125 Increase Farmer Incomes, Agricultural Productivity, and Equity by Scaling up Access to Mechanisation Services

The Solution: Mechanisation is the deployment of technologies, processes, and procedures to improve the effectiveness and efficiency of food moving along value chains; it ranges from small solar dryers and rice threshers to tractors and high-tech drone-enabled soil testing. Mechanisation can benefit diverse stakeholders across agriculture and food systems and be key to future development and growth of smallholder agriculture. Mechanisation, as a market-demand driven service, increases financial viability and allows for full life-cycle service delivery, while generating new employment opportunities and increasing smallholders' market shares. Mechanisation can improve equality and productivity competitiveness between farmers in the industrialised world and farmers in LMICs. To raise agricultural productivity, make rural employment more attractive, and achieve future growth and poverty reduction, food systems stakeholders should embrace the technological, policy, and institutional innovation opportunities afforded by mechanisation by fostering innovative partnerships to pilot and scale up mechanisation and full life-cycle support for it (e.g. reliable services, cooperation arrangements) (MaMo Panel, 2018).

Source(s) of the Solution: Field experience, practical observations, key publications by researchers on agricultural mechanisation. Specifically, representatives from African Green Revolution Forum, Makerere University, IFPRI, and the International Rescue Committee contributed to this solution development.

Problem addressed within food systems: Mechanisation is emerging as critical for staple crops such as rice, maize, and wheat in Asia and especially in Africa, where food prices continue to rise despite import growth. Appropriate mechanisation can contribute to Zero Hunger by reducing the production costs of staple food, shortening value chains, and increasing local production, in turn lowering reliance on imports. It can further value addition by contributing to product differentiation (e.g., enabling milling grain of different coarseness yields different products, targeting more markets). By creating opportunities for technical, skilled jobs and increasing motivation to work in the agricultural sector, especially for the growing youth population, mechanisation contributes to diversified livelihoods and income growth. Moreover, digital and technical skills are transferable and with growing digital literacy and technical skills, training of people in STEM (science, technology, engineering, and maths) areas will become increasingly easier, growing the pool of locally skilled labour. Moreover, mechanisation has great potential to address gender inequalities through opening opportunities for women that in the past were determined by physical capacities. Mechanisation can help lower women's time and effort spend on manual tasks while simultaneously enhancing their profits. For example, the Arid Lands Resource Management project has worked with women mango farmers to maximise profits and reduce losses by facilitating access to fruit processors to process and transform surplus mangoes. The introduction of mechanisation in the processing segment has greatly improved the women's income since mango juice sells for US$1 per litre, compared to a mere US$0.01 for four mangoes (MaMo Panel, 2018). Globally, agricultural mechanisation can potentially reduce vulnerable employment, including that among women (Zhou & Ma 2021).

State-led mechanisation efforts across Africa in the 1950s and 1960s failed largely due to widespread governance challenges (e.g., lack of access to locally adapted tools and machinery, limited or no access to spare parts and qualified operators or technicians) and missing links to viable market opportunities. Coupled with operational inefficiencies of current owners of mechanised equipment, the result is dead capital on entrepreneurs' books. Yet, food system mechanisation is vital for ensuring timely land preparation in the face of increasing climatic uncertainty, reducing production costs where labour cost is rising, reducing on-farm losses through more efficient harvesting and post-harvest methods, and improving the welfare of the farming populations by reducing drudgery.

Presenting mechanisation as a market-demand-driven service increases its financial viability and allows for full life-cycle service delivery, while generating new employment opportunities and

increasing smallholders' market-shares. Existing services range from research and technology development (e.g., CAMARTEC in Tanzania) and technology and machinery access (e.g., storage and retail services by Zambian NWK Agribusiness; rental solar tunnel dryers from Sosai Renewable Energies in Nigeria) to financial and information services for mechanisation (e.g., Moroccan Association of Importers of Agricultural Equipment and Plan Maroc Vert) (MaMo Panel, 2018).

Custom-hiring machines and other mechanisation services is one of the most promising options to make often costly machines accessible to smallholders, who constitute the core of the global food system. However, the growth of viable custom-hiring mechanisation service needs to be facilitated by addressing various challenges, including high transaction costs for matching service providers and areas needing mechanisation at a specific time as well as insufficient knowledge on machine selection and skills for machine utilisation, operations, repair, and maintenance (Diao et al. 2020).

How this solution will address that problem: *Theory of change*: Mechanisation as a service (rather than an end in itself), helps address the core sustainability problems of the past, while its agility allows for adaptation to different contexts and all kinds of mechanisation solutions by creating long-term, financially viable opportunities for market-creating entrepreneurs. In turn, increased demand for mechanisation services will grow the demand for skilled labour and the training of these skilled professionals.

