Demonstration And Evaluation Of Engine Operated Cereal Crop Winnower In Jimma Zone

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Abstract—**The study was conducted in Jimma Zones of Oromia Regional State, Ethiopia. The objective of the study was to demonstrate and evaluate the engine operated winnower performance for cereal crops (wheat, teff, & maize & sorghum) under the farmers' condition at the study area. Four sites were selected as hosting centers for the popularization of the technology at different sites namly Chalte, Doyo Yaya, Sito and Soya Adami selected from two districts (Dedo, and Nada,) for the study. Total of 174 farmer (60 Female, 114Male) households have attended the field demonstration at different sites involving men and women participation. The evaluation result showed that the machine has saved farmers' labor and time having average time taken 18.67, 38, 45.33 and 40.66 seconds for maize wheat teff and sorghum, with winnowing capacity 9.28, 4.14, 3.37 and 3.83 kg/min, cleaning efficiency (%) of 96.33, 87.44, 84.78 and 86.67 showing significantly different across the crops and the machine perform the winnowing activity in a better way than the local methods with relatively less percentage of the product loss 0.35, 3.58, 6.06 and 7.10 for maize, wheat, teff, and sorghum seeds respectively. The participant farmers' perception responses being in the range of 56% to 82 % showed that the engine operated winnower has good capacity where as 18 to 44 % responded to medium level while no respondents ranked it to poor capacity for all the crop varieties. As a result, most of the farmers have positively perceived to this machine towards its capacity. Concerning the cleaning efficiency of the machine, the participant farmers in the range of 56% to 78 % also perceived that it has good cleaning efficiency. Almost 22 to 44% respondents perceived that the machine ranked to have a medium cleaning efficiency for the four varieties under the study while no respondents perceived the machine has poor cleaning efficiency for all the varieties.**

Keywords—Winnower; engine operated, Capacity; Cleaning Efficiency; Grain Loss; Crops.

Introduction

The crops are the first cultural grasses belonging to the poaceae family. In Ethiopia several agricultural production constraints are encountered at different crop growth stages. Energy and the timeliness are the major practical problem encountered in crop production activities, mainly due to lack of appropriate technologies. Post harvest loss is estimated to be about 25% of the total production (FAO, 1976). Improving the post harvest systems will reduce the post production losses. It has a great contribution to food security, raises the living standards in rural and urban areas. In urban area it makes the food available, more effectively and at a lower cost benefiting the poor member of the society in particular through to its c contribution to the generation of farm and non-farm income (Nuru, I (1980).

In wide ranging view, the post harvest activities comprises threshing, winnowing, grading, transport and storing. The winnowing operation, commonly known as grain cleaning is traditionally practiced in most part of the country using local equipment such as darba, afersa, korbi, gundo, hatola, sieve and other accessories. Problems like timeliness, high energy requirement, loss while blowing and removing larger chaff/straws fallen on the clean seed, seed and chaff mixing are happened while using these local equipments. Because the activity will depend on the natural wind, at times the threshed crop is left in hogdi (threshing field) for about 1-2 days in the absence of wind and when the wind speed is high, the seed can be taken away by with the straw/chaff. The average threshing and cleaning out put per man-hour for wheat is sorghum, millet, and maize is 5.5, 6.5, 4.0, 1.5 km/man-hour respectively (R.N.Kaul et al 1994).

However, on the contrary to the above facts, literatures show that multipurpose post harvest farm cleaning and equipments constituting, winnowing grading capabilities are now available at global level in a wide range performance levels (Shimelis, A., 2001.). Similarly in some part (institutions) of our country, though not widely promoted and used by farmers, there are some improved winnowers, which

can help to alleviate the operational problems encountered in winnowing.

Likewise Bako Agricultural Engineering research Center developed engine operated cereal crop winnower machine. Therefore, based on the demand from the farmers of the research mandate area, the machine is demonstrated in selected Dedo and Nada districts of Jimma Zone.

Objective of the study:
- To create awareness on engine operated cereal crop winnower

- To evaluate the performance of engine operated cereal crop winnower farmers' management

- To collect users feedback on farmers perception for future improvement

Material and Method
Material
The prototype for engine operated winnower that made by Bako Agricultural Engineering Research Center was manufactured in Jimma Agricultural Engineering Research Center used for demonstration purposes of different grain size crops. The demonstration was conducted during the crop threshing season in selected two Kebeles selected from Dedo and Nada districts in Jimma Zone. A participatory FRG that consists of fifteen (15) members was formed in every identified Site.
The technical training on general cereal crop processing technology was given to farmer groups at the FTCs and the hosting farmers' site that was followed by demonstration and participatory evaluation of the technology. Finally, the evaluation data and feedback on the farmers' perception on the technology was collected and analyzed.
A sample of three kilograms was taken from crops namely maize, wheat teff, and sorghum at three test sites that were used to know the machine performance. Three kilograms of crops were used in each case to generate performance data.
Field Evaluation

