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Modification And Testing Of Jimma Adjustable Hand Maize Sheller

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***Abstract*— It is more of the responsibility of women in rural Ethiopia to shell maize for household consumption which they mostly do it using conventional finger–palm method for the removal of kernels by pressing it between thumb and hand palm which is laborious and painful. Motorized and simple hand held devices have so far been developed with objective of improving labor productivity, reducing the drudgery work and minimizing finger sore. However, lower shelling capacity of existing hand held devices and costs of motorized shellers necessitated availing mini hand maize sheller adjustable to a varying cob diameter and having an overall dimension of 30cm×11.5cm×27cm was developed. The test crop maize had grain moisture content of 14.7% wet basis (w.b). Maize shelling using the developed hand sheller resulted in causing no damage to maize kernels at all. The results revealed that the sheller has mean shelling capacity of 26.26 kg/hr. Shelling efficiency 99.67% was obtained. The average value for visible grain damage was 0.21% and 0.13% for sheller and conventional methods respectively.**

Keywords—Maize sheller; adjustable; shelling; kernel damage

I. INTRODUCTION

Maize is the most important cereal grain in the world, after wheat and rice, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and, more recently, fuel. Maize shelling involves detaching of the maize grain from its cobs [1, 2]. Maize shelling is among the major activities involved in the processing of maize like harvesting, drying, de-husking, storing, and milling [2]. All these processes are costly and for the rural farmers to maximize profits on their produce, appropriate technology suiting their needs must be used. Maize shelling is a necessary process subsequent to harvesting because the maize kernels when harvested are firmly attached to the hard cob [3].

Shelling of the dried cobs by majority of farmers (about 96%) in the study area is carried out by repeated beating of the cobs with a club while held inside Sacks, open barrels or spreading it over plastered ground floor in the house or outdoor [4]. This methods cause damage to the kernels and are time consuming involving drudgery [1, 2, 3]. Other traditional maize shelling technique is rubbing the maize cobs against one another by hand or by direct removal of kernels pressing it between thumb and hand palm. This option is being used and known for low shelling capacity of about 8 kg/hr to 10 kg/hr [5, 3].

Shelling using simple shelling tools like CENEEMA and TPI hand held maize shellers is another option compared to earlier conventional shelling method though the shelled grain average output capacity achieved by these devices range between 10 kg/hr to 15 kg/hr [6, 7]. The drawback of these shellers is not only their comparatively small output capacity but also the difficulty to shell all diameter of maize cob. Motorized and manually operated shellers with a satisfactory shelling performance have already been developed and being used in the country by farmers. However, there are farmers who could not afford these improved shellers due to their prices and still using the conventional method at household level. Thus, the search for a satisfactory, cheap and effective means of detaching the kernels from the cob is important alternative technology to the small and even medium size farmers in the country to be used at family level. Therefore, the aim of this study was to develop mini hand maize sheller with a comparatively better performance and which can be one shelling technology option to be used at family level.

Objective of the study

- To develop adjustable hand maize sheller
- To test the performance of the hand maize sheller

II. MATERIALS AND METHOD

A. *Development of the Sheller*

Adjustable hand operated maize sheller was developed in Jimma Agricultural Mechanization Research Center workshop. Its preliminary and final test was conducted in same center. Hand maize

sheller with dimensions 30cm×11.5 cm×27cm consists of a wooden standing frame and rolled, adjustable metallic sheet shelling unit having ring diameter of 10.5 cm (Fig. 1). The shelling unit shells out the kernels from the maize cob when the cob is manually inserted and rotated against the shelling unit which is threaded bolt assembly (Fig. 2).

