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Participatory Demonstration Of Bako Modified Engine Operated Dry Coffee Dehuller Machine Though FRG In South Western Oromia

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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 Bako Modified Engine Operated Coffee Dehuller machine performance under the farmers' condition at the study area. Five sites were selected as hosting centers for the popularization of the technology at different sites namely Wanja Kersa , Suse, Kedamasa, Kenteri and Seko selected from four districts (Gera, Goma Mana and Dedo) purposively. Total of 69 farmers (19 Female, 50 Male) and, 10 agricultural workers (SMS and DAs), 16 others (Kebele Administrators and Researchers) have attended the mini field days. The performance evaluation of the technology was made based on the attributes recognized as important showed that average capacity of 120.19g/sec, dehulling efficiency (78.65%) and breakage of 8,12 % having good dehulling performance as preferred by the participant farmers that need be scaled up for wider popularization.**

Keywords—Demonstration, Dehuller, Coffee, Engine Operated, Capacity, Efficiency.

Introduction

Agriculture is the most important economic sector of the country. According to the data from the Central Statistical Agency (CSA, 2015) it contributes 42 % of the GDP, 85% of the foreign earnings and employs around 85 % of the total population of the country.

Coffee is one of the world's most vital agricultural commodities and the primary source of income for125 million people globally (Werrell & Femia, 2017). According to the International Coffee Organization (ICO), it is also one of the most traded agricultural commodities in the world and a source of income for millions of smallholder farmers, mostly in middle- and low-income countries (ICO, 2021). Ethiopia is the largest producer of coffee in Africa and the fifth in the world, next to Brazil, Vietnam, Colombia, and Indonesia, contributing to about 4.2% of the global coffee production (International Coffee Organization,2021b),(Rica&Salvador, 2021)

The country has a diverse ecology and production system for growing coffee in all regional states with varying ranges of suitability and area coverage. Nevertheless, the major coffee growing areas are concentrated in the southwestern, southern, western, and eastern parts of the country (Reay, 2019). According to (Tassew et al., 2022), the estimated area of land covered by coffee in Ethiopia is about 0.8million ha of land whereas, estimated annual production of coffee is about 0.5million tons with average productivity of 0.63 tons ha-1.

Coffee is one of the most tradable agricultural commodities in the world and plays a very important role in the national economies (Wolde, 2017, Cochet, 2014). It is the major source of foreign currency and employments for Ethiopia and it contributes about 4-5% of GDP, 10% of total agriculture production, 25–30% of total export earnings and 80% of total employment ((Esteri, 2016), Worku, 2019). Over 25% of the population of the country are directly or indirectly engaged in the production, processing, trading of coffee and deriving a major part of their livelihoods from coffee (Gardens et al., 2019; Ayele et al., 2021).

Coffee land coverage and dependency of smallholder farmers on coffee is high especially in southwest Ethiopia. Jimmaa zone is one of the potential coffee growing zones in Oromia region, which has a total area of 1.1millions hectares of land (Gashaw & Shumeta, 2018). According to (Diro et al., 2019) the share of coffee income from total income in coffee producing districts of Jimma zone is 77% and share of land allocated to coffee crop in these areas is more than 69%. This shows that coffee is not only the source of cash and income; but also the means of livelihood for the smallholder farmers of the area. Despite the abundant opportunities in the zone for increasing coffee production & productivity, such as a suitable growing environment, and variety of local coffee types, coffee quality is declining from time to time.

These quality problems are mainly associated with improper post-harvest processing and handling practices such as drying on bare ground, improper wet dry processing, storage and transportation, (Fininsa, 2019). Among, the problem of post-harvest processing and handling, dry coffee pulping being practiced in the study area is traditional methods. The local farmers de-hull their coffee by using pestle,

which leads to low quality of coffee, time consuming and laborious activity.

Taking these problems in to account, demonstration and on farm evaluation of engine operated dry coffee DE hulling machine was undertaken by the Jimma Agricultural Engineering Research Centre (JAERC). The machine had demonstrated and evaluated at different purposively selected districts. It has average capacity of 87kg/hr., with efficiency of 76.7% and minimizes wastage of crop and time to de-hulling it.

Object of the study

- ❑ To create awareness on engine operated coffee dehuller at small farmers level in the
- ❑ To evaluate coffee dehuller machine under farmers condition
- ❑ To get feed backs on the improved dehuller from farmers and other stake holders

Materials and Methods

Materials

Raw materials used for manufacturing the prototype of engine operated coffee dehuller were produced and the prototype was manufactured in Jimma Agricultural Engineering Research Center production workshop. Dry coffee was used to demonstrate and evaluate the machine.

