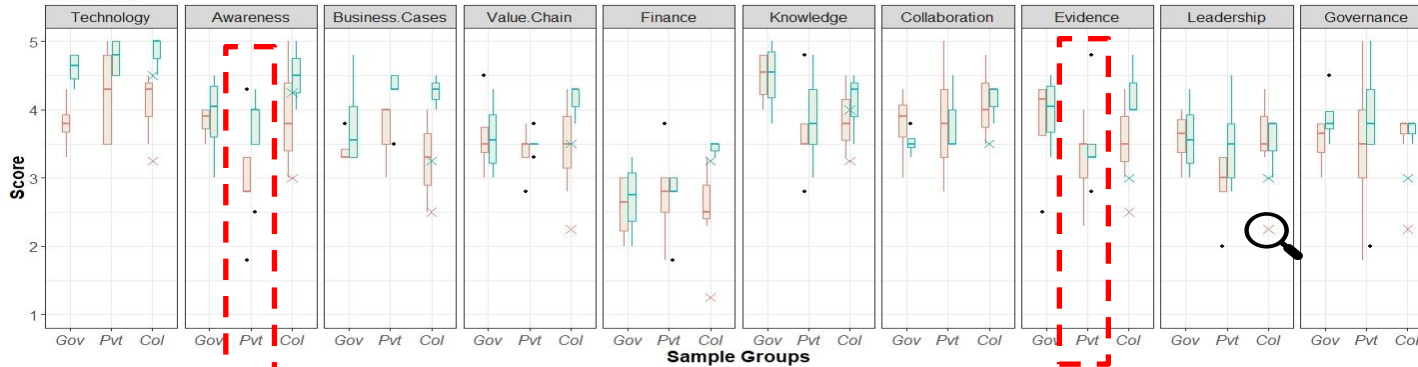
Bangladesh



Mexico



Zimbabwe



MSPM
 MSPM (Planting)
 MSPM (Shelling)

INGREDIENT SCALABILITY ASSESSMENT

MECHANIZATION SERVICE PROVIDER MODELS

Technology & Practice

Least inhibiting to scaling, but access to information and effective communication are in general largely reliant on projects

Bangladesh is exception as deliberate action is undertaken to link interventions with existing machinery platforms and service provider arrangements

Business cases



*Shelling in **Zimbabwe** scored higher, specific case where technology outweighs the provision mechanism*

***Mexico** high score, but danger of misconception that business is only about finding customers*

Mechanization Service Provider Models as organizational innovation to make mechanization service accessible and affordable for smallholders farmers.

***Conducive to scaling** since alternatives less appropriate or efficient, but adopting MSP business requires technical and business skills*

Awareness & Demand

*MSPM can stimulate entrepreneurship opportunities for machinery value chain actors, but attractive financial and economic propositions are **prerequisite for successful scaling***

Farmers can reduce drudgery and productions costs, MSP can generated income if enough clients year-round at limited distance, dealership if new market segment can be gained

Value Chain

Access to low-risk finance is important bottleneck to enter into service provider arrangements. Poor client information and lack of collateral hinder development of financial products adapted to agriculture.

Bangladesh is exception due to rural micro-lendings services but difficult for more expensive equipment. Need for prolonged engagement to turn farmer-clients into professional service providers

Collaboration

MSPs require knowledge and skills in effective operation of farm machinery and managing a business. All case studies deploy training material and provide capacity strengthening but in diverse formats and at different levels.

Critical to look for solutions to overcome expensive and time-consuming training activities through building improved national extensions services, after sales services and vocational curriculums

High dependency on equipment suppliers and development of business skills. Because of **poor self-organization** of value chain actors, CIMMYT actively brings stakeholders together. Trade barriers, low populations density can negatively affect efforts to increase supply.

Finance

In all cases CIMMYT **actively brokers and facilitates collaborations** among extension services, research partners and governmental or local development programs. Collaboration with active participation of financial or marketing services are crucial but weak.

Especially in Bangladesh the lack of mechanisms to have organized associations to learn from each other is considered a major bottleneck to scaling

Knowledge & Skills



Data and information is **actively used to facilitate scaling** processes, including analysis of geospatial information, to match machinery with cropping systems and measure progress of implementation. Results indicate exponential growth over projects lifespan.

Leadership & Management

Evidence & Learning

MSPM benefit from leaders who position machinery in a broader context, as part of climate smart and/or sustainable intensification practices. Government hosts often support mechanization projects in this sense, but hesitate to lead the scaling efforts.

Sample groups results indicate directly involved value chain stakeholders lack incentive to coordinate sustained scaling efforts **suggesting a need for continued effort** to make appropriate mechanization more appealing.

Public Sector Governance

All governments recognized that mechanization is **crucial for rural development** and in each case study country interaction with agricultural ministries takes places.

Continuity on implementation of agricultural mechanization policies as governments change and **adequately rolling out financing mechanisms** are perceived critical for scaling.



SCALING AGRICULTURAL MECHANIZATION SERVICES

CONCLUSIONS

All 3 studied Mechanization Service Provider Models have potential to catalyze a service economy around agricultural mechanization driven by private sector

- *Each project was partly successful to develop a model to be suitable to the operating context and with evidenced potential to grow beyond the project boundaries.*
- **Common strengths**
 - *Focus on technical and entrepreneurial capacity development, supported by geospatial and market data*
 - *Active stakeholders engagement successful in leveraging interest of local governments for continued efforts*
 - *MSPM regarded as relevant and better than alternatives*
- **Common obstacles**
 - *Few solutions to transition from project to market finance to sustainable facilitate machinery purchases*
 - *Supply inadequately keeps up with demand for consistently high-quality mechanization services*
 - *Large project dependence to establish exchange and learning platforms*



SCALING AGRICULTURAL MECHANIZATION SERVICES

CONCLUSIONS

Scaling scan facilitate a structured exchange on what local ownership, leadership, sustainability and systems change means in context of assessed intervention

- *Rapid evaluation allows to generate strong indications for adaptations in project implementation strategies to be viable at scale beyond the projects*
- *Benefits*
 - *Critical reflection on the dependencies of a project in terms of financing, governance and ownership*
 - *Identifies clearly what lies within the sphere of control of the project, where new collaboration can fill the gap and what cannot be influenced*
- *Considerations*
 - *Snapshot of opinions and interpretations that would be more robust when repeated over time and with bigger groups*
 - *No direct solutions to tackle the obstacles are offered*

*Local conditions and project design **context** are fundamental from scaling perspective, taking into account **systems change** and **sustainability** of non-technological aspects*





**THANK YOU FOR YOUR
INTEREST !**

CONTACT

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