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Participatory Evaluation and Demonstration of Improved Haricot Bean Varieties in Daro Lebu & Habro Districts of West Hararghe Zone, Oromia, Ethiopia

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Abstract: The activity was conducted in 2018/19 main cropping season at Daro Lebu and Habro districts of West Hararghe zone. Two improved Haricot bean varieties namely Awash-2 and Carcar were demonstrated with the objectives of to evaluate improved variety of Haricot bean under farmer's condition and to enhance farmers' skill & knowledge on haricot bean production through participatory demonstration in the study area. Two kebeles (one kebele from each district) were selected purposively based on haricot bean production potential. A total of seven farmers; two from Daro Lebu and five from Habro district were used for demonstration. Single plot with 10mx10m area were used on each farmer's field for each variety. Yield of each variety was collected from each farmer and analyzed through descriptive statistics. On the other hand, farmer's preferences were collected and analyzed by using simple rank analysis. Financial analysis was also used to analyze the economic benefit gained from the experiment. The result of the study revealed that improved varieties had yield advantage over the local check. The highest yield (1550 kg/ha) was recorded by Carcar variety with 25% yield advantage over the local check under farmers practices. On the other hand, Awash-2 Variety was ranked 1st then followed by Carcar as 2nd based on numbers of pod per plant, numbers seed per pod, seed size, early maturity, drought tolerant and disease resistance identified as selection criteria Therefore, Awash-2 & Carcar varieties were recommended for further scaling up to enhance haricot bean productivity under smallholder farmers.

Keywords: Improved Variety, Farmers Preference, Demonstration, Profitability and Farmers

1. Introduction

Ethiopia is known as the homeland of several crop plants. It is ranked 13th among pulse producing countries in the world [9]. The country produced about 2.8 million tons from total land of 1.5 million hectares in 2016/17 [7] Pulses play crucial economic, and food and nutrition security roles in Ethiopia. Recently, the production and supply of pulses, increased due to increased demand in both local and international markets, thus enhancing smallholders' income [6]. Haricot beans are among the most important grain legumes produced by small-scale farmers, both for subsistence and cash. They are usually intercropped with complementary crops such as maize, sorghum, and *enset* owing to increasing population pressure on agricultural land

and paired nutrient needs in the soil. There are two main types of beans, red and white. Smallholder farmers typically grow the red bean types for household consumption, while white haricot beans are produced almost exclusively for the export market [13].

According to [9] haricot beans have a high nutritional value, are rich in calcium, phosphorus and iron, and are thus considered a key crop for improving food security. Beans in Ethiopia are traditionally seen as a 'poor man's food' by the medium to high income urban and rural consumers, and thus urban demand is low. For instance, pulse retail in many major town centres do not want to keep haricot beans or others pulses (i.e. chickpeas, lentils, split peas, fava beans), implying that their customers were less interested in these low value products. Consumption of haricot beans are

common for the rural poor in the major producing areas, however, with the food price spike and increasing awareness about its nutritional value, the perception of haricot beans is changing rapidly in urban centers.

Haricot bean (*Phaseolus vulgaris L.*) has been an export pulse crop for Ethiopia for more than 50 years and probably been grown as food crop for a much longer period in the low and mid land altitude areas of the country [13]. There are a wide range of haricot bean types grown in Ethiopia, including red, white and black varieties. The leading white bean varieties are the Awash 1, Awash melka and Mexican 142 varieties. Haricot bean is ranked as the second largest pulse crop in the country in terms of production with a share of 16.45 percent, next to Faba beans [5]. The production obtained from faba beans, haricot beans (white) haricot beans (red) and chick peas was 3.02% (about 8,780,108.79 quintals), 0.43% (about 1,259,801.75 quintals), 1.23% (3,579,424.75 quintals) and 1.53% (4,441,459.26 quintals) of the grain production, respectively.

The crop is widely grown in areas between 1400-2000 m.a.s.l. The main production areas include the East Hararghe, West Wellega, East shewa, West Arsi, Sidama, Wolayita, Wollo and East Gojam [8]. The crop is grown either as a sole crop and/or intercropped with either cereal or perennial crops [18]. From total production area of a country, oromia region covers around 116,696.94 hectares of land and obtained total yield of 1 million tones in 2016/17 cropping season. The average yield harvested from one hectare in the same year indicates about 1.7 tones which is low. West Hararghe zone also produce haricot bean for both food and marketing purpose. In 2016/17 cropping season a total of 5,178.41 hectar of land was covered with haricot bean [5].

