UPS 3: Improved maize sheller and millet thresher machines for reducing human labor in rural areas

Yusto Yustas, Sebastian Romuli, Nickson Elly, Charles Mgeni, Simon Munder, Bashiri Makoko Götz Uckert, Valerian Silayo, K. Mutabazi, Christopher Magomba, L. Mwinuka, and Joachim Mueller

Key Objective **The main objective of the UPS is to improve the livelihood of farmers by introducing machinery that increases the efficiency of shelling maize and threshing millet at their location.**

FVC component(s): Processing

Key constraints addressed

Some of the key constraints associated with post-harvest processing of agricultural products by smallholder farmers include low income; highly intensive human labor needs for shelling and threshing activities, as well as poor knowledge of better processing methods at the case study sites.

Description

Primary processing by smallholder farmers in Tanzania is still largely performed directly in the field or with technically insufficient devices. As maize shelling and millet threshing is performed in a labor-intensive way, the products are of poor quality and polluted with dust, animal waste and insects. Awareness of better and more efficient shelling and threshing methods is lacking at the case study sites.

Appropriate technologies to address the aforementioned challenges are available and have been focused on by numerous projects (Tefera et al., 2012). Both manufacturers and traders are present in Tanzania and are willing to sell the machinery to stakeholders in CSS. Regarding this fact, researchers from SUA and MVIWATA along with stakeholders carried out discussions about advantages, disadvantages and possible benefits of mechanizing both maize shelling and millet threshing. The stakeholders in question were farmers in the Kilosa district for maize shelling and those in the Chamwino district for millet threshing. Later, development of business models to help stakeholders purchase the machinery was completed by SUA researchers while MVIWATA were involved with the machine procurement process. These machines can be powered by engines or electrical motor. Since the electricity is a challenge in the CSS, the chosen machines were powered by diesel engines.

PROVEN SUCCESS IN TZ AND BEYOND

Based on machine improved performance compared to the traditional processing, the maize sheller and millet thresher have been adopted by farmers in Nigeria and other countries. For instance, a survey conducted in Nigeria found that about 77% of farmers adopted maize shellers after realizing the benefits of maize shellers, which include time saving and ease of operation if a sheller is available in the community (Adeleye et al., 2015). While the engine is imported, most other parts of the shelling and threshing machines are manufactured in Tanzania. This is one of the successful processing industries in Tanzania (Yustas et al., 2015) and is evident in many regions where intensive production of maize and millet occurs.

TRANS-SEC FINDINGS

Some of the selected key findings from this UPS are categorized into economical and technical sections.

ECONOMICS: Procurement based on estimated financial returns is as shown in the table below.

The Return on Investment (ROI) and the Return on Capital (ROC) were calculated at the beginning of the project. The purpose of the ROI metric is to measure, per period, rates of return on money invested in an economic entity in order to decide whether or not to undertake an investment. It is also used as indicator to compare different project investments within a project portfolio. Return on capital employed (ROC) is a financial ratio that measures a company's profitability and the efficiency with which its capital is employed. The higher the ROI and ROC ratios, the better. Generally the ROI and ROC for maize have found to be higher, which means the project is worth taking (Table 1).

Table 1: Return on investment and Return on Capital

SN.	Type of Machine	Case Study Site (village)	Capital Investment (T. Shs)	RoI*	RoC**
1.	Maize sheller	Ilakala	5,100,000	1.69	4.3
		Changarawe	5,200,000	1.47	5.53
2.	Millet thresher	Ilolo	3,600,000	1.22	1.93
		Idifu	3,650,000	1.44	1.72

* RoI = Return on Investment

** RoC=Return on Capital

Based on the output in Changarawe and Ilakala, the most common economic parameters, such as the operating cost of maize sheller, gross revenue, and benefit-cost ratio of maize shellers models (i.e. machine and hand maize shellers), were determined and presented in Table 2. It is shown that the Benefit Cost ratio for machine maize sheller is higher than for the hand maize sheller. Results for hand maize sheller is from the study by Monim (2009). The results suggest that despite the challenges of moving the maize shellers, farmers are better off using the machine maize sheller than the hand maize sheller.

