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Pre-extension Demonstration and Evaluation of Animal Drawn Potato Digger in Selected AGP-II Districts of Harari Region

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ABSTRACT

Pre-extension Demonstration of the potato Digger was conducted at Dire Tayara of Harari Regional State. The objectives of the study were to demonstrate improved potato digger technology and to create awareness among the farmers of potato digger in the study area. The farmers were organized into two FRG groups having 30 members. The evaluation result showed that the digger has a working speed of 1.57km/hr., a working width of 35cm, a working depth of 15cm, and an effective time of 0.39hr. Farmers' feedback showed that the potato digger has good working speed, good tuber lifting, low tuber damage, good working width, and high time-saving. Therefore, better if the technology is further promoted to the study area and other similar agroecology.

KEYWORDS: *Potato, potato digger, FRG, Demonstration*

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INTRODUCTION

The potato is the most important food crop in the world after wheat, rice, and maize. Potato is a staple food in the colder regions of the world, while it is generally used as a vegetable in other parts of the world (Mohamed *et al*., 2006). Ethiopia has possibly the highest potential for potato production than any country in Africa with 70% of the 13.5 million ha of arable land suitable for potato cultivation (Dagninet *et al.,* 2015). Among the field operations concerned with potato cultivars, harvesting is the most laborious and costly endeavor. The method of harvest employed depends upon the type and the level of technologies available**.** According to (Dagninet *et al.,* 2015) post-harvest loss (20 -25%) is one of the major problems in potato production. Physical damage is due to the digging (lifting) of the tubers by the hoe or local plow meresha (Tesfay, 2008; Hakan, 2012). This entails that significant loss is incurred to the smallholders that could have helped in nutrition, food security, and income generation (BoFED, 2007).

Mature potato is dug out from the soil and is the main product. Potato digging is a cumbersome process and requires 600 man-h/ha for manual digging (Anonymous, 2006). The major reasons for the demand for machinery are to reduce drudgery, to reduce timeliness, and to increase productivity. Fedis Agricultural Engineering developed an animal-drawn potato digger tested under field conditions. The evaluated digger consisted of beam, frame, and handle, having a manual depth adjustment mechanism and V-blade. The average working width and depth of the digger were 35.5 cm and 15 cm respectively. The effective field capacity and field efficiency were 0.04 ha/hr. and 70% - 85% respectively. The draft values of pair oxen and labor requirement ranged from 600-750 N and 40 - 60 man-h/ha, respectively.

The technology increases production and productivity of the smallholder by reducing labor, and time, and improving post-harvest loss. The promotion and demonstration of the digger were not conducted in the area. The farmers continued using traditional hand-digging. Therefore, the activity was initiated to demonstrate and evaluate the improved potato digger by creating awareness among farmers, developmental

agents, subject matter specialists, and other participant stakeholders and building farmers' knowledge and skills on animal-drawn potato digger technology.

Materials and Method

Description of the study area

The pre-extension demonstration of an animal-drawn potato digger was conducted in the Dire Tayara AGP-II district of the Harari region. Dire Tayara is located at a distance of 16 km from Harar city in the North direction. The climatic condition of Dire Tayara is almost midland with maximum and minimum temperatures of 24^0 C and 16^0 C respectively. Major crops grown in the study area include; sorghum, maize, pulse, oil crops, and legumes are practiced under rain-fed agriculture. Crops grown under irrigation are potato, head cabbage, carrot, leaf cabbage, and Khat.

Site and farmers' selection

Site selection was conducted through the collaboration of district agricultural and natural resources and DAs. Dire Tayara was selected purposively based on potato production potential. Kebeles were selected purposively based on the potentiality, and appropriateness of the area by considering lodging, slop's land escape, access to road, and suit for repeatable monitoring and evaluation. Farmers were selected based on their willingness, and accessibility of the site for monitoring and ability to allot land. The selected farmers were grouped in the form of Farmers Research Group (FRG) in selected kebele with consideration of gender issues (women, men, and youth). Each FRG had 15 farmers per kebele. Two FRGs having 30 members were established in the study areas. Five farmers per kebele and a total of ten trial farmers from both kebeles were selected.

