FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Women's Thresher Project Evaluation: Benefits of Women-Led Thresher Micro Enterprises in Ghana

In many parts of rural Ghana – as in many parts of sub-Saharan Africa – smallholder women farmers are expected to thresh both their own fields and their husbands' fields, which is a tremendous physical and time burden for women as mechanized threshing is rarely available. Mechanized threshing impacts efficient production, food security, profits, and empowerment.

Through support of the Soybean Innovation Lab and the ADM Institute for the Prevention of Postharvest Loss (ADMI), a project was established to evaluate the benefits and challenges that women smallholder farmers encounter as members of thresher micro enterprises in Ghana's Upper West Region (K. Clark, PI; K. Ragsdale, PI).

A women's cooperative member manages a threshing operation in Ghana using a MEDA-donated thresher.

WOMEN-LED THRESHER GROUPS

In 2018, the Mennonite Economic Development Associates (MEDA) partnered with local NGOs to provide 20 mechanized threshers to Village Savings and Loan Associations (VSLA) in Ghana's Upper West Region whose members were primarily smallholder women farmers. The VSLA model – which was first implemented in Niger by CARE in 1991 and has been successfully implemented worldwide – is defined as "a group of 15-25 people (most often women) who save together and take small, low interest loans from those savings" (CARE, 2011).

PROJECT APPROACH

In order to explore the benefits and challenges of machinery sharing, researchers from the University of Missouri and Mississippi State University conducted 15 focus group discussions (FGD) among 128 women farmers who were members of women-led thresher groups that received a MEDA thresher. The research team focused on the question, "What constitutes successful women-led thresher groups?" The team looked at 'success' from a number of angles, such as reducing the physical labor of women and children and increasing women's agricultural productivity and profits, food security, and empowerment.

WHAT CONSTITUTES A SUCCESSFUL WOMEN'S THRESHER GROUP?

- Members financially benefit either through increased income from providing thresher services or increased profit from the sale of higher yields and/or higher quality crop
- Labor burdens were reduced
- Employment of an effective thresher ownership model
- Employment of an effective thresher operator model
- Employment of safe thresher operating practices
- Employment of an effective thresher service fee scheme
- Retainment of operation profits and payouts records
- Employment of regular thresher maintenance strategy
- Retainment of operations and maintenance records
- Existence of a sustainability and expansion plan

Edward Martey (left) and Jeffrey Appiagyei (right) interview Juliana, leader of a MEDA women-led thresher group.

USAID FROM THE AMERICAN PEOPLE

ADMI Institute for the Prevention of Postharvest Loss University of Illinois

FGD participants reported that belonging to a women's thresher group provided extra resiliency against food insecurity by allowing harvested grain to reach households faster due to reduced threshing time and increased grain by substantively reducing postharvest loss. Participants also reported that grain collected as payment in kind served as a food bank for those group members whose households were more vulnerable to food insecurity. By significantly reducing the time and physical labor necessary to thresh a field, as reported by thresher groups, mechanized threshing is a clear opportunity to boost soybean cultivation among smallholder farmers of both genders, including impoverished farmers who are most vulnerable. Participants reported feeling more 'important' and empowered within their communities because men recognized that they had control over a valuable resource – a mechanized thresher. Men were willing to engage them in a respectful dialogue on how they could access the women's thresher services

Soybean threshed mechanically by a women-led cooperative in rural Ghana.

"The grain we collect after threshing for people becomes a food bank for the group. Members who need food come to borrow from the group. The thresher has come to reduce hunger in our families."

"The thresher has brought relief to women. For the first time in my life, I finished my farm before my husband's, and we will no longer manually thresh again. See my palm this year!" [Participant showed that the skin of her palm was not torn or damaged from hand-threshing]

"School children can go to school consistently without missing this year. Because of the reduced labor [needed for threshing], we no longer need them on our farms. This is what the thresher has done."

"The men in our community have seen our importance, and they can't believe we have a thresher to ourselves. When they want to use our thresher, they come, and we negotiate in a meeting."