The evaluation of engine operated cereal crops was conducted in farmer's field at Dedo and Nadda of Jimma zone districts under the farmers' field condition. Separation and cleaning process was made along the sieve length as grain and chaff straw were transported over the sieve. The performance evaluation of the separating and cleaning machine was made on the basis of the following parameters; separating, cleaning efficiency, grain loss and cleaning capacity.
Where:
M1= the mass of impurities after cleaning (kg),
M2= the mass of impurities before cleaning (kg),
M3= the mass of grains after cleaning (kg),
M4= the mass of grains before cleaning (kg),
CE = cleaning efficiency (%) and GL = grain loss (%)

Data collected
Quantitative data on the machine performance based in terms of time and labor consumed in Man-hr per kg/hr.
Qualitative data through: observation and interview and Feedback data and comments from participant farmers

Method of data analysis:
The quantitative and qualitative data collected on the technical performance and the perception through interview, observation and group discussion and analyzed by using descriptive statistics.

Results and Discussion
Training Farmers, SMS and DAs on the engine operated crop winnower machine

Both practical and theoretical trainings were given for the participant farmers, Subject Matter Specialists (SMS) and Development Agents (DAs) that exist at the selected Kebele level on the operation and maintenance of the engine operated crop winnower machine to create awareness before actual demonstration carry out at large. Accordingly a total of 51 farmers, 8 DAs and 6 Subject Matter Specialists were participated in training.

Table1. Training given to farmers, DAs & SMS

No	Location		Training Participants				
			Farmers		Others		Total
	District	Kebele	Adult	Youth	DAs	SMS	
1	Nada	Doyo Yaya	4	8	2	2	16
		Soyadami	5	7	2	1	15
2	Dedo	Calte	7	6	2	1	16
		Sito	8	6	2	2	18
	Total		24	27	8	6	65

On-farm Evaluation of improved crop cereal winnower
Winnowing involves removal of larger chaff/straws to have the clean seed separately. It can be adjusted as per the crop variety by changing the sieve with

different size. This winnower is specially designed to maze, teff, sorghum, wheat and barley crops.
The performance of the winnower was calculated as follow:
Winnowing capacity = weight of winnowed grain/time taken

Cleaning efficiency =total weight of winnowed grain /total weight of the sample (input) x 100 Loss = total

weight of the sample (impute)-output per input x100

Table 2. Average performance of engine winnower for cereal crops (maize wheat, teff, and sorghum) under the farmer's management

Rep	Time taken(sec)	Winnowed grain (kg)	Chaff blown(kg)	Cleaning Efficient (%)	Winnowing capacity (kg/min)	Loss (%)
Ma	17	2.85	0.12	95	10.05	0.71
Mb	19	2.89	0.08	96.33	9.12	0.11
Mc	20	2.93	0.07	97.66	8.77	0.24
Av	18.67	2.89	0.09	96.33	9.28	0.35
Wa	40	2.71	0.21	90.33	4.07	3.51
Wb	36	2.56	0.25	85.33	4.27	3.23
Wc	38	2.60	0.24	86.67	4.11	3.99
AV	**38**	**2.62**	**0.23**	**87.44**	**4.14**	**3.58**
Ta	45	2.55	0.33	85	3.4	3.19
Tb	49	2.58	0.28	86	3.16	7.01
Tc	43	2.53	0.33	84.33	3.53	7.98
Av	45.33	2.55	0.31	84.78	3.37	6.06
Sa	37	2.54	0.31	84.67	4.12	6.85
Sb	43	2.69	0.24	89	3.75	5.47
Sc	42	2.57	0.29	85.66	3.67	8.99
Av	**40.66**	**2.60**	**0.28**	**86.67**	**3.83**	**7.10**

The letters a, b and c indicate the winnower evaluated at four different sites were as the letter M, W, T and S represent maize, wheat, teff and sorghum respectively.

On farm evaluation and demonstration of the improved engine operated winnower technology was made in teamwork with participant farmers, SMs and DAs. The improved machine is evaluated for maize wheat, teff, and sorghum seeds. The evaluation of the technology was made in terms of the machine clearing efficiency, clearing capacity and the grain loss percentage.

In view of that it has shown the average time taken 18.67, 38, 45.33 and 40.66 seconds for maize wheat teff and sorghum, with winnowing capacity of 9.28, 4.14, 3.37 and 3.83 kg/min having the cleaning efficiency (%) of 96.33, 87.44, 84.78 and 86.67showing significantly different across all crops and the machine perform the activity in a better way

than the local methods with relatively less percentage of the product loss 0.35, 3.58, 6.06 and 7.10 for maize, wheat, teff, and sorghum seeds respectively.