Technology multiplication

The digger was produced in the Fedis Agricultural Research Center. The main components of an animal-drawn potato digger consisted of a main frame, digging blade, shank, lifter rods, pulling beam (traditional wood beam (*nuguya*), wood handle, and adjusting clamp (Fig-1a, b). six lifter rods of reinforced round mild steel bar (weight: 1 kg) of 12 cm length and 10 mm diameter were provided which were welded at 50 mm intervals in the rear of V shape blade of 1.75 kg weight and overall dimensions of 350 x 330 width and length of the digger respectively. The bearing points were touching the ground and the digger was well-balanced when the unit was set at its working position and placed on a plain surface. Pair oxen animal drawn digger evaluated and demonstrated under field/ farmers conditions on established FRG.

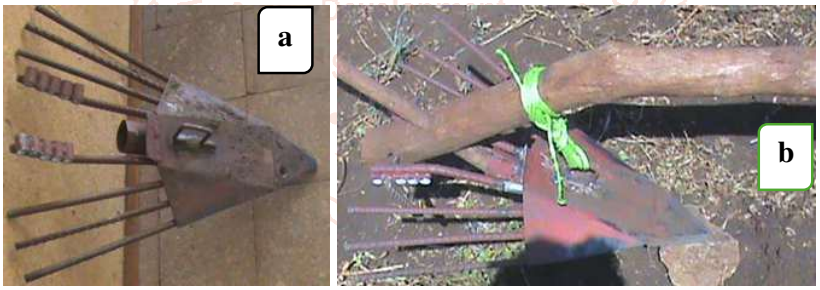

Fig-1 a, b Digger part and assembly

Technology evaluation and demonstration methods

The demonstration was done on selected trial farmers by involving all FRG members, DAs, and district experts. Demonstration conducted on trial farmers field using implement to the participants. The activity was monitored by FRGs, researchers, experts, and development agents starting from land preparation to harvesting.

Research implementation and fieldwork

A plot size of 20 m x10 m was selected from an individual trial farmer for potato varieties planting during the main season. Spacing for the selected potato varieties is 75 cm x 30 cm between rows and plants respectively. Five trial farmers per kebele and a total of ten farmers were used as replication from two kebeles for on-field demonstration. All agronomic practices were applied as recommended and an animal-drawn potato digger was demonstrated on the farmer's field.

Data collection

Digger performance and social data were collected during a demonstration. Both quantitative and qualitative data were collected through personal field observation, individual interviews, and focus group discussion using a checklist and datasheet. Quantitative data were the number of farmers participating in FRG, yield performance, and number of stakeholders participated in training and mini-field days while qualitative data were farmers' perception towards the new technology, awareness created, and farmers' technology selection criteria.

Data analysis

Quantitative data were summarized using simple descriptive statistics such as mean, frequency, and percentage while the qualitative data were collected using focus group discussion, and field observation was analyzed using narrative explanation and argument. Data from different sources was triangulated to get reliable information.

Results and discussion

Training of farmers and other stakeholders

The training was given as an intervention activity. Stakeholders are developing knowledge and skills to adapt new practices. Multidisciplinary researchers such as research extension, socio-economic research, and agricultural engineering participated in the training delivering program. The training was given on improved potato digger and knowledge, skill, experience sharing, and technology transfer approaches. Accordingly, a total of 26 farmers (16 males and 10 females), 3 DAs, and 2 experts participated in the training organized in the target areas.

Table 1: Type of profession and number of participants during the training

No.	Participants	Male	Female	Total
1	Farmers	16	10	26
2	DAs	3	0	3
3	District experts	2	0	2
	Total	**21**	**10**	**31**

Source: Own computation

Working capacity of animal-drawn potato digger

The demonstration of the digger was conducted on a 20 m x10 m plot size. The soil texture class of the experimental plot was sandy clay loam according to the AGP- II survey report. The soil moisture during the testing digger was selected at optimum moisture conditions as 17.5% at mass bases. The Moister content of the soil was measured by a portable digital moisture meter having 30 cm measuring depth at field conditions. The lightweight pair oxen animal-drawn digger was tested at an average speed of 1.52 km/h and an average depth of 15 cm for digging the Bubu variety of potatoes in an area of 200 m^2. The digging and field efficiency of the digger was 96.55% and 86.7% respectively. The mean draft required for digging was 700 N. Effective field capacity and cost of operation were 0.04 ha/h. According to different authors, animal-drawn potato digger are better than traditional spade digging. The result reported by (Tiwari *et al*., 2018) the digging and field efficiency of the digger were 93% and 88%, respectively. Effective field capacity and cost of operation were 0.03 ha/h and Rs 1250/ha, respectively. The labor requirement was 34 man-h/ha excluding 150 h for picking the tubers which showed savings of 38.25% in labor and 60.93% in cost of digging (including picking of potato) over traditional digging by spade.