ECONOMIC OUTCOMES

The FGD highlighted the direct and indirect economic impacts the threshers had on MEDA's project beneficiaries and their households. Thresher benefits cut across the value chain and included:

- Increased market value of farmers' produce
- Reduced cost of threshing
- Improved grain quality
- Reduced postharvest loss
- Reduced manual labor
- Reduced time engaged in threshing
- Easier to sell mechanically threshed crops

58% reported no longer needing cash to pay for threshing services

61% reported better prices for their crops

55% reported an increase in cash on-hand and access to credit

Preliminary results from the Women's Thresher Project Evaluation pilot study suggest that – when adequately supported with even a modest training program – smallholder women farmers with little formal education can profitably participate in providing mechanization services to other rural farmers along food crop value chains while simultaneously directly reducing the cost of threshing and improving access amongst vulnerable populations. This evaluation will help guide development of best practices and recommendations to increase participation across sub-Saharan Africa among women's groups in providing mechanized thresher services and women farmers' in utilizing mechanized thresher services.

FURTHER READING Kolbila R, Ragsdale K, Read-Wahidi MR, Clark K. (2020, May). *Women's Thresher Project Evaluation: Preliminary Results Report*. USAID and the Feed the Future Soybean Innovation Lab. [Link to come]

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Soybean Innovation Lab Multi-Crop Thresher Capacity, Efficiency and Operation

In most small farms across Africa, crop threshing is a laborious and difficult process of dislodging grains from pods or racemes using hand power. Like many crops, soybean is often threshed by beating with a stick. Mechanized threshing machines that can harvest crops other than maize are rare in most African farming communities

Through support of the Soybean Innovation Lab (SIL) and the ADM Institute for the Prevention of Postharvest Loss (ADMI), a project was established to evaluate the benefits and challenges of a mechanized thresher that is built by local artisans and can thresh a variety of crops including maize, soybean, cowpea, common bean, millet, sorghum, rice, barley and others.

Top photo: Young boys stick thresh soybean in Northern Ghana. Bottom photo: After the crop is beat, the chaff and seeds are separated by hand. Often women and children do both the stick threshing and the chaff winnowing. (Photos: SIL 2019)

SIL MULTI-CROP THRESHER

The SIL Multi-Crop Thresher (MCT) was developed in 2018 by two Ghanaian designers with over 15 years of design and fabrication experience. Powered by either a tractor PTO or a diesel engine, the SIL MCT was designed to support a thresher service provision business and to service hundreds of small farmers per season. To accomplish this, the thresher had to prove durable, sturdy, fast, efficient, and profitable. Thresher users reported that stick beating one acre of soybean took a group of people up to two weeks of hard manual labor but the same amount of soy could be threshed in four hours with just a few people with the SIL MCT. The resulting grain from the MCT is also free of contaminants such as rocks and sand and is more marketable than stick-threshed grains. An interchangeable concave sieve and a variable speed motor enable the MCT to be used with multiple crops.

PROJECT APPROACH

In order to determine the throughput capacity and threshing efficiency of the SIL MCT, researchers from the University of Missouri tested five threshers being used by service providers and farmers in Northern and Upper West Ghana. The threshers were tested using rice, maize and soybean and determinations were made for fuel use, grain threshed per hour of use, cleaning efficiency, seed damage, seed loss, seed weight, and seed moisture. The five threshers had some variations in design and all lacked the two most recent SIL design modifications, which include a secondary cleaning fan and a feeding shaft to pull soy plants in quicker. Maize ears were fed into the machine with the husk intact, rice included the grain head and about 30 cm of stalk and soy plants were fed in whole.

USAID FROM THE AMERICAN PEOPLE

ADMI Institute for the Prevention of Postharvest Loss University of Illinois

RESULTS

The SIL MCT was found to use approximately 1.5 liters of diesel fuel per hour. Maize has the highest throughput capacity because it is quickly fed into the machine by pouring in containers of maize ears. Seed weight of maize is also high, leading to a higher grain volume per time threshing than any other crop. Rice can also be fed into the machine very rapidly, but the low seed weight of rice leads to a lower throughput capacity. Soybean throughput capacity is slowed significantly by the need to feed the entire soybean plant into the feeder. All brands of threshers will experience these same feeding issues. Average moisture levels of crops during testing were: soybean 12%, maize 14%, rice 13%. Seed weight in g/100 seeds was: soybean 12.2 g/100, maize 27.2 g/100, rice 3.2 g/100. Seed loss and damage was less than 1% for all crops. Some MCT users have reported higher throughput averages than those found below in the SIL field tests. Throughput is also very dependent on the speed of the humans feeding the machine.