Demonstration of the improved cereal crops winnower

In this study, the farmers' feedback after the demonstration of winnower machine is collected based on evaluation criteria jointly set by researchers and farmers. These includes, values for optimum pulpier output capacity, visible grain loss, and cleaning efficiency considered for them and farmers' perception in respective of these criteria. Farmer to farmer learning is used to promote the technology simply by arranging winnowing program at the host farmer's farm site. Evaluation of the technology was made together with the participant farmers, based on the attributes recognized as important mainly clearing efficiency, clearing capacity and Loss (%) as per their perception.

Table 3 Participants on mini field days

No	Location		Participants of field days									
			Farmers				DAs & SMS		Others Stalk-holder		Total	
			Adult		Youth							
	District	Kebele	M	F	M	F	M	F	M	F	M	F
1	Nada	Doyo Yaya	21	9	10	8	2	2	2	1	35	20
2		Soya Adami	16	8	14	12	2	1	2	1	34	22
3	Dedo	Calte	14	7	15	10	2	1	2	1	33	19
4		Sito	13	3	11	3	2	0	3	0	29	6
	Total		**64**	**27**	**50**	**33**	**8**	**4**	**9**	**3**	**131**	**67**

Mini-field days conducted

Mini-field days were made at different sites namely Doyo Yaya, Soya Adami, Calte and Sito which attended by different stalking holders. In view of that, 174 farmers (60 Female, 114 Male), 12 agricultural workers (SMS and DAs), 12 others (Kebele Administrators and Researchers) have attended the mini field days.

Farmers' perception on the technology attributes

Farmers' perception

Data on technical operation and social perception aspects were collected and analyzed. The primary data on crop winnower were collected during and after demonstration on perception or farmers' opinion. Some of the attributes used about the technology was winnower efficiency (%), winnower capacity (kg/hr) and Grain loss (%). Farmers have positively perceived concerning the winnowing efficiency (%) of 96.33, 87.44, 84.78 and 86.67, winnowing capacity (kg/hr) 9.28, 4.14, 3.37 and 3.83 and Grain loss (%) of *0.35, 3.58, 6.06 and 7.10* values for maize, wheat, teff and sorghum respectively as it has good performance compared to the method of manual winnowing to clean the threshed grains of the rural farmers at the study areas.

Table 4. Farmers' Perception on improved winnower for Maize, Wheat, Teff and Sorghum crops

Attributes used for acceptance degree	scale measurement	participants' reaction per Crop Variety (No=32)							
		Wheat		Teff		Maize		Sorghum	
		Column Fr	%	Column Fr	%	Column Fr	%	Column Fr	%
Winnowing capacity (kg/hr)	Poor	-	-	-	-	-	-	-	-
	Medium	13	41	14	44	4	18	10	31
	Good	19	59	18	56	28	82	22	69
Cleaning efficiency %	Poor	-	-	-	-	-	-	-	-
	Medium	10	31	14	44	7	22	14	44
	Good	22	69	18	56	25	78	18	56
Grain loss (%)	Poor	-	-	-	-	-	-	-	-
	Medium	5	16	7	22	6	19	8	25
	Good	27	82	25	78	26	81	24	75

The participant respondents replied that the winnower machine has good cleaning capacity are in the range of 56% to 82 % where as 18 to 44 % responded medium level while no respondents ranked it to poor cleaning capacity for the four crop varieties. Thus it showed that most of the farmers have positively perceived to this machine towards its cleaning capacity.

Furthermore, the participant respondent farmers were also perceived in the range of 56% to 78 % that it has good cleaning efficiency. Respondents of virtually 22 to 44% had perceived that the machine was ranked to have a medium cleaning efficiency for the four varieties under the study while no respondents perceived the machine has poor cleaning efficiency for all the varieties.

The response on the winnower also showed its strength and drawbacks as to the farmers' observation during the field work. Farmers just liked it in its less grain loss while winnowing or cleaning the seed and easy to operate and other time and labor reducing attributes.

However, they commented on its construction and strength so as to avoid easily damage during operation. The machine needs some refining work based on the users' remark to upgrade its winnowing capacity and efficiency for more accuracy per the required desire.

Conclusion and Recommendation

Conclusion

The improved crop winnower was evaluated and demonstrated on farmers' farm site for maize, wheat, teff, and sorghum seeds in terms of the machine clearing efficiency, clearing capacity and the grain loss percentage.

The machine has saved farmers' labor and time having average time 18.67, 38, 45.33 and 40.66 seconds, capacity of 9.28, 4.14, 3.37 and 3.83 kg/min, cleaning efficiency (%) of 96.33, 87.44, 84.78 and 86.67 with relatively less percentage of the product loss 0.35, 3.58, 6.06 and 7.10 for maize, wheat, teff, and sorghum seeds respectively.

Most farmers have positively perceived to this machine for its good capacity, cleaning efficiency, less grain loss during cleaning the seed, easy to operate, save time and labor.

Recommendation

Accordingly, based on the study result, the machine need be scaled up to the cereal crop producer farmers of the region with special care in properly following the appropriate designee during the manufacturing.

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