Original Research Article||

Pre-extension demonstration and evaluation of enset processing technologies in selected districts of west Shewa and southwest Shewa zones, Oromia, Ethiopia

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Abstract

The pre-extension demonstration of the engine driven enset (*Enset ventricosum*) processing machine was conducted in 2021 in the West Shewa and South-West Shewa zones of Oromia with the objectives of demonstrating and evaluating engine-driven enset processing machines under farmers' conditions and creating awareness of the availability and importance of the technologies. Toke Kutaye and Dirre Incinni woredas from West Shewa and Waliso from Southwest Shewa zonal administrations of Oromia Regional State were purposively selected based on enset production potential covering a total of five kebeles (Afinjo Dega, Omi Anni, Maaruuf, Obi Koji and Xombe Anchebi. Fifteen farmers from each kebele were also selected purposively based on their enset production experience. One host farmer was selected based on their willingness. Training and demonstrations were conducted in 2020 and 2021 in the selected districts to create awareness and understanding among other farmers, Development agents and experts on the operation, management, and advantage of the enset processing machines. Accordingly, training was given to 60 farmers (45 females), 6 development agents, and 11 agricultural extension experts. Data were collected through Focus Group Discussions and observation. The collected data were grouped, summarized, discussed, and interpreted. The results revealed that five enset can be decorticated in 1.08 hr. at 790- 880 rpm using an engine-driven decorticator, which would otherwise needs 8 hrs. for 3-4 women to traditionally decorticate 5 enset. A corm of 5 medium enset was grated in 10 min at 2200 rpm using an engine operated corm grating machine, a process that could traditionally needed 8 hrs. for 3-4 women. The traditional practices are inefficient; requiring a lot of labor and time and also it is one of the major problems which leads to physical damage. Therefore, the technology is highly preferred and thus should be widely available and recommended for further pre-scaling up.

Key words: Demonstration, enset processing machines, decorticator, enset grating, qualitative evaluation

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INTRODUCTION

Approximately one-fifth of Ethiopia's population currently relies on enset as a staple or co-staple diet (Country STAT Ethiopia, 2016). Men assist with cutting and harvesting mature plant, but processing is an extremely labor-intensive process that is mainly done by women.

Traditional Enset decorticating and squeezing methods are complete abomination. It entails putting a leaf sheath on an inclined *watani*, holding it up with one foot from a sitting posture, and scraping the leaf with both hands with a *sibisa*, *hadu*, or other scraping tool (Dereje, 2009). This process is time-consuming, labor-intensive, unsanitary, inconvenient for female workers, and associated with significant yield loss.

Farmers' still use traditional corm grating techniques. Indigenously carved wood implements serrated on one end were used to chip the corm in traditional grating processes. Traditionally, grating takes about 2-3 hours per tuber. Enset tubers cannot be stored longer after harvest before decaying, implying that processing should follow immediately.

To address these issues and reduce the strain on women farmers and boost labor efficiency, research on mechanizing enset processing has begun. Bako Agricultural Engineering Research Center (BAERC) has designed and tested engine-driven enset decorticator and corm grating machines.

The maximum grating capacity for the *Sharte* variety was 1277 kg hr^{-1} when the drum was rotated at 2200

rpm, while the minimum grating capacity for the *Baladati* variety was 604 kg hr^{-1}. when the drum was rotated at 2000 rpm. A total of 1.32 liters of fuel were consumed per hour (Kibi, 2018)

The machine is powered by a 10-horsepower petrol engine and has a decorticating capacity of 255.38 kg hr^{-1} with the highest decorticating efficiency of 98.97 %, and the lowest loss of 1.03 % were obtained at 850 rpm, 1 mm and 0.074 kg s^{-1} of drum speed, concave clearance and feeding rate respectively (Workesa et al., 2021). It is easily portable being moved only by two persons.

Increasing smallholder access to machinery on a large scale remains difficult, despite the small scale and increased affordability of many appropriate mechanization options. Smallholders, on the other hand, can benefit from the use of machinery through low-cost rental or service providers and hiring arrangements that reduce farmers' individual cost burdens associated with purchasing, owning, and maintaining machines (Diao et al., 2018; Mrema et al., 2014; Sims and Kienzle, 2017). Nonetheless, these options may incur higher transaction costs (Laxmi et al., 2007), which must be offset and appropriately accounted for in the respective business models. Furthermore, service provider arrangements can help farmers who own and operate machines become rural entrepreneurs by using machinery for profitable on- and off-farm activities (Sims et al., 2018). Such service bundling offers multiple benefits. By providing a diverse set of services to farmer clients, such service bundling can aid in the faster recovery of machinery investments (Baudron et al., 2015). Machine service provides a buffer against rising labor costs and scarcity in rural economies where rural-to-urban and international (e) migration occurs as a result of farmers seeking more lucrative employment opportunities (Gartaula et al., 2012; Biggs and Justice, 2015).

The presence and active role of private owners and repair and maintenance service providers are among the main reasons for the speedy adoption and use of agricultural mechanization technologies. However, there are few private owners in the demonstration sites of this investigation.

