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Current Practices of Farmers Adoption of Improved Food Barley Variety in Case Study of Welmera District of Oromia Region Ethiopia

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Abstract: This research activity was conducted in Welmera districts of west Shewa zone Oromia with the objective of examining the current practice of smallholder farmers toward the adoption of improved food barley varieties in the study area. Food barley is a stable grain, widely grown by farmers in Ethiopia's different highlands. One of the most important tactics for ensuring food security in the nations is seen to be improving its production. One of the most widely consumed and produced foods is food barley in the district. The aim of this research was to assess the current practices of farmers toward the adoption of improved food barley in the study area. This study used a three-stage sampling procedure in which purposive selection of district and Kebeles were selected by using random sampling. Stratified sampling was employed to identify adopters and non-adopters and simple random sampling was used to select respondents. The study is based on primary data collected from 142 samples selected through an interview schedule-assisted survey questionnaire. The findings of the study reveal that adopters and non-adopters of improved food barley varieties differ in their land preparation, fertilizer application, topdressing, weeding and protection practices, as well as seed preparation and seedling assessment In general, the study concluded that adopters were better practice recommended extension package. Therefore, the extension and research system should address these factors to provide solutions.

Keywords: Adoption, Improved, Perception, Technology, Welmera District

1. Introduction

The agricultural sector is the cornerstone of Ethiopia's economy with approximately three-quarters of the economically active population engaged in agricultural production activities [1] Creates 33% of gross domestic production (GDP), employs 66% of its population, and creates 76% of export commodity value four major cereal crops barley, Tef, wheat, and maize account 71% of the total production in 2020/21, growing in 64% of the cultivated land [2].

Barley (*Hordeum vulgare* L.) is one of the main cereal crops produced in the World. It ranks fourth in the world in production after wheat, maize, and rice [3]. Global barley production is estimated at about 141.7 million tons [4]. Many countries grow barley as a commercial crop. Globally Russian federations Australia, Canada, the United Kingdom, and Turkey are the top five largest world barley producers whereas the Russian Federation is the top country by barley production in the world. As of 2020, barley production in the Russian Federation was 20,629 thousand tonnes which accounts for 19.75% of the world's barley production. The top 5 countries (others are) Australia, 13000. Canada, 10741. The United Kingdom, 8.117and Turkey 8100. thousand tones that account for 58% of it. The world's total barley production was estimated at 104,434 thousand tonnes in 2020 [5].

In Sub-Saharan Africa Ethiopia is one of the major producers of barley the second largest producer in Africa next to Morocco, accounting for about 26 percent of the total barley production in the continent [6]. In 2017/18, about 3.5

million smallholder farmers grew barley on more than 0.95 million Meher hectares of land and produced 2.053 million tons [7].

In the highlands of Ethiopia barley is grown in Oromia, Amhara, Tigray and part of the Southern Nations, Nationalities and Peoples' Regional State subsistence farmers in the highlands above 1800 meters above sea level (masl) grow barley, mainly under rain-fed conditions with minimum or no external inputs [8]. It is preferred over other cereals for its early maturity relieving hunger and amenability for small rains (Belg) growing. Hence, it is used for double cropping and grain yield stability than other cereals under low and erratic rainfall. Its grain has many uses, including livestock feed and human food in Ethiopia, the grain is mainly produced for human consumption and sold for cash. About 90% of the grain is used for human food and it accounts for over 60% of the food of the inhabitants of the highlands [9].

Barley in Ethiopia is produced mainly for human consumption and it is one of the most important staple food crops [10]. It is also the most dependable, desirable, and preferable crop by the highland and subsistence farmers due to its early maturity and ability to grow better on poor soil fertility/marginal farms than other cereals [11]. The share of malting barley production is quite low (2%) and most is used for making local bread (Injera). Barley grain is used in the diversity of barley recipes that are deeply rooted in the culture and traditions of people's diets. Furthermore, barley straw is a good source of animal feed, and it is a useful material for thatching house roofs and for use as bedding [10]. Barley cropped twice a year. It is more suitable for Belg-season production than Meher-season production.

In Ethiopia, barley production covered a total area of 926,106.90 hectares, and total annual production of about23, 391,098.80 quintals, and productivity of25.26 qtha-1 in the main season [12]. At the Oromia Regional State level, an area covered by barley in 2020/21 was 440,702.06 ha, production12, 319,947.95 qt, and productivity 27.96 qt ha-1 [12].

