Mechanized Tillers, Planters and Fertilizer Applicators

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Summary

Farm activities such as land preparation, sowing and fertilizer application are largely performed by hand in small-scale millet and sorghum production systems. Farmers endure physical drudgery to cultivate their land and bear the cost of maintaining draught animals or services. Low and erratic rainfall in millet and sorghum growing areas narrow the window for planting without, intensifying labor demand. Recommended practices such as precision sowing and fertilizer micro-dosing are time consuming when performed by hand. These different factors counteract the intensification of agriculture on existing croplands and its expansion into new areas, which are needed to improve food and nutritional security. Mechanizing tedious farm activities is of key importance to decrease labor costs, allowing more timely field operations, improving crop productivity, and generating higher profits.

Technical Description

A large range of mechanized and motorized equipment is available that reduces the workload of farming for millet and sorghum producers. This includes walking-style power tiller, hand pushed planters, fertilizer applicator, small engine backpack brush cutters and paddle weeders, and power sprayer for applying chemical control agents. A power tiller has multiple uses. It performs shallow ploughing, rotavate to break large soil clumps, and build ridges and furrows for planting. Most walking-style tractors also pull carts for local transportation. Some also have power takeoff that connect to water pumps and threshers. A motorized planter and fertilizer micro-dose applicator, locally called “Sénékéla”, was developed by Institut d’Economie Rurale in collaboration with ICRISAT as an alternative for manual and animal-drawn seeders. It ensures precise and fast placement of seeds and mineral inputs on finely harrowed soils or pre-made ridges. Agricultural machinery requires skillful use to make investments financially viable. Sharing equipment through rental services provides access to larger numbers of farmers who would otherwise not be able to afford this equipment.

Uses

Small-scale mechanization of land preparation, planting and fertilizer application is suitable for farmers growing millet and sorghum limited access to markets and infrastructure. The ideal size of land for power tillers and motorized planters is between

0.25 and 2.5 acre (0.1 to 1 hectare), for larger farms a four-wheel tractor is better suited. Equipment can be purchased by individual farmers or their associations or obtained through rental or contract services.

Composition

The most efficient equipment is powered by internal combustion engines. The Sénékéla machine consists of a hopper containing the distributor disc, a four-stroke petrol engine of 6.8 HP and a 4-liter tank, two rear wheels that move the machine forward, and two front wheels that spin the distributor disc. Spacing between plant stands is adjustable and seed and fertilizer is placed in pockets at regular intervals by the distributor disc. A following skimmer and press wheel ensure that seed and fertilizer are adequately covered with soil.

Means of application

Hand operated planters for millet and sorghum and fertilizer micro-dose applicators are readily fabricated by local metal workshops. Motorized tillers, weeders and planters are imported, mostly from China or India. The use of power tillers, weeders and motorized planters requires a trained operator to ensure safe and effective use. Every day the engine oil levels must be checked. Settings of the rotor blades must be adjusted according to the desired tillage depth and width. To construct furrows, an opener must be set according to space between planting lines. Clearing straw and stones from rotor blades is crucial to prevent jamming that may damage the engine. Using mechanical hand planter is simple when there are no large clumps of soil following ploughing and harrowing and can plant on either a level surface or on top of pre-made ridges. The seed meter must be regularly checked and calibrated to ensure appropriate spacing and planting depth. Metering devices of planters and fertilizer applicators play a vital role by distributing the inputs uniformly at desired rates and row spacing. Sowing a farm of one hectare requires walking 10 km. The machinery is lightweight so it is easily transported between fields. Maintenance of small-scale equipment is relatively easy, and many spare parts are locally available.

Agroecologies	Dryland area, Moist savanna.
Regions	Africa South of Sahara.
Developed in Countries	Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Available in	Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Solution Forms	Equipment.

Solution Applications	Mechanized Farming.
Agricultural Commodities	Sorghum/Millet.
Target Beneficiaries	Women, Youth, Small-scale farmers, Agro-dealers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

Actors seeking to enhance the uptake of modern farming equipment must: 1) Build public-private partnership for scaling and investment of small-scale mechanization, 2) Demonstrate labor saving and agronomic benefits of equipment to incentivize uptake by farmers, 3) Train farmers and operators in the maintenance and use of the planters and fertilizer applicators, 4) Establish local hiring centers for machinery and technical support that provides access in remote communities, and 5) Link community-based organizations, youth groups and individuals to credit facilities for purchasing or hiring small equipment.

Production Costs

Prices of tillers, planters, and fertilizer applicators largely vary depending on size, engine power, and manufacturer. Imported models are generally more expensive than locally fabricated types. A single-row planters for millet and sorghum pushed by hand cost between US $250 and $350. Suppliers in Africa sell power tillers with 7 to 12 horsepower engines for US $1,200 to $2,500 depending on the make, power, and attachments. The Sénékéla motorized planter and fertilizer applicator costs about US $1,000 and comes with one year warrantee on engine and parts. Fuel consumption is about 2 liters per hectare if regularly and appropriately serviced, and the machine has a lifespan of 10 years. The maintenance and repair costs for machinery is about 70% and 100% of its price.

Customer Segmentation

A diverse market exists for modern agricultural machinery in millet and sorghum growing zones. Motorized tillers, planters and fertilizer applicators are fit for agricultural service companies and larger associations. Hand-pushed planters and fertilizer applicators can be operated by individual producers or shared among farmers that cultivate a few hectares. Satisfying increased demand for mechanization services is a rapidly growing business investment opportunity.

Potential Profitability

Manual and engine powered equipment is profitable because of low maintenance cost and fuel and labor expenses, the increased area of land cultivation, and improvement of yields by more optimal planting time and density. Sowing and fertilizer micro-dosing with the single-row Sénékale machine cuts the working time down to 2 hours per hectare whereas the same operation takes 8 hours with an animal-drawn machine and more than 64 hours when performed by hand. Substantial reductions in drudgery and labor costs are achieved through use of mechanized tillers, planters, and fertilizer applicators, which enhance income opportunities and livelihoods of farmers, especially among women and youth. Access to modern equipment makes agriculture more appealing as a choice of employment and promotes investments in other technologies.

Licensing Requirements

There is no patent covering the production of the Sénékéla planter and fertilizer applicator. Blueprints and detailed building plans for some hand planters are freely available and may be fabricated without license. Manufacturers hold the intellectual property of equipment that is commercially fabricated and marketed.

Innovation as Public Good

Training manuals for modernized operations are developed as a Public Good by ICRISAT and its partners and warrants replication throughout Africa.

Solution Images



Mechanical planter for small grain crop



Sénékéla planter and micro-dose fertilizer applicator



Mechanical planter for small grain crop

Institutions

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

Accompanying Solutions

Fertilizer Micro-Dosing to Enhance Yield and Use Efficiency