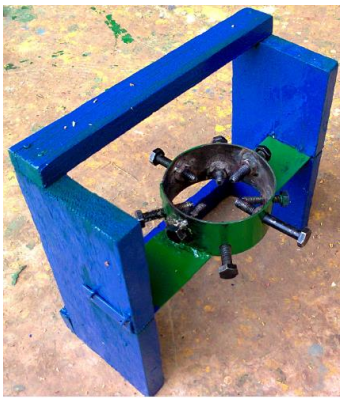

Fig. 1. *Adjustable hand operated maize sheller*

Fig. 2. *Shelling activity using adjustable hand maize sheller*

B. Evaluation of Sheller

The operators were given the tips of information regarding shellers' operation for 10 minutes before starting the actual trials. In each trial the sheller was operated with 9 kg of cobs for a given time recorded to shell the maize cobs. Three trials were conducted by sheller and conventional (finger-palm) method. The local variety of maize called *Orome* relatively known for its difficulty to detach the kernels from its cob was used for the experiment at moisture content of 14.7% (w.b). The weight of partially shelled kernels, spread kernels, damaged kernels and completely shelled cob was recorded after each trial to determine shelling capacity, shelling efficiency, collection efficiency and kernel damage percentage. The definitions and calculations of these parameters are as under. Performance test of sheller was conducted in Kersa woreda during threshing season of 2015. Shelling capacity, percentage of unshelled grains, shelling efficiency and kernel percentage damage of the thresher were calculated using the procedures of [3, 8]. The collected data were finally analyzed using descriptive statistics.

Shelling Capacity

The weight of the maize kernels detached from the cobs in unit time was taken as shelling capacity. It was calculated as:

$$\text{Shelling capacity (kg/hr)} = \frac{\text{Weight of shelled maize kernels (kg)}}{\text{Time (min)}} \times 60$$

Percentage of Unshelled Grains

$$\text{Percentage of unshelled grains (\%)} = \frac{\text{Quantity of unshelled kernel from all outlets (kg)}}{\text{Total kernel input (kg)}} \times 100$$

Shelling Efficiency

It is the percentage by weight of shelled kernels from all outlets of the sheller with respect to total kernel input.

$$\text{Shelling efficiency (\%)} = 100 - \text{percentage of unshelled kernels}$$

Kernel Damage Percentage

The ratio of weight of damage kernels to total weight of kernel was taken as Kernel damage percentage.

$$\text{Kernel damage (\%)} = \frac{\text{Weight of broken grains (kg)}}{\text{Weight of shelled maize kernels(kg)}} \times 100$$

III. RESULT AND DISCUSSION

The test result showed that the newly developed adjustable hand maize sheller is easy to operate and comparatively better in output capacity of 26.26 kg/hr with 99.67% efficiency (Table I).

Shelling capacity

The mean kernel shelling capacity of hand maize sheller was 26.26 kg/hr (Table I).The kernel mean shelling capacity using conventional shelling method was 12.63 kg/hr. Higher mean shelling capacity which is approximately 2.1 times more than conventional method of shelling was attained. During conventional method of shelling, pain following a sore containing watery fluid was observed on thumb of operators that lasted for four to seven consecutive days whereas it never appeared on operators while shelling using adjustable hand maize sheller.

Table I. PERFORMANCE OF JIMMA ADJUSTABLE HAND MAIZE SHELLER

Shelling Method	Replication	Shelling Capacity (kg/hr)	Shelling Efficiency (%)	Kernel Damage (%)
Conventional (Finger-palm)	Rep1	12.23	100	nil
	Rep2	16.62	100	0.4
	Rep3	9.03	100	nil
Mean		**12.63**	**100**	**0.13**
Adjustable Hand maize sheller	Rep1	19.30	99.57	0.14
	Rep2	34.08	99.88	0.44
	Rep3	25.41	99.55	0.04
Mean		**26.26**	**99.67**	**0.21**

Shelling Efficiency

The mean shelling efficiency of sheller was 99.67% while 100% was attained using conventional finger-palm method (Table I).

Kernel Damage

The developed adjustable hand maize sheller and conventional shelling method detached the kernels from cobs with visible kernel damage of 0.21% and 0.13% respectively (Table I).

IV. CONCLUSION

The average kernel shelling capacity and shelling efficiency of the sheller was 26.26 kg/hr and 99.67% where as that of conventional method was 12.63 kg/hr and 100% respectively. The level of visible grain damage to the detached kernels recorded by both methods does not almost exceed the standard (0.2%) set by Ethiopian commodity exchange as standard for quality maize in Ethiopia in terms of damaged kernels [9]. Thus the sheller seems to solve the problem that rural women facing to shell maize for household consumption.

V. RECOMMENDATION

In comparison with conventional shelling method, the sheller has a better output capacity, reasonable shelling efficiency and kernel damage. It is therefore recommended to demonstrate and pre-scale it up to solve the problem the rural women are facing for maize shelling at household level.

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