Welmera district is one of the major food barley growing areas in the West Showa zone of the Oromia regional state. They are known for the cultivation of many crops which include, among others, cereals such as barley, wheat, tef, Faba bean, Field pea, potato etc. In this district, despite its vital role in production improvement, there has been no empirical information so far on the adoption of food barley technologies, and there are no studies focused on its adoption which could help to broaden the use of technology.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Wolmera district of Oromia region, Ethiopia, Walmara is one of the districts of the west Shewa zone in the Oromia Region of Ethiopia. it is located at a distance of 30 km West of the capital, Addis Ababa at latitude9º3'Nand38º30'Elongitude. Agro-climatic feature of the district is classified The total surface area of Wolmera district is about 66,299 hectares and the altitude of the district ranges from about 2,000-3,380m.a.sl. Climatically, most parts of the district are dega (61%) and woina-dega (39%) of agro-climatic zones. The mean monthly temperature (T^0) and total annual rainfall are 16.5°C and 1,067mm respectively. The total area of land is used for the cultivation of annual and perennial crops, range land, and forest land Farming system of the community was mixed-farming, i.e. animal rearing and growing of different crops The district has two crop seasons, which are 'rain fed' and 'irrigation season [13].

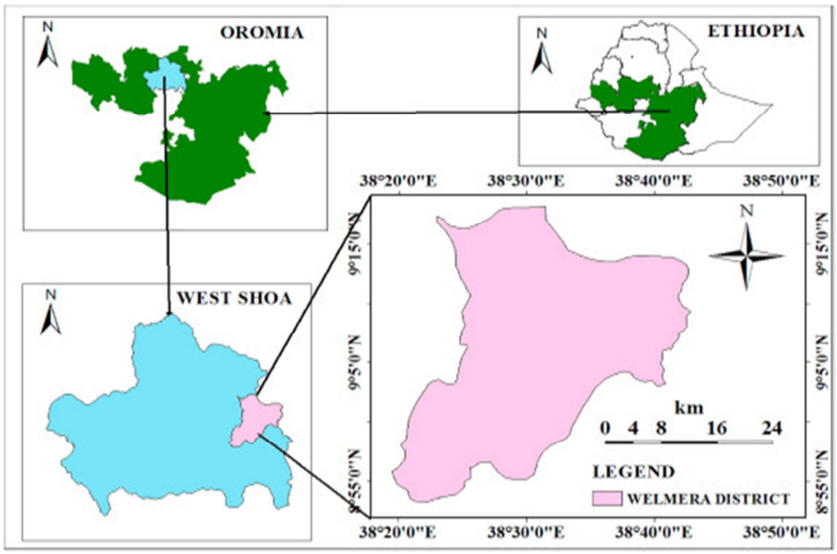


Figure 1. *Map of The study area.*

2.2. Sampling Procedures and Sample Size

This study employed multiple stage sampling method. In the first stage, the district was purposively selected based on barley production potentials and accessibility to interventions and data collection. In the second stage, with

the support of the district office of agriculture officials, barley-producing peasant associations of the district were purposively identified of which three peasant associations were randomly selected. In the third stage, with the help of the respective peasant association level officials, a sampling frame (barley farmers) was identified out of which 142 households were randomly selected for interview using probability proportional to size.

2.3. Sample Size Determination

The sample size for collecting data through household survey was determined by using the sample size determination formula proposed [14]. The required sample size was determined at a 95% confidence level. The study used the following formula to calculate the sample size.

$$n = \frac{N}{1+N€^2}$$

$$n = \frac{1509}{1+1509(0.08)^2} = 142$$

Therefore; the total sample size will be 142 out of this (58) from Ela fota, (48) from telecho, and (36) from Dufa wear selected based on household from each Kebeles were selected in proportional to their population size in their Kebeles.

Table 1. *Sampling frame and sample size.*

No	Study Area	Sample Kebeles	Total No, of HHs			Sample House hold		
			Male	Female	Total	Male	Female	Total
1	Welmera Distirict	Ela fota	500	61	561	44	14	58
		Telecho	456	88	544	41	7	48
		Dufa	235	169	404	22	14	36
Total			1191	318	1509	107	35	142

Source office of agriculture Welmera district

2.4. Methods of Data Collection

The data has been collected from primary and secondary sources. Primary data was collected from Welmera district barley producers and extension workers by using a structured questionnaire focus group discussion, Key Informant Interviews (KII). The data were collected during the fiscal year of April 2021. The secondary data sources were collected from Welmera district Office of Agriculture and published and unpublished materials, which include books, journals, scientific research works, and office records. The collected data were arranged into a coding sheet and inserted into computer statistical software SPSS/PC and analyzed using appropriate statistical techniques.