The lack of improved varieties is one of the top problems for low yield of common bean in the country [10]. Similarly, shortage of improved variety was major problem which causes low productivity. Considering this problem Mechara Agricultural Research Center has been conducted adaptation trial of white haricot bean varieties at Daro Lebu, Habro and Meiso district in 2017/18 cropping season and the result of the trial revealed Awash-2 gives (2800 kg/hect) followed by Carcar (2530 kg/hect) & standard check (Awash-1) (2390 kg/hect) in which those varieties gives higher yield. Therefore, promotion of those improved varieties which are adapted to the study area should be needed to enhance agricultural productivity and improved nutrition of people living in the study areas especially smallholder farmers. The aim of this study was (i) to evaluate improved variety of Haricot bean under farmer's condition and (ii) to enhance farmers' skill & knowledge on haricot bean production through participatory demonstration in the study area.

2. Material and Methods

2.1. Descriptions of the Study Area

Daro Lebu is one of the districts found under West

Hararghe Zone. The capital town of the district Mechara is found at about 434 km South East of Addis Ababa. The district is situated between 7°52'10" and 8°42'30" N and 4°02'3'57" and 41°9'14" E at 08°35'589" North and 40°19'114" East [1]. The district is characterized mostly by flat and undulating land features with altitude ranging from 1350 to 2450 m.a.s.l. Ambient temperature of the district ranges from 14 to 26°C, with average of 16°C and average annual rainfall of 963 mm/year. The pattern of rain fall is bimodal and its distribution is mostly uneven. Generally, there are two rainy seasons: the short rainy season 'Belg' lasts from mid-February to April whereas the long rainy season 'kiremt' is from June to September. The rainfall is erratic; onset is unpredictable, its distribution and amount are also quite irregular [2].

Habro district is another district in West Hararghe zone of Oromia region. The district has an altitude range from 1600-2400 m.a.s.l. The mean annual rainfall of the district is 1010 mm and the annual temperature ranges from 5- 32°C [15]. The rainfall pattern in the area is uni-modal with high amount of rainfall occurring during the main rainy season between June to September (Kiremt) and the short rainy season stretching from March to June (Belg). The agroecology of the district comprises highland (19%), mid altitude (50%) and lowland (31%) areas [16]. It occupies a total area of 725 km² i.e. about 4.2% of the zonal total area. The district has an estimated total population of 244,444; of whom 126,176 were men and 118,268 were women [4]. Mixed crop livestock agriculture is a common farming system in the study area. The main crops grown in the area are cereals such as *teff* (*Eragrostis tef*), maize (*Zea mays*), wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), haricot bean (*Phaseolus vulgaris*) and sorghum (*Sorghum bicolor*) and cash crops such as coffee (*Coffea arabica*), *chat* (*Catha edulis*), pepper (*Capsicum species*) and onion (*Allium cepa*) [3].

2.2. Farmer's Selection and Demonstration Field Establishment

The study was conducted in Daro Lebu and Habro districts of west Hararghe zone in 2018/2019 cropping season. Site and farmers selection was conducted with participation of respective district of Agricultural and natural resource Office based on haricot bean production potential. Similarly, trial farmers were selected collaboratively with respective Developmental Agent by considering different selection criteria's like farmers interest to the technology, model farmers and managing the field as required. Thus, a total of seven (7) farmers were selected from both districts (five farmers from Habro district of Bereda kebele & two farmers from Daro Lebu district of milkaye kebele).

Two improved varieties of haricot bean namely Awash-2 and Carcar were evaluated with local check under farmer's field condition. The experiment was demonstrated on 100 m² demonstration plots for each varieties on each trial farmers and seed rate of 80 kg/ha was used with 100 kg/ha PSN at the time of sowing. A spacing of 40cm X 10cm between row &

plant spacing was used, respectively during the demonstration. Before conducting the trial, farmers were trained about improved common bean production practices like seed rate, fertilizer rate, planting dates, crop management aspect and recommended agronomic practices. In addition, mini field day was organized at vegetative stage to create awareness and collect farmers’ feedbacks on evaluated varieties.

