



## Mobile feed grinders boost farm efficiency and provide multiple benefits for livestock farmers

### KEY MESSAGES

- An affordable feed grinder, locally manufactured in Tunisia, now has new features that allow it to be moved directly to the field and be powered by a tractor.
- The grinder can chop and grind raw materials for feed, including cactus cladodes, barley grains, straw, olive leaves and date kernels. Ground feed is more digestible by small ruminants and increases absorption of nutrients that leads to increased productivity.
- The grinder can be adopted by cooperatives, farmers and entrepreneurs (agripreneurs) to provide services for livestock keepers and generate additional income.
- The use of the grinder reduces the workload for women and children who are often tasked with the labour-intensive role of feeding the animals.

### SUMMARY

Locally manufactured mobile grinders are used on-farm in Tunisia to chop or grind available feed resources in the field. Feeding small ruminants with chopped and mashed feed improves digestion and absorption of nutrients, increasing the health and productivity of the animals. Increased use of mobile grinders has the potential to raise the performance of the farming sector. It also reduces waste by repurposing crop residues and other natural materials, with the added benefit of producing compost as a by-product that can raise soil quality in rural areas.

### INTRODUCTION

Agricultural systems in low and middle-income countries, such as those in north Africa, are characterized by low levels of mechanization. This hampers both productivity and sustainability and prevents realizing the full potential of both crop and livestock sectors. Machinery promoted in local markets is often unaffordable and is typically imported from industrial countries where larger farm systems are common. As a result, small-to-medium-scale farmers struggle to upgrade and modernize their operations.

Raw materials often used in feeds include olive twigs and leaves, barley, date kernels, cereals and faba beans. Supplementary feed, such as cactus cladodes, are also used to feed animals from July to October. These cladodes and other feed ingredients are typically transported to farms and cut by hand into smaller pieces to be fed to the animals. This is labour and time intensive, and the risk of injury is high.

Researchers from the International Center for Agricultural Research in the Dry Areas (ICARDA), together with national partners in Tunisia, have been working on developing machinery suited to smallholder farming systems that can help boost efficiency and animal productivity. A mobile grinding machine was developed to reliably grind and chop raw materials for feed quickly and efficiently, greatly reducing the risk of injury and the time and labour required to produce the mash.

The grinder comes with various sized sieves so that the right feed size can be predetermined and maintained. Enhanced consistency contributes to increased nutrient digestibility, which can boost livestock performance and reduce the impact of livestock grazing on soil covers. The grinder can also be used to produce high-quality compost - one agripreneur started a compost business, selling the product in 50 kilo bags.

Although grinders are not new in Tunisia, this specific machine can be powered by a tractor, in addition to electricity, which has the added benefit of mobility to reach farmers in their fields.



**A woman in a rural area in Tunisia cutting cactus cladodes.**  
Photo ICARDA/Udo Rudiger

## AGRIPRENEURS BECOME BUSINESS OWNERS



**Small-scale feed chopper and grinder on a farm in Tunisia.** Photo ICARDA/Zied Idoudi



**Young agripreneurs received grinding machines to develop their own businesses.** Photo: ICARDA/Udo Rudiger

A 380-volt prototype of the mobile grinder was developed by a Tunisian manufacturer in collaboration with the country's National Agricultural Research and Extension Systems (NARES) and ICARDA.

The production capacity of the machine, which costs 3,000 Tunisian dinars (TD) (USD 1,050), varies between 1.5 and 10 tons per day, depending on the material.

In 2019, 20 machines were donated to 11 young agripreneurs and 9 farmer cooperatives in northern, central and southern Tunisia. The machines were used to grind and chop feed for their direct use, but as the machines are small and mobile, the owners also offered neighbouring livestock farmers to use them. This created a double win - providing additional revenue for the cooperatives as well as a much-needed service for local farmers. The use of the machine reduced feed loss by up to 40% and enriched the quality of feed given to sheep and goats, which improved the animals performance and productivity.

Beneficiaries of the grinders were selected based on their interest in farming and need for the machine. They contributed 10%, approximately TD 300 (USD 105), towards the purchase cost. Financial contribution by the beneficiaries was considered essential to foster a sense of ownership. Researchers and partners from the project monitored and coached the agripreneurs and cooperatives, guiding them in the economical and sustainable use of the grinders.

## CHALLENGES

The response and level of uptake varied, highlighting some challenges of the business model including ensuring the full participation of women. In Tunisia, women are not encouraged to operate machinery, so the female owners tended to employ someone to operate the grinder but the volume of business generated was too small to justify this additional expense.

Another challenge was finding agripreneurs who fulfilled the criteria for ownership. Particularly access to electricity (380 volts) or a tractor, and access to subsidized feed like barley, which is a common feed ingredient in Tunisia.

