

Motorized Crop Residue Processing of Animal Feed

Solution Holder is **Dougbedji Fatondji** and can be contacted through **d.fatondji@cgiar.org**

Summary

Crop residues and stover from millet and sorghum offer an important source of livestock feed. When animals are herded over croplands only 20%-30% of stover is grazed since they prefer the leaves that are sweeter and easier to digest. Farmers normally chop stems into small pieces by hand so it can be fed to cattle, but this task is time consuming. The manual process limits the amount of millet and sorghum stem residues that farmers utilize for livestock. What is not fed to animals is often burned in the field, a practice that contributes to soil carbon depletion, local air pollution and unnecessary CO₂ emissions. To address the challenges of feed cost and seasonality, and to improve the management of agricultural resources, ICRISAT and its partners developed a mobile processor for millet and sorghum stover. It allows materials to be chopped or crushed for use as either feed or mulch. It is self-powered, easy to operate, low-cost and easily transported between fields. A large amount of crop residues can be processed with the machine by only just two people. By increasing resource use efficiency, the chopper facilitates better integration of crop and livestock enterprises.

Technical Description

Access to quality feed is the most important factor in successful livestock rearing. Many farmers feed whole stover from millet and sorghum to animals, which reduces their digestion and leads to sub-optimal animal diets. Motorized choppers and crushers make it possible to provide suitable feed while saving time and effort. The technology serves both animal and crop production since crop residues fed to livestock produce manure which in turn improves soil fertility when returned to the field. Farmers obtain particularly large gains by combining dual-purpose millet and sorghum varieties with this chopper technology. Mechanized crop residue processing benefits storage and preservation of feed products by making it possible to compact the material in bags that can tightly packed instead of piling whole stover into a shed. Packing enhances flavor and nutritive value as well. Increased availability of chopped and shredded crop residues from millet and sorghum in addition to legumes such as cowpea is fundamental to local production of well-balanced feed rations. Chopped and crushed stover of millet and sorghum is also suited to produce silage. Through mechanized crop residue processing, farmers can earn additional income, rear larger numbers of animals, increase milk and meat yield, and avoid feed shortages during dry seasons or prolonged drought.

Uses

Motorized crop residue processing is ideal for drylands in Sub-Saharan Africa where people heavily rely on mixed crop-livestock farming and where availability of feed biomass is limited owing to lower levels of annual rainfall and frequent drought. It is suitable for different materials available during the wet and dry seasons. The machinery can be used for either fresh and dry plant materials from a wide range of crops including sorghum, millet, maize, and cowpea. Chopping works best for green stover before fibers harden, while crushing is mostly done when crop residues have dried.

Composition

Machines have four main parts; a pair of horizontal rollers that moves stover forward, a hexagonal shear cutter with knives, a hammer for crushing the chopped stover, and a 7 to 13 horsepower engine running on petrol or diesel. The small, two-wheeled motorized cutter makes collection of stover from the field easy and fast. This equipment may be offered as a package to individual farmers, their associations, other service providers or feed producers.

Means of application

Crop residue processing machines are easily transported between fields and farms using a donkey cart or motorbike. Most models are fitted with wheels. Depending on the model, throughput capacities range from 1 to 1.5 ton of stover per hour. Choppers and hammers work at the same rate as the roller to ensure uniform sized feed material. The top and bottom roller turn in opposite directions so the stover moves steadily through the machine. After chopping, materials fall into the crushing chamber where hammers mounted on a rotating shaft revolve at high speed. Material is further ground through the beating action of the hammers until it passes through holes in an adjustable screen. Crushed material is pushed forward by the motion inside the chamber. The size, number and positioning of hammers is very important for desired and efficient operation. Regular checks of engine oil and moving parts must be performed for ensuring that the machine does not clog or become damaged. Operators must be trained on maintenance and safety to keep running costs low, obtain the desired size of feed and avoid physical injuries.

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

Solution Forms	Equipment.
Solution Applications	Feed/Fodder Production.
Agricultural Commodities	Sorghum/Millet.
Target Beneficiaries	Women, Youth, Small-scale farmers, Agro-dealers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

To enhance agricultural productivity of crop-livestock farming system, the following steps are required: 1) Promote the stover chopper/crusher through demonstration sessions at community level, 2) Train operators in the maintenance and use of the machine, and 3) Link community-based organizations, youth groups and individuals to animal feed producers.

Production Costs

The price for a self-contained stover chopping and crushing machine ranges from US \$1,250 to \$1,700 depending on the size, the manufacturer, the country of origin. Imported models also exist but are more expensive than local fabricated ones. Machines usually come with one-year guarantee and have a lifespan of 10 years if well maintained. In the dryland belt of northern Nigeria, whole sorghum stalk costs between US \$100 and \$170 per ton on animal feed markets depending on the quality. The main operating expenses of chopping and crushing stover are the labor to collect materials on the field, carry it to a processing site, operating the machine, and loading bags with chopped or crushed feed. Fuel consumption ranges from 2.5 to 3.5 liter per ton of stover for different sized choppers. Alternative motorized cutters that can handle all types of cereals costs about US \$ 1,000 to \$1,500 on international markets.

Customer Segmentation

These machines can be used by farmer associations and youth groups for service provision, or by animal feed processors. Processing stover from millet and sorghum offers an attractive business opportunity since added value is created and a market demand exists.

Potential Profitability

Return on investment depends on the cost of whole stover, labor, fuel, and maintenance, which vary between locations and times of year. Machines provided to farmer associations in Niger led the production and sales of more than 100 tons of stover worth US \$22,000 in less than six months. On animal feed markets in the drylands of Northern Nigeria, one ton of crushed sorghum stover sells for US \$330 to \$500 depending on the quality.

Licensing Requirements

Blueprints and detailed building plans for some mobile crop residue processors are freely available and may be fabricated without license. For commercially marketed models, the intellectual property is held by manufacturers.

Innovation as Public Good

Training of manufacturers and farmers on the chopper machine across Sub-Saharan Africa is offered by ICRISAT and its partners.

Solution Images



Forage chopper with in-built engine



Use of motorized stover cutter (left) and mobile chopper (right)



Removing cured silage prepared from sorghum leaves and stems

Institutions



Accompanying Solutions

[Dual-purpose Varieties for Crop and Livestock Integration](#)