Table 1. Summary of selected kebele, farmers and variety used for demonstration.

Location/district	Kebele	No. of trial farmers	Varieties used for the trial
Daro Lebu	Milkaye	2	Awash-2, Carcar & local check
Habro	Bareda	5	
Total		7	

Source: Demonstration result, 2019/20

2.3. Data Types and Method of Collection

Both qualitative and quantitative data were collected for the study. Qualitative data like farmer preference on demonstrated varieties was collected through personal interview of farmers during mini field day organized. On the other hand quantitative data like gained yield from demonstrated variety from each farmers and economic data cost incurred & benefit gained from the trial was collected directly from the field by researchers.

2.4. Method of Data Analysis

Descriptive statistics were used to analyze the crop performance concerning yield and yield components of the experiment harvested from demonstration plot. While qualitative data were analyzed through simple ranking and summarization. Profitability of the variety was analyzed through financial analysis method.

Farmer’s preference were collected and analyzed by using simple ranking method in accordance with the given value [7]. The formula of ranking method used was specified as:

$$\text{Rank} = \sum N/n, \tag{1}$$

Where N_i is value given by group of farmers for each variety based on the selection criteria and n is number of selection criteria used by farmers.

3. Result and Discussions

3.1. Yield Performance of Demonstrated Variety on Farmer’s Field

The mean yield gained from Awash-2, Carcar and local check was 1457, 1550 and 1275 kg/ha respectively from demonstration result as indicated on table 2. The mean yield of Carcar variety gives higher yield than others which indicated that using this variety enhance the yield harvest of farmers from their land. The study result also shown as 275 kg/ha and 182 kg/ha yield increment of Carcar & Awash-2, respectively over local check under farmers management condition. Similary study, conducted by [14] at Adami Tullu Jidu Kombolcha and Shalla districts of East Shawa indicated that using improved haricot bean maximize farmer’s profitability from their acre of land in which the result support the result of our study.

Table 2. Yield summary of the variety on farmers’ fields in kg/ha (N=7).

Variety Name	Max.	Min	Mean	Std deviation
Awash-2	2690	500	1457	699
Carcar	2825	625	1550	862.8
Local	2750	450	1275	743.5

Source: Our computation, 2019/20

3.2. Yield Advantage of Improved Variety Over Local Check Across Location

The result of the study indicated in (Table 3) shows the recently released varieties of common bean have higher yield increment over the control across location/districts. The larger yield increment was gained from Daro Lebu district of Carcar variety with 550 kg/ha (25 %) increment and yield increment of 100 kg/ha (5 %) by Awash-2 variety over the control. Similar study conducted by [3, 11, 12] conclude that using improved variety was more advantages than local variety under farmers` condition.

On the other hand at Habro district, higher yield increment was gained from Awash-2 variety which is 210 kg/ha (23 %) and 160 kg/ha (17 %) from Carcar Variety over control. From table 3 below we also conclude that higher mean yield were recorded at Daro Labu than Habro district for all improved varieties as well as for local check which may be Daro Lebu district is more favorable for haricot bean production than Habro district.

Table 3. Yield gap and advantage of improved variety.

District	Variety	Max.	Min.	Mean	Std. Deviation	Yield increment in Kg/ha.	Yield advantage over control (%)
Habro	Awash-2	500	1600	1140	440	210	23
	Carcar	630	1500	1090	400	160	17
	Local	450	1400	930	350	-	-
Daro Lebu	Awash-2	2690	1820	2260	620	100	5
	Carcar	2830	2600	2710	160	550	25
	Local	2750	1520	2160	870	-	-

Source: Our computation, 2019/20

3.3. Financial Benefit

The result of study shown that highest total return and net benefits were gained from Carcar and Awash-2 varieties under farmers' condition as presented in Table 4. Application of improved varieties under on-farm demonstration with farmers practices records higher total returns for Carcar

which was 24,375.75 birr/ha while total return for local check was 20,049.38 birr/ha within similar practices. Net benefit gained from Carcar & Awash-2 were 13,785.5 & 12,321 birr/ha, respectively while for local check record 9,681 birr/ha. The result of this study supported with study of [14, 17].