No.	Item description (list of raw materials)	Unit	Quantity
1	Mild steel	Pcs	4
2	Angle iron	Pcs	20
3	Bearing with housing	Pcs	4
4	Metal sheet	Pcs	15
5	Belt	Pcs	2
6	Cast steel	Pcs	2
7	Shaft	Pcs	2
8	Bolt and nut	Pcs	400
9	Paint	Kg	15
10	Antirust	gal	1
11	Bolts and nuts (10 dia)	Pcs	15
12	Engine	PCS	1
No.	**Item description (list of raw materials)**	**Unit**	**Quantity**
1	Mild steel	Pcs	4
2	Angle iron	Pcs	20
3	Bearing with housing	Pcs	4
4	Metal sheet	Pcs	15
5	Belt	Pcs	2
6	Cast steel	Pcs	2
7	Shaft	Pcs	2
8	Bolt and nut	Pcs	400
9	Paint	Kg	15
10	Antirust	gal	1
11	Bolts and nuts (10 dia)	Pcs	15
12	Engine	PCS	1

Source; from own data

Sites Selection, Farmers identification, and FRG organization techniques

Demonstration of engine operated coffee dehuller technology was conducted Jimmaa and Bunnoo Bedellee zones of Oromia region. Purposive sampling method was employed to select each representative districts and respective kebeles. Accordingly, Five districts namely Dedo, Manna, Gomma, Gera districts from Jimma & Bedele district from Buno Bedele zone were selected purposively based on status of coffee production. Seven kebeles namely, Omo Funtule, Omo Gurude, Waro Kolobo, Waro Sombo, Kenteri, Jisa & Ilaala kebeles were selected purposively based on existence of coffee & accessibility for demonstration.

Selection of FRGs members was based on farmers consent or interest to be held as member, accessibility for supervision of activities, good history of harmony with groups and transparency to share innovations to other farmers. To this end, one FRG having 20 members with the arrangement of all classes of farmers including gender with proportion of almost 70% to 30% men and women respectively was established at each selected kebeles to improve better communication and learning system among Farmers, researchers and other extension agents. Lastly, one host farmer was selected based on his

willingness, his potential for coffee production, and suitability and proximity to all FRG members to attend on all demonstration activities from each established FRG. To this end, all FRG members and other follower farmers were encouraged to participate during demonstration conducted at each site.

Technology demonstration techniques

During demonstration and evaluation of engine operated dry coffee dehuller machine, Agricultural Extension Participatory Approach (PA) that consisted of group meeting (FRG) and field demonstrations were used as the main methods to enhance involvement of the farmers in all demonstration process and, ensure maximum engagement through discussions and interactions among participants as well as with the facilitators.

Capacity building techniques

During provision of extension services such as training and mini-field days, Farmers to Farmers Communication Approach was used with the aims of improving better communication and learning system among Farmers, researchers and other extension agents. Thus, training and mini-field day were organized at all demonstration sites through extension teaching methods such as, individual methods, group discussion method, result and method demonstration with the purpose of, creating awareness and enhancing knowledge & skills of the farmers toward engine operated dry coffee dehuller machine.

Type of data collected and data collection methods.

Data collection is the process of collecting and measuring information on specific attributes of technology. So that, for this study necessary data was collected for the purpose of gaining a better understanding of participants conviction and finding areas of improvement. To collect both qualitative and quantitative data several methods of data collection were employed. Those methods are face-to-face interviews, observation and focus group discussion (FGD). Types of data collected are, machines performance like capacity (kg/hr.), efficiency (%) and breakage loss(kg), number of farmers participated on extension events (demonstration, training and mini-field days), farmers opinion toward demonstrated technology.

Method of data analysis

The collected quantitative data was expressed in numbers and analyzed by descriptive statistics like, frequency, percentage whereas, the qualitative data was expressed in words and analyzed by interpretation, and categorizations through three stages of Likert scale ranking method.

Result and Discussion

Training Farmers, SMS and DAs on the engine operated coffee dehuller machine

Practical and theoretical trainings were given for the participant farmers, Subject Matter Specialists (SMS) and Development Agents (DAs) at the selected sites on the operation and maintenance of the machine to create awareness during demonstration. Accordingly a total of 68 farmers, 7 DAs and 6 Subject Matter Specialists were participated in training.