The current research was designed with the objectives of creating awareness and demand for the availability and importance of enset processing technologies; evaluating the capacity of the machines under farmers' condition, and assessing farmers' feedback for further improvement of the enset decorticator and corm grater machines.

MATERIALS AND METHODS

Description of the Study Area

The on-farm demonstration of the machines was conducted in West Shewa and Southwest Shewa zones. A district (woreda) is an administrative level that is composed of villages (kebeles). A kebele is the smallest unit of the administrative structure in Ethiopia. The selected sites/ districts were known for enset production which helps to improve their livelihood strategies for consumption as food and for income generation. Enset in West and Southwest Shoa zones is cultivated for a range of services. Every part of the plant is useful for something; Products such as *Kocho*, *Bulla*, and *Amicho* are three popular enset derived foods. While the crop has such importance, limited research has been done to improve the processing aspect of the crop and thus in most cases farmers are observed to use age-old traditional tools and techniques (Hunduma and Ashenafi, 2011).

Materials

The enset processing technologies that were used for pre-extension demonstration were enset processing technologies that are engine driven leaf sheath decorticator/scrapper and corm grater machines. The machines were developed by the BAERC of the Oromia Agricultural Research Institute.

Site and Farmers Selection

Toke Kutaye and Dirre Incinni *woredas* (sub-regional administrative divisions): from west Shewa, one *kebele* from each woreda, and Waliso from southwest Shewa zone, two kebele, were selected purposively covering a total of five *kebeles* namely: *Afinjo Dega*, *Omi Anni*, *Maruf*, *Obi Koji and Xombe Anchebi* (Table 1). Fifteen (15) farmers per kebele were selected purposively along with one volunteer host farmer. The farmers that hosted the demonstrations were selected in collaboration with extension workers.

Table 1. Summary of selected sites

Activity	Zones	District	*Kebele*
Pre-extension demonstration of enset Processing Technologies in West and South West Shewa Zones	West Shewa	Dirree incinnii	Afinjoo Dagaa
			Omi Anni
		T/Kuttaye	Maaruuf
	South-West Shewa	Waliso	Obi Koji
			Xombe Ancabbi

Technology Evaluation and Demonstration

On farm demonstrations were organized in each kebele, and farmers came to learn about and evaluate the demonstrated improved enset processing machines and farmers were able to compare the machines with their traditional practices. Method and result demonstration were used. Method demonstration was used to show the farmers how the technology decorticates the leaf sheath and grate corm of enset. The result demonstration was used to show the final products of the decorticated and grated enset products compared with traditional counterparts. The training was organized for farmers, development agents (Das), and subject matter specialists (SMS) to raise awareness on the importance, operation, management, and handling of enset processing technologies.

Data Collection

Both secondary and primary data were used in the present investigation. Primary data were collected through observation during the demonstration and through focused group discussion (FGD) after the demonstration. The capacity, time, and labor required for the machines were collected during demonstration while for traditional processing the labor and time required and the capacity were thoroughly discussed and agreed upon during the FGD among the participants.

As indicated in Table 2, five FGDs, two in Waliso; another two at Dirre Incinni, and one in Toke Kutaye were carried out in each kebele with a mixture of men and the majority of women to ensure the knowledge of both women and men was well represented in the demonstration. Holding a focus group discussion is an effective way to learn about people's interests, perspectives, opinions, and knowledge about different topics. Knowing the perspectives, attitudes, and desires of the target audience is essential to identify relevant support services, and dissemination approaches.

Table 2. Participants in the focus group discussions

Site	Districts	kebele	# Participants			Date
			Female	Male	Total	
West Shewa	T/Kuttaye	Maaruuf	11	4	15	Jan 30, 2020
	Dirree incinnii	Omi Ani & Afinjoo Dagaa	11	4	15	Jan 31, 2020
South-West Shewa	Waliso	Obi Koji	12	3	15	March 16, 2021
		Xombe Ancabbi	11	4	15	March 16, 2021

Data Analysis

The quantitative data was analyzed using descriptive statistics such as the mean, and qualitative data through clustering. The result was interpreted and discussed in comparison with other findings. Recordings of focus group discussions were transcribed and translated. The results were organized using Microsoft Excel and Word to combine and compare the results from the five focus group discussions. The analysis considered enset decorticator and squeezer separately.

RESULTS AND DISCUSSION

Awareness on Enset Processing Technologies

Training and demonstrations were conducted in 2020 and 2021 in Toke Kutaye and Dirre Incini districts of west Shewa and Waliso district of south-west Shewa in order to create awareness and understanding among farmers, DAs, and subject matter specialists (SMS) on the operation, management, and advantages of the enset processing technologies. Accordingly, training was given for 60 farmers (45 Females), 6 DAs, and 11 SMS (Table 3).

