

From Muscle to Machines: How to modernize smallholder farming in Mozambique

Summary and key facts



Smallholder farmers lack access to and knowledge of draught animal and motorized agricultural mechanization limiting productivity



Trials show conservation agriculture-based mechanization sustainably improves maize yields and farmer incomes



Research finds use of mechanization reduces grueling labor and reduces time spent on farm activities



Mass demonstrations, training and extension services key to boosting farmer demand for mechanization

What is the problem?

A lack of appropriate agricultural mechanization

Almost all smallholder farmers in Mozambique depend on hand-hoeing and human muscle-power to run all their farm operations. Farmers spend many weeks in undertaking physically grueling farming activities that could be done in a matter of days or less. For example, to prepare one hectare of land for sowing using hand-hoe requires 23 to 31 person-days (upto 1 month of labour). This can cost anywhere between 2600 to 6000 meticals. With mechanization, this same task can be accomplished in about 2-2 1/2 hours per hectare including setting up improved ridges.

Use of small-scale agricultural machinery, like seeders and

planters, remains low with agriculture dominated by the use of conventional hand-hoes. To modernize agriculture, produce more food and to support economic transformation, farmers need to increase the adoption of labor-enhancing technologies based on appropriate mechanization.

The majority of rural smallholder farmers cannot afford to invest in agricultural machinery. Agricultural machinery suppliers are mostly found in the larger towns and cities, as the perceived low demand in rural areas for equipment does not always justify the establishment of distribution networks.

Beyond Tillage: Emphasizing Multifunctionality

Mechanization covers all levels of farming and processing technologies, from simple basic hand tools to more sophisticated and motorized equipment. Benefits include:

- Eases and reduces hard labor
- Relieves labor shortages
- Improves productivity and timeliness of agricultural operations
- Improves efficient use of resources
- Enhances market access
- Contributes to mitigating climate related hazards

What solutions were identified from research?

The importance of adaptive research on multifunctional mechanization and business development

Motorized and draught animal mechanization along with other conservation agriculture-based technologies and practices form part of a modern, resilient farming system. The need for mechanization is well recognized at the top echelons of Mozambican policy communities, as such a modern transformation will benefit the whole economy.

The SIMLESA project was designed to test and adapt appropriate conservation agriculture based agronomic practices to achieve better sustainable intensification of agriculture. However, there was no component to support mechanization. Many experts understand that conservation agriculture is more feasible when farmers can have appropriate machinery. Therefore SIMLESA collaborated with APPSA¹ project to introduce affordable and multifunctional machinery in the context of Conservation Agriculture-based Sustainable Intensification (CASI). The APPSA mechanization project (SIMECMM)² was motivated by SIMLESA. The unique approach of SIMLESA was that this was an integrated

and interdisciplinary approach that involved agronomy, agricultural engineering, economics and policy.

SIMLESA introduced and promoted agricultural machinery to smallholder farmers through field demonstrations and on-farm trials. SIMLESA partnered with nonprofits, government initiatives and private sector to successfully promote mechanization to farmers through demonstration plots, training, and trials that are used as schools for learning about conservation agriculture-based mechanization.

SIMLESA promoted an evolution from manual to mechanized CASI. From manual, planting in basins manually to direct planting using dibble stick and jab planters, progressing to animal draft powered direct seeding using of riplines, and finally introducing mechanized CASI through the use of small 4 wheel tractors.

Simple machinery improves productivity

Jab planter: A simple hand held drill with seed and fertilizer dispensers and a sharpened point that opens a hole through vegetative soil cover and deposits seed and fertilizer at a required depth.

Ripline: Rippers powered by animal draught power or small 4 wheel tractors which cultivate a narrow strip of soil where seed can then be planted. Riplines break the soil to a depth of just 5-12 cm to enable direct seeding, causing minimal disturbance to the soil surface compared with conventional practices.

Small 4 wheel tractor: Small four wheel tractors (<30 hp) and implements are used to build improved ridges and graded conservation agriculture raised bed systems.

Research shows that with mechanization, farmers can reduce labor and increase yield. On farms where small tillage machines were tested and demonstrated, there were significantly higher yields compared to conventional hand-hoe tillage systems.

Across SIMLESA sites, farmers using jab planters - a simple hand held drill with seed and fertilizer dispenser - were able to increase maize yields by 170 kg per hectare, reflecting an extra 3-4 months of food security for a family of five.

The use of animal-driven riplines, resulted in a boost for farmer income generating US\$450/ha in maize-legume rotation compared to conventional method which earned

just US\$250/ha. The benefits resulted from cost reduction and yield increase, as direct seeding requires less labor. The combined effect of use of conservation agriculture, improved seed, timely planting, and mechanization resulted in more yield. Significant reductions in labor. Animal draft riplines reduced labor demand by an average of 18 to 39 person-days per hectare. This time saved was used by smallholders for other activities, such as other farm jobs, household chores, education and off-farm income generating activities.

¹Agricultural Productivity Program for Southern Africa Project

²Evaluating sustainable intensification opportunities for improved labour productivity using mechanized conservation agriculture in central Mozambique and Malawi.

Opportunities for policy action

Invest in the growth of machinery agribusinesses

The research identified some key areas where policy could strengthen demand and distribution of agricultural mechanization in rural areas. Individual businesses may not have the capacity nor the business incentive to invest in sector-wide efforts to improve the mechanization with the potential that all future players will benefit. A collective approach from government and private agribusiness is needed to develop machinery markets and value chains.



Invest in the incubation of new business opportunities including demand creation

Research shows that custom hire services can help overcome the high costs of equipment. This is because ownership of machines is likely to be a relatively high capital expenditure and so many farmers find it more cost effective to hire instead. Training in the use of mechanization

and business operations provides new rural business opportunities in providing services to farmers who lack capital to invest in machinery. A framework for market demand creation through demonstrations and promotional messages oriented to farmers and CASI is warranted.



Facilitate investment funds to support acquisition of machinery by agribusinesses

An important opportunity for action may revolve around creating funds that small and medium agribusinesses can access to buy machinery for custom hire. When this approach is combined with the demand creation opportunities above, the impacts are likely to be considerable. Experience from other parts of the world shows

that extending credit products to farmers to invest in agricultural machinery not only allows them to raise their productivity and participate more fully in the market economy, but can also incentivize the local machinery manufacturing industry to supply their needs



Invest in training

Invest in training for large cohorts of technicians. To mainstream smallholder mechanization, technical training for localized capacity is critical. Individual private players may not have the capacity or incentive to provide training to large numbers of people without the ability to recoup such costs. Thus, it is important to continue

the funding of local agricultural colleges to provide training in the use of mechanization for conservation agriculture and practical business skills for hire service providers. This can provide opportunities for youth in machine repair, servicing and custom hire.

Why act now?

Increased productivity and resilience cannot happen without modern and smallholder-appropriate machinery

The prevalence of manual labor and human muscles as the primary source of farm power is not consistent with any known trends of modernization. Dependence on muscle power alone is costing crop yields due to inefficient and late operations that undermine the ability of farmers to

respond to changing rainfall and other climatic conditions. Without mechanization, little progress can be made towards increasing productivity and resilience of Mozambican agriculture.

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