Table1. Training given to farmers, DAs & SMS on engine operated coffee dehuller machine

No	Location		Training Participants				
			Farmers		workers		Total
	District	Kebele	Adult	Youth	DAs	SMS	
1	Gera	Wanja Kersa	12	5	1	1	19
2	Goma	Omo Funxule	8	4	2	1	15
3	Goma	Kedamasa	9	6	1	1	17
4	Mana	Kenteri	7	2	1	1	11
5	Dedo	Seko	10	5	2	2	19
6	Total		46	22	7	6	81

Table2. On-farm Evaluation of engine operated dry coffee dehuller machine

Site	Sample (g)	Time (sec)	unpulped (g)	Broken(g)	Capacity(g/sec)	Efficiency (%)	Percent of breakage (%)
Goma, OF1	6000	44	883.33	500.00	136.36	77.92	8.33
Goma, OF2	6000	40	816.67	611.11	150.00	79.58	10.19
Goma, OF3	6000	50	1000.00	555.56	120.00	75.00	9.26
Average	**6000.00**	**44.67**	**900.00**	**555.56**	**134.318**	**77.50**	**9.26**
Gera, WK1	6000	45	916.67	577.78	133.33	77.08	9.63
Gera WK2	6000	57	733.33	600.00	105.263	81.67	10.00

Gera WK3	6000	52	816.67	600.00	115.384	79.58	10.00
Average	**6000.00**	**51.33**	**822.22**	**592.59**	**116.89**	**79.44**	**9.88**
Dedo Seko1	6000	54	833.33	488.89	111.11	79.17	8.15
Dedo Seko2	6000	49	1083.33	388.89	120.44	72.92	6.48
Dedo Seko3	6000	49	1000.00	333.33	120.44	75.00	5.56
Average	**6000.00**	**50.67**	**972.22**	**403.70**	**118.41**	**75.69**	**6.73**
Mana, Kenteri1	6000	50	666.67	388.89	120.00	83.33	6.48
Mana, Kenteri2	6000	55	583.33	411.11	109.09	85.42	6.85
Mana, Kenteri3	6000	54	916.67	388.89	111,11	77.08	6.48
Average	**6000.00**	**53.00**	**722.22**	**396.30**	**113.20**	**81.94**	**6.60**
Grand Average	**6000.00**	**49.92**	**854.17**	**487.04**	**120.19**	**78.65**	**8.12**

Note: OF (Omo Funtule), WK (wanja Kersa) sites

The performance evaluation of the technology was made based on the attributes recognized as important showed that average capacity of **120.19** g/sec, dehulling efficiency (78.65%) and breakage of 8,12 % showing good performance.

Thus, the above table indicates that the engine operated dry coffee dehuller machine has good dehulling efficiency as preferred by the participant farmers.

Demonstration of the improved engine operated coffee dehuller machine

Mini-field days conducted

Table3. Participants on field day

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	Gera	Wanja Kersa	6	3	2	1	1	1	2	2	11	7
2	Goma	Omo Funxule	5	2	1	2	1	-	3	2	10	6
3	Goma	Kedamasa	7	2	4	2	2	-	2	1	15	5
4	Mana	Kenteri	8	1	3	-	2	1	2	-	15	2
5	Dedo	Seko	10	4	7	2	1	1	2	0	20	7
	Total		36	12	14	7	7	3	11	5	71	27

In view of that, 69 farmers (19 Female, 50 Male), 10 agricultural workers (SMS and DAs), 16 others (Kebele Administrators and Researchers) have attended the mini field days.

Farmers' perception on the technology attributes

Table4. Farmer's perception toward engine operated dry coffee dehuller

Attributes used for acceptance degree	scale measurement	participants' reaction on coffee dehuller (No=29)	
		Frequency	Percentage %
Dehuller capacity (kg/hr)	Poor	-	-
	Medium	8	29.58
	Good	21	72.41
Dehuller Efficiency %	Poor	-	-
	Medium	2	6.9
	Good	27	93.1
Breakage/loss (%)	Poor	-	-
	Medium	1	3.5
	Good	28	96.5

The participant farmers' perception responses showed that 72.41% replied the engine operated dry coffee dehuller machine had good dehulling capacity and the rest 29.58% responded it to the medium performance. Similarly, 93.1responses replied for good dehulling efficiency. Yet no respondent responded for its poor level of capacity and efficiency. Hence, most participant farmers perceived its performance positively.

3. Conclusion and Recommendation

Conclusion

- The engine operated dry coffee dehuller machine had average capacity of 120.19 g/sec, dehulling efficiency (78.65%) and breakage of 8.12 % with good performance.
- The perception responses showed that the participant farmers viewed the dry coffee dehuller machine positively for its good dehulling capacity and efficiency while no respondent responded for its poor level of dehulling capacity.

Recommendation

- The research centre has to arrange the follow up training for local microenterprises and the end user for sustainable utilization of the technology.
- As the improved dry coffee dehuller machine was appropriate for small and medium level coffee producer farmers and private investors, it has to be scaled up.

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