Soybean

Maize

Rice

Averages	Soybean	Maize	Rice
Throughput Capacity:	142 kg/hour	2,839 kg/hour	105 kg/hour
Chaff/weight %:	1.8%	0.1%	0.3%

OPERATION

As with all threshers, operator choices can affect performance. The SIL MCT should be run at the correct engine speed for each crop. Fast threshing speed and low grain moisture lead to grain breakage. Dicotyledon plants such as soybean, beans, cowpeas and pigeon peas are more susceptible to breakage than monocot plants like maize and rice. The SIL MCT thresher has two suction fans for chaff removal and three air regulation devices to control chaff removal and seed loss. The air regulators need regular attention during the threshing process to ensure that seed loss is minimized and chaff removal is maximized. The MCT has been field tested in multiple locations by several organizations over four harvest seasons and has been found to be a reliable, durable, efficient thresher that can provide enough capacity to support a service provider and dozens to hundreds of farmers each season. As with all equipment, it should be used as recommended by the manufacturer and will require that the operator pay attention to machine settings for best results.

Left: the SIL MCT can be fabricated locally and is of a size and price appropriate for service providers.
Right: Good operator practices lead to the best threshing results. The MCT delivers fast threshing with good winnowing capacity. Soy capacity is much lower than maize due to need to feed entire soy plant into the machine.

USAID FROM THE AMERICAN PEOPLE

ADMI Institute for the Prevention of Postharvest Loss University of Illinois

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Economics and Profitability of Locally Produced Commercial Multi-Crop Threshers in Ghana

Agricultural mechanization in sub-Saharan Africa (SSA) lags behind all other continents, which affects productivity, levels of post-harvest losses and food security. Due to government subsidy programs, some countries have tractor services that provide field preparation, but there is often very little access to crop threshers and shellers for post-harvest operations, especially locally-produced commercial equipment. The high labor and time needed to manually harvest and thresh a crop leads to delayed harvest and loss from shattering, lodging, and reduced grain quality[1]. Threshing loss is second only to storage loss as a contributor to post-harvest losses in most crops[2]. In Ghana, as in most SSA countries, hand threshing using sticks is the most common way to thresh crops, whether on farm or in the seed sector. Threshing technology is important in reducing human drudgery and work exertion, in addition to improving productivity and yields.

Manual stick threshing is labor intensive and time consuming. Children will often miss school to help thresh during harvest

The Soybean Innovation Lab's (SIL) locally produced multi-crop thresher reduces hand threshing and speeds up the time needed to thresh crops. This protects crops from bush fires, gets crops to market faster, and provides income for farmers in a timelier fashion. Mechanical threshing also reduces contamination from stones and dirt introduced during hand threshing, thus producing grain with higher market value. The SIL multi-crop thresher can thresh many crops including maize, soybean, millet, rice, sorghum, cowpea, common bean, sunflower, and barley. The Soybean Innovation Lab promotes local production of the machine and has trained fabricators in its manufacture in Ghana, Ethiopia, Zimbabwe, Zambia, Uganda, Burundi, Rwanda, Kenya, Malawi and Tanzania.

INVESTMENT RISK

Field studies done by the Soybean Innovation Lab from 2016-2018 showed user preferences for threshers that are large enough to provide income production for private-sector commercial service providers. Smaller threshers that are more affordable to individual farmers were found to have too low of a threshing capacity to attract investment, while larger threshers were attractive to both private sector investors and to farmer groups interested in communal ownership. The price of the thresher is driven by the cost of raw materials in each country and in 2020 ranges from $2500 in parts of West Africa to $4000 in land-locked areas of Central Africa. To determine if the return on investment warrants the price of the thresher and to help determine the economic risk for investors, the Soybean Innovation Lab conducted research on costs and income associated with use of the SIL multi-crop thresher in Ghana in 2019.