Table 2: Benefit Cost Analysis

Model of shelling	Total Operating cost*	Revenue	Benefit Cost Ratio (BCR)
Machine maize sheller	668,100	2,315,000	3.47
**Hand maize sheller			0.54

* Including labor costs for three months

** results from Alam and Momin (2009)

Technical section:

MAIZE SHELLERS procured for Changarawe and Ilakala in Kilosa district-Morogoro performed technically as follows (Yustas et al., 2016):

i. For Changarawe–the machine was able to produce an average 7 bags per day for three months (July to September, 2015). About 57600 kg of grains were obtained from shelling. Fuel consumption averaged 0.7 liters per day over this period. The cost of fuel (diesel) was 2000 TSH per liter. The total cost for fuel amounted to 126,000 TSH. Additional costs included transportation, which cost 15,000 TSH for this season (TSH 5000/month). Shatter losses were estimated to be less than 1% with grain moisture content being more than 10% w/w; whereas the amount lost with the cobs was estimated at 1.4%. With regard to the shelling quality, the grain produced was good. However, additional research is required.

ii. For Ilakala- the performance was the following: Total bags of maize grains obtained after shelling was 773 between March and April, 2016, with total revenue of TS 2,315,000 TSH and a profit of 936,900 TSH. Other performance parameters are yet to be evaluated. Due poor yield of maize in the village, maize shelling completed by machine in July and September 2015 is not included.

MILLET THRESHERS were procured for Ilolo and Idifu in Chamwino-Dodoma. Although these machines have been procured for both villages, they are yet to be utilized due to a lack of material for threshing. Additionally, the threshers need to be slightly modified to facilitate pulling by animal draught power.

Type of food crops applicable

The target food crops for this UPS was maize and millet for the Kilosa and Chamwino districts, respectively.

Technical specifics, dimensions

The machines are diesel engine driven and comprise of both shelling/threshing and winnowing components.

MAIZE SHELLER: On average, the machine sheller has a capacity of shelling up to 70 bags/hour or about 600 bags/day, with 6 people involved compared to 21 bags/day by manual shelling with same number of people. The machine required approximately 1 liter fuel to shell 29 bags of maize grains, with one bag holding approximately 100kg of maize grains. The machine has a water cooling system with a capacity of 40 liters. Water is refilled every 14 days. It has a two tire axles and a hitching point for pulling the machine. Usually at least six people are involved in operating the machine, two on top and four on the ground. From its design the machine is moved from one area to another manually as shown in picture above. The general dimensions of the machine is 2.2 X 1.8 X 1.2 m. The engine used has the following specifications: Max output power is 24HP@2200rpm, net mass is 194 kg. The total weight of the threshing machine is approximately 650 kg.

MILLET THRESHER:

These machines have designed capacity of producing 1200 kg of threshed pearl millet grains each hour. Their engines are water cooled. Other specifications are similar to that of maize shellers except that the machine weighs less, about 400 kg.

Implementation constraints

- There are a number of constraints impeding the implementation of the UPS, including:
- Difficulty of moving the machines from one place to other: This can be addressed by using a tractor for the maize sheller and animal draught for millet thresher.
- Appreciable dust generation while operating the machine: This can be mitigated by having the operators wear a mask over their eyes, nose, and mouth.
- Group management disputes: This can be handled by putting in place a viable group management guided by their own formulated group constitution.
- Need of fuel and maintenance experts: This can be handled by having fuel venders and maintenance experts within the locality.
- Business model requirement: The model should be in place to ensure the viability of the UPS introduced.

Linkage to other FVC components

The UPS is linked to the natural resources and crop production, as these FVC components have some UPS that contribute to obtaining inputs (maize and millet) to feed to the UPS in question. This UPS is also linked to marketing and consumption as it produces the maize and millet grains that can be commercialized (grain) and consumed (food).

Considerations & criteria for UPS outscaling

UPS outscaling potential exists as the farmers in Ilakala have managed to shell maize in the neighboring Ulaya village. In addition, as the UPS group was set out on business bases, its sustainability is possible, to the point of being able to expand the enterprise. The expansion of the enterprise will reach neighboring villages as the demand for the services is high in the region.

Key lessons learned

- Maize shelling and millet threshing efficiency and effectiveness can be improved in rural areas by introducing mechanized shelling and threshing.
- The role of gender is changing as now men are more involved in shelling and threshing activities than they were before.
- Maize shelling and millet threshing machines have the possibility of creating employment in the community.

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