Table 2: On-farm working capacity of the digger

S. No	Parameter	Unit	Animal-drawn potato digger
1	Plot size completed(area)10 m x 20 m	m^2	200
2	Soil moisture(dry basis)	%	17.5
3	Working speed	km/hr	1.57
4	Working width	cm	35.0
5	Working depth	cm	15.0
6	Total time to complete area	hr	0.45
7	Effective time	hr	0.39
8	Field efficiency	%	86.7
9	Effective field capacity	ha/h	0.04
10	Measured draft	N	700
11	Total lifted potato (improved variety Bubu)/ row(20 m) length(exposing efficiency)	%	96.45
12	Total un-lifted potato (digging loss)	%	3.55
13	Damage potato	%	1.05

Participatory evaluation and farmers' perception

All FRG members and neighboring farmers, development agents, experts, and researchers closely evaluated the performances of the digger based on their criteria. The feedback of the farmers was collected during the

demonstration. The most important criteria used by farmers were digging efficiency, working speed, tuber lifting, low tuber loss, and working width. Based on the above criteria; farmers evaluated the improved implements and ranked it first. For comparison purposes, farmers' perceptions were collected on traditional potato digging working drudgery after evaluating improved animal digger by setting the same criteria from past indigenous knowledge and experience.

Table 3: Farmers' selection criteria of animal-drawn potato digger and traditional potato-digging

Implements	Farmers rank	Reasons
Animal-drawn potato digger	1st s	High working speed, Good Tuber lifting, Low tuber damage, Good working width, high time-saving
Traditional implement	2nd n	Low working speed, Low tuber lifting up, high tuber damage and Low working width, more time or more human per operation

Therefore, most farmers selected improved implements to use on their farms in the future. The major criteria used by farmers were high tuber lifting/exposing efficiency, working speed, tuber loss, low damage, and working width and time-saving. Based on the above criteria; farmers evaluated the improved implements and ranked it first. Therefore, most farmers selected improved implements to use on their farms in the future.

Table 4: Pair-wise ranking matrix result of the digger

S.N	Traits	Time of Operation	Working Speed	Tuber lifting	Working width	Tuber loss	Frequency	Rank
1	Time of operation		**1**	**1**	**1**	**1**	4	1st
2	Working Speed			3	2	2	2	3rd
3	Tuber lifting				**3**	4	3	2nd
4	Working width					3	1	4th
5	Tuber loss/damaged						0	5th

Conclusion and Recommendation

Potato harvesting and post-harvest operation usually consist of a series of operations comprising digging, lifting, washing and drying, grading or stocking and storing. Harvesting is the most laborious and costly endeavor. During the harvesting process, the digging of the tubers by hoe is one of the major problems that facilitate physical damage. Hence available potato harvesting technology on farm evaluation and demonstration best solution for alleviating potato production and productivity constraints under smallholder. The training was given on awareness creation about digger and skill development digger assembly, adjusting with local plough beam, operation and, repair and maintenance. During the demonstration and on-farm evaluation potato digger was observed practically. The lifting efficiency per row and effective field capacity of the digger on sandy clay loam soil was 96.55 and 0.04 ha/hr. respectively. Total amount of tuber per row un-lifted or tuber loss and damaged tuber at average forward speed ox 1.52 km/hr. was 3.45% and 1.0 5% respectively. The labor requirement was 50- 60 man-h/ha. Animal drawn potato digger saves 20% - 30% labor requirement and reduces 40% operating time when compared to conventional method of digging with spade.

Based on criteria, established the FRGs member evaluation showed that, animal drawn potato digger was preferred by farmers and ranked first in both PAs due to its better exposing/lifting percentage and little damage during digging operation. In addition less labor and time consumption was observed when compared with manual digging. Therefore based on farmer's idea and importance of this technology the following recommendations were drawn:

- More popularization and scaling up is necessary
- Capacity building (training) could be required for farther promotion
- More Effort is required on availability, distribution and demonstration of the technology made on
- Future study could require on technology in different area for more post-harvest loss minimization and busting production and productivity

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