Three SIL multi-crop threshers manufactured by Soya Solutions Eastern Africa Ltd. in Kampala, Uganda.

[1] Shelar, V.R., (2008). Role of mechanical damage in deterioration of soybean seed quality during storage-a review. *Agric. Rev*, 29(3), pp.177-184

[2] Jha, S.N., Vishwakarma, R.K., Ahmad, T., Rai, A. and Dixit, A.K., (2015). Report on assessment of quantitative harvest and post-harvest losses of major crops and commodities in India. All India Coordinated Research Project on Post-Harvest Technology, ICAR-CIPHET.

USAID FROM THE AMERICAN PEOPLE
Soybean Innovation Lab
Feed the Future Innovation Lab for Soybean Value Chain Research
ADMI Institute for the Prevention of Postharvest Loss University of Illinois

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

PROJECT APPROACH

This study used primary data collected by a SIL economist from eight thresher operators in four regions of Ghana and operator business records from a commercial rollout of 15 SIL threshers in Zambia. These two sets of data provide unique insights into the business and economics of operating multi-crop threshers as a service business. Data include quantities threshed, crops, duration, costs, revenues, and business structure.

RESULTS

The daily cost of operating the multi-crop thresher (Table 1) on average amounts to $38.25 USD with the cost of labor making up 55% of that daily cost. Service providers report using from 2-4 operator/laborers, depending on the crop and customer needs. Another large operating expense reported was transportation from field to field, which takes place using either a tractor, motorized tricycle, or animal draft. Fixed costs associated with depreciation and amortization add an additional $9.45 USD or 25% to the cost of operating a thresher. Thus, the total daily cost of operation totals $47.70 USD on average for our sample of eight operators in northern Ghana.

Table 1: Daily operating costs

Expenditure items	Daily Cost (US$)
Transportation of thresher to field	8.17
Fuel (liters)	5.23
Oil (liters)	0.42
Belt (number)	2.31
Pulleys (number)	0.00
Bearings (number)	0.05
Other maintenance	0.99
Labor cost (4 laborers @$5.27/person/day)	21.08
Total	38.25

Soybean Innovation Lab Multi-Crop thresher

Assume a revenue rate for operators of 10% for soybean and 10% for maize of the threshed grain (Table 2). Also assume that the thresher operates about 6.5 hours per day, and the daily cost is $47.70 USD. Finally, assume the operator spends half the day on soybean and half the day on maize. Using the Zambian throughput averages, the operator would thresh 15,576 kg of maize and 924 kg of soybean. The total value of the maize crop would be $1,558 USD and the soybean crop would amount to $323 USD crop. Thus, the operator would receive a percentage of that total; $156 USD and $32.00 USD of grain, respectively in the form of maize and soybean. Total daily revenue for the operator would amount to $188 USD, yielding a profit when accounting for depreciation and amortization of $140 USD, or 75%.

Table 2. An illustrative profitability example of a day: half the day threshing maize and half the day threshing soybean

	Hours Threshed	Thresher Revenue Rate	Throughput per hour (kg)	Price per MT (USD)	Threshed Total (kg)	Farmer Revenue USD per day	Operator Revenue Per day	Operator Revenue Per hour	Cost Per day	Net Margin USD	Net Margin %
Maize (8 Ha.)		10%	4,734	$100	15,576	$1,558	$156	$47			
Soybean (.55 Ha.)	3.29	10%	281	$350	924	$323	$32	$10			
Total	6.58				16,500		$188	$57	$48	$140	75%

Clearly, the assumptions matter in terms of the relative value and yields of crops, the spatial location of each stop, the density of crop at each location, and the costs charged to thresh. The commercial operators, both in Zambia and Ghana, have only one or two years of experience. Similarly, farmers are very new to having their grain mechanically threshed. The market for threshing services is forming and price and cost discovery is taking place. SIL will conduct a second round of data collection in Ghana and Zambia during the upcoming harvest seasons that will certainly refine our understanding of the economics of operating a thresher services business.

USAID FROM THE AMERICAN PEOPLE
Soybean Innovation Lab
Feed the Future Innovation Lab for Soybean Value Chain Research
ADMI Institute for the Prevention of Postharvest Loss University of Illinois