A learning platform will be created to share experiences with using mechanisation services (e.g., Hello Tractor, TroTro Tractor, FarMart, Cold Hubs), building mechanisation training institutions (e.g., Ghana), or cross-country knowledge sharing on agricultural mechanisation (e.g., AGCO Agribusiness Qualification at Strathmore University in Kenya, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in Asia), and researchers (including the Malabo-Montpellier Panel) to build a knowledge and evidence base to identify successful business and partnership models and analyse how they can be scaled up.

This information will be used in co-creation hubs to be established at national, regional, and global levels (e.g., technology innovation parks, blue sky innovation hubs, food technology incubation centres, 'Dragons Den' pitches to potential funders for commercialisation) for generating and growing solutions. Hubs will offer services to support intellectual property registration and financing for scaling up and taking products to market. They could include an 'Impact Marketplace' to facilitate the matching of emerging ideas to potential funding mechanisms. They could also include mechanisms for South-South learning on mechanisation growth and for sourcing new ideas from traditional knowledge by linking them to scientific innovation support. Supporting the growth of a skilled workforce is required for effective mechanisation service provision, including machine selection, machinery design, manufacturing, operation, repair and maintenance, and utilisation, as well as the network that links service providers with farmers, including smallholders who can afford such services if accessible. Internships could assist with inspiring youth; for example, the Igbo apprenticeship system has been shown to benefit participating entrepreneurs' business outcomes.[1]

Solution's alignment to the 'game changing and systemic solution' criteria:

*Impact potential at scale (*MaMo Panel, 2018): Estimates show that a farmer using a combination of power-based mechanisation and animal power can provide food for up to 50 people, compared to just six when using draught animal power alone. In the food processing sector, machines and frugal technologies have allowed women farmers to transform their crops and, through value addition, to diversify and improve their incomes. Post-harvest operations such as peeling, chipping, grating, and drying can greatly enhance the value of the cassava crop, allowing farmers to produce fried cassava

[1] Economic assessment of the Igbo entrepreneurship model for entrepreneurial development in Nigeria: Evidence from clusters in Anambra State

chips and starch for cooking or flour. The same applies to processing fruit, such as mango or bananas, that can be sold as dried fruits or jams. Transformed oilseeds, such as peanut or coconut, are used to produce soaps and oil, while processed rapeseed can be used as high-protein livestock and poultry feed. Other estimates indicate that around one million tons of additional milled rice (17% of current annual rice imports, worth USD 410 million) could be available in sub-Saharan Africa by halving on-farm post-harvest losses using appropriate milling machines.

Actionability: Several governments show interest in learning from viable mechanisation service provision models. Various enabling factors are necessary (including market opportunities, subsidies to support the acquisition of equipment, registration and protection of intellectual property (IP), a regulatory environment for business development, skills development, and innovative finance mechanisms that take into account start-up phases) before solutions can be taken to scale.

Sustainability: By connecting innovation capacity with market demand, we ensure that current and future technologies and services can be sustainably and viably developed, as has been demonstrated through other innovation hubs (e.g., CCHub, iHub, as well as larger-scale innovation hubs linked to research institutions, e.g., MIT, Wageningen University, Kista Science City) around the world.

Existing evidence: Previous attempts to scale up the adoption of mechanisation through direct investment have not been successful. The recent emergence of multiple market-creating agribusiness start-ups across the world, focused on developing and deploying mechanisation solutions as services, indicates that more appropriate business models that make the unit price of services affordable, increase the operational lifecycle and efficiency of equipment through better maintenance, address the seasonality, availability and reliability of services, and create additional livelihood opportunities across the value chain can be pursued (see multiple examples in the MaMo Panel report, page 12).

Current/likely political support: Various member states in Africa and Asia show interest in developing effective mechanisation service provision models. Several African governments, such as Ghana, are also interested in integrating training and skill-enhancement components into their mechanisation programmes. Interests in models utilising mechanisation services like HelloTractor and FarMart are growing across African and Asian countries, including Ethiopia, Ghana, Kenya, Nigeria, and India. Also, various countries support the emergence and growth of innovation hubs as a means of connecting multiple stakeholders to create new products and services. Similarly, various companies see the value in investments in up-skilling in order to expand their market shares (e.g., Schneider Electric and investment in solar energy solutions technicians).

Contexts where this is well/not well suited: This is suited for all contexts that provide sufficient entrepreneurial stability for service-business models to be operationalised and sufficient stability for farmers to make investment commitments; it is particularly well suited to countries with low and medium levels of mechanisation.