Table 3. Number of participant farmers, DAs and SMS by gender

Title of Training	Location	Farmers			DAs			SMS		
		M	F	Total	M	F	Total	M	F	Total
Advantage, operation, and handling of enset decorticator and corm grating machine	West Shewa	8	22	30	2	1	3	5	-	5
	South West Shewa	7	23	30	3	-	3	6	-	6
Total		15	45	60	5	1	6	11	-	11

Note: M-male, F-female, DAs-development agents, SMS -subject matter specialists

On-Site Demonstration of Enset Processing Technologies

The demonstrations were used to showcase the appropriate use of the machines, and also to improve the flow of information between farmers and researchers about technology performance and appropriateness under farmers' conditions. The training sessions were complemented by demonstration, to ensure comprehensive knowledge transfer. On-farm demonstrations were conducted in the kebeles so that farmers could learn and evaluate enset processing machines. In the demonstrations, comparisons were made between the machines and traditional processing methods. The demonstrations were conducted to show how the machine operated and to get feedback on their performances. A total of 216 farmers were made aware of the potential benefits of enset processing machines across the six study kebeles. The highest number of farmers reached was in Waliso district (120) where the demonstration was conducted around the FTC near the road on a market day, while the fewest number of farmers reached was in Toke Kutaye District. The amounts of enset decorticated and corm grated were small, medium and large according to farmers' categorizations.

Capacity of Enset Decorticator

Table 4 shows the comparison of the enset decorticator and traditional methods with regard to average labor required and time spent in decorticating a given amount of leaf sheath. Accordingly, using an engine-operated enset decorticator 5 snset leaves were decorticated in 68 min at 790- 880 rpm, which could traditionally take 8 hrs. and 3-4 women to working. This result was in line with that reported by Tiruneh, (2020) the average time required to scrap a single plant using traditional tools is 2 hrs.

Table 4. Comparison of traditional processing and engine operated enset decorticator

Treatments	No. of enset	Criteria of comparison	
		Labor required	Time Required
Traditional tools	5 enset	3-4 women	8 hrs.
enset decorticator	5 enset	2 persons	68 min

Capacity of Enset Corm Grater

Table 5 shows the comparison of the enset corm grating machine and traditional processing methods with regard to average labor required and time spent in grating the same amount of corm. Accordingly, using engine operated corm grating machine a corm of 5 medium enset can be decorticated in 10 min at 2200 rpm which could traditionally take 8 hrs. for 3-4 workers. This finding is in line with previous reports by Kibi (2018) in which traditionally 2-3 hours were required per tuber for grating corm and 26 enset corm per hr. using the machine.

Table 5. Comparison of traditional processing and engine operated corm grating

Treatments	No. of Enset	Criteria of comparison	
		Labor required	Time Required
Traditional tools	5 Enset	3-4 women	8 hrs.
Enset corm grating machine	5 Enset	2 persons	1 0 min

Farmers' Feedbacks on the Technologies

Feedback was collected on the performances of the machines, their perception in terms of time and labor saving, and product quality during focus group discussions. The women raised that the demonstrated enset processing technologies were better in terms of capacity, labor and time saving, ease of operation, hygiene, the inclusion of other members of the family to participate in the processing, and reducing health risk (Box 1). The users of this technology gave their feedback to modify certain parts of the introduced technologies, particularly on options of integrating the two machines into one. The enset corm grating machine needs tires for ease of mobility. The enset decorticator needs adjustment on the inlet.

Box 1: Farmers' opinion on demonstrated enset processing technologies

Excerpts from one of FGD member at *Xombe Anchabi of Waliso district in Afan Oromo:*
'Utuu hin du'in baga kana argine, ijaan arginee deebinee hin arginuu laata? , fiixaan nuuf baasaa'
Meaning 'Happy to see these machines before my death. Can't we see it again? Take it to success.'

This indicates the farmer's satisfaction with the machine and the interest to use the machine and concern about the supply to get the machine in their village and giving an assignment to BAERC for further continuity of the intervention.

CONCLUSIONS

The pre-extension demonstration of enset processing machines were conducted to create awareness and to evaluate the machine under famers' condition. Time and labor-saving benefits of the machines were valued by farmers. The result obtained during demonstrations revealed that the machines are better than traditional methods of enset processing in terms of capacity, labor, and time required. Based on the finding mentioned above, engine-operated enset decorticator and corm grating machines are recommended for further pre-scaling up. However, the machine is not affordable at an individual level, the strategy should be designed that help farmers to use the machines. It is also better to integrate the two machines in to one.

The study recommended mechanisms that enable farmers to utilize technologies in groups. One mechanism towards this is the promotion of private ownerships of enset processing machines by facilitating access to credit.

Based on the findings of the study, the following points are further suggested to improve for pre scaling up:

- Efforts should be made by the respective Bureau of Agriculture and manufacturing companies to popularize enset processing machine developed by BAERC among smallholder farmers;
- Operators of the machine and farmers should undergo appropriate trainings in order to gain the required skills, techniques and knowledge of proper operation. Training and support should be focused on capacitating the operators and farmers to maintain minor failures of the machines by themselves. Trainings should be effective to enable farmers, DAs and operators to become proficient users of machines in most places.

CONFLICTS OF INTEREST

Authors declare that they have no conflicts of interest regarding the publication of this paper with the Journal of Science and Development.

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