Outside of the scope of this project, it was noted that the TD 3,000 price tag (approx. USD 1,000) for the grinder may be a barrier to uptake because it is unaffordable for many smallholder farmers who have limited access to subsidies and finance. Government and financial institutions would need to partner with this project to eliminate these barriers. On the upside, maintenance costs are low which makes it a good long-term investment. The machine requires only a fan belt replacement once a year, the cost of which is minimal (approximately US\$10).

**Table 1.** Trial results that demonstrate the different times and power supply costs related to operating the grinder when using different materials and when connected to either a tractor PTO or 380 volts electricity source.

	Cactus cladodes (100 kg)		Barley straw (100 kg)		Olive branches (100 kg)	
	Time	Energy cost	Time	Energy cost	Time	Energy cost
<b>Tractor PTO</b>	4 mins	USD 0.15	40 mins	USD 1.50	48 mins	USD 1.80
<b>380 volts</b>	5 mins	USD 0.08	72 mins	USD 1.13	87 mins	USD 1.37

## HATHEM BUILDS A PROFITABLE BUSINESS

Hathem is one of the 11 young agripreneurs based in the town of Chebika in western Tunisia. He and his partner rent a small shop to deliver their feed production and grinding services. After seven months of operation, their business is generating a monthly net profit of TD 1,450 (USD 500). This is more than three times the average Tunisian household income, which is USD 150 per month.

Hathem plans to expand the business and is looking to purchase a grinder with even greater production capacity.



*Hathem preparing feed using the grinder.* Photo ICARDA/Udo Rudiger ICARDA

“ Thanks to the grinder I have diversified my source of income. Besides providing grinding services and selling compound feed to customers, I also started producing compost to fertilize the soil on my farm and improve production. If things go well, I’ll purchase a bigger grinder and start a business selling compost. Thanks to the improved income I plan to get married in the near future. ”

Hathem, agripreneur

**Table 2.** Agripreneurs and cooperatives using a grinder as a service or to sell a product.

	Mefthahi Saddam, Sbitla, Kasserine	Adel Ben Amor-Tozeur	Cooperative El Maraïi, Douz	Cooperative Green, Kef
<b>Business idea</b>	Grinding service and selling animal feed	Grinding service	Grinding service	Grinding service
<b>Grinding ingredients</b>	Barley, straw, old bread, soy, maize	Date by-products, barley, lucerne, straw, palm leaves	Dates by-products, barley, lucerne, straw, palm leaves	Barley, faba beans, hay, straw, wheat, sorghum, cactus pear, olive branches
<b>Price of service/product offered</b>	Grinding service - Straw bale: TD 2 (USD 0.72)/20kg - Old bread: TD 1 (USD 0.36)/bag Product - Animal feed: TD 0.8 (USD 0.29)/kg	TD 220 (USD 78.87) per ton (200 kg/h)	TD 20 (USD 7.17)/ton	TD 20 (USD 7.17)/day rental
<b>Total feed sold/ground (tons)</b>	Grinding service: 30 tons Product: 5 tons	52 tons (42 tons auto consumed and 10 tons service)	300 kg/day (average), or 9 ton/month	22 clients x 1.5 days = 33 days
<b>Overall benefits/achievements</b>	Grinding service: TD 1,500 (USD 537.73) Animal feed: TD 500 (USD 179.24)	Grinding service: TD 1,900 (USD 681.13)	Grinding service: No benefit, only service for members	Grinding service: TD 660 (USD 236.60)
<b>Total clients served</b>	Grinding service: 40 Animal feed: 5	Grinding service: 6	Grinding service: 60 members of cooperative	Grinding service: 22 members of cooperative

Table 2 shows how different grinders were used by individual agripreneurs and cooperatives during the project. The number of beneficiaries varies between six and 60, while ground material varies according to agro-climatic zone and available vegetation.

The different charges depend on the objective of the grinding service as well as the feed supply situation in the region (very scarce in the south).



**Sheep in Tunisia's arid region. Vegetation is scarce, therefore farmers need to find alternative source of feed for their animals.** Photo CGIAR Research Program on Drylands



**Livestock provide farmer families an important source of income, especially in marginal lands where crops cannot grow easily.** Photo CGIAR Research Program on Drylands



**Training farmers on how to use the mobile feed grinder.**

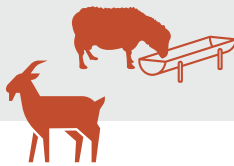
Photo ICARDA/Udo Rudiger ICARDA

## DIFFERENT GRINDING STRATEGIES OF FARMER COOPERATIVES



### OUTCOMES

More and better-quality ground feed



Increased farm efficiency



Reduced workload for women and children



Increased income for all: farmers, cooperatives, agripreneurs



## CASE STUDY : AN ADDITIONAL SERVICE AND REVENUE STREAM FOR COOPERATIVES

The grinder is a valuable machine for farmer-led organizations, such as cooperatives (business-oriented groups) and associations (non-profit oriented). Not only do the machines provide essential grinding services to its members, they can also generate additional income for the groups, each of which have its own management strategies for the use of the grinding machine.