Table 4. Financial benefit gained from demonstration trial.

Variety Name	Cost & Benefit per ha. for demonstrated varieties			
	Total Cost	Mean yield gain in kg/ha	Total return	Net benefit
Awash-2	10,590.25	1457	22,911.33	12,321
Carcar	10,590.25	1550	24,375.75	13,785.5
Local Check	10,368.25	1275	20,049.38	9,681

*Current price of haricot bean in 2019/20 = 1572.5 birr per Qt

Source: Our computation, 2019/20

3.4. Awareness Creation and Farmers' Preference of the Technology

Mini field day was organized to collect farmers' preference and create awareness on improved variety for further application in the study area. Accordingly, a total of 83 (72 male & 11 female) participants consisting of farmers, extension agents, experts and researchers were participated on mini field day. Number of pod per branch, number of seed per pod, seed size/shape, early maturity, drought and disease tolerant were criteria's settled by participants of mini field for selection purpose among the varieties. The result of farmers' preference for improved variety was indicated below (Table 5).

Based on the selection criteria, farmers indicated that Awash-2 was preferred as 1st rank by trail farmers and participant farmers during field day organized on farmer's field. The mean scores of farmers' selection criteria ranged from 4.8 (Improved variety) to 3.1 (local check). The highest score (4.8) recorded for number of pod per plant, number of seed per pod and early maturity for improved variety and 2.3 for local check against disease tolerance. However, Awash-2 variety gets highest score in terms of early maturity and drought tolerant than others varieties. From this farmers selection Carcar variety record highest score for number of pod per plant and number of seed per pod which support higher yield of this variety gained during demonstration of the trial on farmers field (Table 2).

Table 5. Farmers preference on the varieties (score 1-5).

Variety	Selection criteria (Score 1-5)						Total score	Mean score	Rank
	No. pod per plant	No. seed per pod	Seed size	Early maturity	Drought tolerant	Disease resistance			
Awash-2	4.7	4.3	4.5	4.8	4.6	4.2	27.1	4.5	1 st
Carcar	4.8	4.8	4.3	4	4	4.2	26.1	4.3	2 nd
Local check	3	3.3	3.2	3.3	3.4	2.6	18.8	3.1	3 rd

Source: Our computation, 2019/20

4. Conclusion and Recommendation

Haricot bean is among pulse crops grown for food and market purpose in Ethiopia in general and west Hararghe zone specifically. Hence, this study conducted to evaluate yield performance of improved varieties of haricot bean under farmer's condition. Two improved varieties of haricot bean were evaluated with local check on under farmer's field condition. The experiment was arranged on 100 m² single plots for each varieties on each trial farmers and seed rate of 80 kg/ha was used with 100 kg/ha PSN at the time of sowing. A spacing of 40cm X 10cm between row & plant spacing was used, respectively during the demonstration. Both qualitative and quantitative data were collected for the study and analyzed with descriptive statistics, simple ranking, summarization and financial analysis for the study.

The result of the study indicated that recently released varieties of Haricot bean have higher yield increment over the control check across location/districts. The study showed that the improved shown better performance in grain yield than the local check. The mean yield gained from Awash-2, Carcar and local check was 1457, 1550 and 1275 kg/ha respectively. Thus, the cultivation of haricot bean with improved varieties has been found more productive and the yield capacity can be enhanced by 25 percent. The result of study from financial analyses shown that application of improved varieties under farmers condition with farmers practices records higher total returns for Carcar which was 24,375.75 birr/ha while total return for local check was 20,049.38 birr/ha under similar practices.

On the other hand, Mini field day was organized to collect farmers' preference and create awareness on improved variety for further application in the study area. Accordingly,

a total of 83 participants consisting of farmers, extension agents, experts and researchers were participated on mini field day. Number of pod per branch, number of seed per pod, seed size/shape, early maturity, drought and disease tolerant were criteria's settled by participants of mini field for selection purpose among the varieties. Accordingly, participant famers had select Awash-2 as 1st rank followed by Carcar variety. Hence, Seed producer enterprise, cooperatives or organized seed producer farmers groups should continuously and consistently multiply and supply the seeds of this variety so that there is sustainable seed supply for Carcar and Awash-2 varieties in the area.

Conflicts of Interest

The authors declare no conflicts of interest.

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