### COOPERATIVE SMSA ETTAOUCEN

With 120 members, the cooperative SMSA Ettaouen in Siliana, northwest Tunisia, uses three different business models, with varied associated costs, for its members to access the grinder:

1. Those who do not own a tractor can ask the cooperative to come and chop feed on the member's farm using the cooperative's tractor and driver. The member cost is TD 30/hour (approx. USD 10), which includes the rental charge for the tractor, the tractor driver's wage and petrol.
2. Members who own a tractor can use the grinder at their farm at a cost of TD 25/day (USD 8.96) for the cooperative's grinder technician (operating the grinder) and TD 15/day (USD 5.38) for the cooperative as a rental fee, which goes to the cleaning and upkeep of the machine. Petrol charges are the farmer's expense.
3. Members can also transport their feed material to the cooperative's warehouse and use the cooperative's tractor to grind

material there. This costs the member TD 3 (USD 1.08) per 100 kg of raw material.

To date the response has been positive, and the cooperative has served 40 members and employ one person part-time. Profit is not the cooperative's objective for the grinder, but instead they want to use the machine to encourage new farmers to join and provide useful services to their current members.

### FARMER'S ORGANIZATION SMSA SERJ - WESLET

A different approach has been taken by a smaller farmer's cooperative (46 members), SMSA Serj - Weslet, in Ouslatia, central-west Tunisia, which has opted to make grinding services available to non-members to generate additional revenue for the organization. They estimate about 100 farmers in their region could be interested in using the grinder.

Their business model is similar to that of SMSA Ettaouen, though the fees charged vary (they are somewhat lower). During six months of operation, this side-business has generated an estimated monthly net income of TD 150 (USD 50). Although the financial benefit for the cooperative is low for now, there is potential to grow its use. In addition, the grinder is being used by individual member farmers who are benefitting from increased efficiency and improved feed, which are improving their livestock production.

## CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

The mobile grinder, which has great potential to be scaled to other countries and regions, has proven to serve as a valuable machine for farmers and as a tool to generate additional income for farmers, agripreneurs, and cooperatives. It can be used to produce and sell a product like animal feed or compost, or to provide services to generate additional income.

Farmers directly benefit in various ways from using the grinder. They can achieve up to 40% less feed wastage, reduce labour costs and time spent on manual chopping of materials,

the animals perform better from improved digestibility and therefore better absorption of nutrients, and the farmer can generate additional income.

In the next phase of the initiative, the team aims to document the impact of chopped and ground feed on small and large ruminants and determine the direct health and performance improvements as well as the associated financial gains made. More scientific evidence is required in this regard, which can be used to lobby, promote and further expand the concept.

### Partners



SFEMI

### Further reading

Frija, A., Idoudi, Z., Rudiger, U., Rekik, M., 2020. *Collaboration between ICARDA projects and linkages to IFAD investment portfolio for enhancing seeds quality and forage production through entrepreneurship and farmers associations. Some examples from ICARDA activities in Tunisia*. Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA). <https://repo.mel.cgiar.org/handle/20.500.11766/11134>.

Rudiger, U. December 2020. Workshop with beneficiaries - describing business models of farmer cooperatives and entrepreneurs using grinders and seed cleaning unit. Hammamet, Tunisia. <https://repo.mel.cgiar.org/handle/20.500.11766/12556>.

Rudiger, U., Idoudi Z., Frija, A., Rekik, M., El Ayed, M., M'hamed, H.C., Zaim, A. 2020. *Locally Adapted Machinery Solutions For Sustainable Intensification Of Crop-livestock Systems In Tunisia* <https://hdl.handle.net/20.500.11766/12453>.

Rudiger, U., and El Ayed, M. 2020. *Report on business opportunities for cooperatives and young entrepreneurs for the use of mobile grinders for grinding services and feed production*. CGIAR. <https://hdl.handle.net/20.500.11766/12536>.

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The solution proposed in this brief is part of a basket of solutions that can help support livestock producers to raise efficiencies and productivity. While there is opportunity for more research, the mobile grinding machine can be considered as a candidate model for scaling as well as be adapted into an integrated model for sustainable intensification of livestock production for smallholder farmers