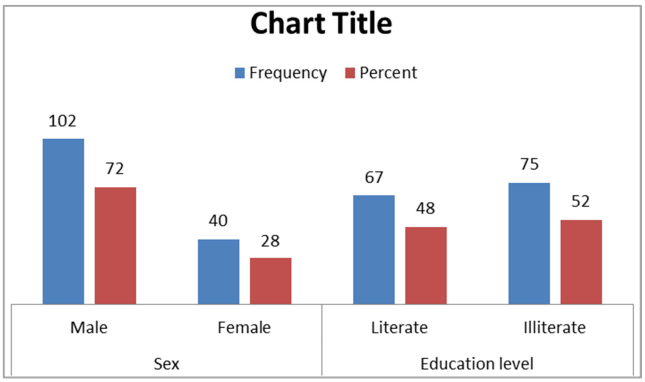
2.5. Methods of Data Analysis

To analyze data the researcher used both qualitative and quantitative techniques. In this study to analyze the relevant data gathered from different sources the researcher used qualitative and quantitative methods of data analysis. The quantitative data was analyzed by using simple descriptive analytical techniques such as frequency and percentages. The analyzed data was presented in the form of tables. In the qualitative methods of data analysis, the researcher would ~~use~~ descriptions and explanations.

3. Results and Discussions

3.1. Demographic and Socio-Economic Characteristics of Respondents

To address the objective of the study 142 sample respondents were selected from three rural Kebeles of Welmera district (Ela fota Telecho and Dufa) and interviewed by recruited enumerators that were used for analytical purposes. Some of the demographic and socio-economic characteristics of sampled respondents like age, sex, level of education, family size, livestock ownership, and farm size are described in this section.



Source: Survey result 2021

Figure 2. *Descriptive statistics of sex and Educational Level of sampled respondents*

Survey results showed that 72% are male-headed and 28% are Female-headed households. This indicates participation of males' food barley production is higher than females. This also implies there is socio- culture oriented gender division of labor. Survey results showed that the educational levels of sampled household heads are literate 48% and illiterate 52 %

Table 2. *Descriptive Statistics of Age, Family, farm Size and livestock ownership of Sampled HH.*

Variable	N	Minimum	Maximum	Mean	SD
Age of HH head	142	21	77	46.82	12.499
Family size	142	2	11	5.39	1.837

Variable	N	Minimum	Maximum	Mean	SD
Farm size	142	.50	5.20	1.9102	1.07444
Livestock ownership	142	1	23,84	5.62	3.53454

Source: Survey result 2021

The survey result showed that the minimum and maximum age of sampled respondents was 21 and 77 respectively. The mean age was 46, 82, having a standard deviation of 12.499. The mean family size of sampled respondents from survey results was found to be 5.39 people. The minimum and maximum family size of sampled respondents was 2 and 11 respectively.

The mean farm sizes of sampled respondents households are 1.9102; with a standard deviation of 1.07444. The minimum and maximum land holding size of respondents households are 0.5 0 hr. and 5.20 hr. respectively (see Table 4). The minimum and maximum livestock ownership of sampled respondents' households was 1 and 23.84 respectively. The average TLU was 5.62 with a standard deviation of 3.53454.

3.2. Current Production Practices of Food Barley Technology in the Study Area

The agriculture policy direction of Ethiopia is to enable farmers to use modern agricultural technologies and new agricultural practices efficiently and effectively to increase production and productivity. Adoption of improved technologies offers potential advantages for increasing productivity and income for smallholder farmers. In the study area, smallholder farmers depend on traditional agricultural practices ploughing the plot, use of the new varieties, land preparation, and utilization of fertilizer as per the recommended extension package.

To increase production enhancing technologies adoption is important to tackle production constraint that exists in the study area. Even though barley is one of the staple foods in the study areas; its production per hectare of land is 30 quintal this low production is due to low adoption practices of improved food barley technology. The improved food barley technologies that are practiced for production in the district are HB1307, shege, Gelane.

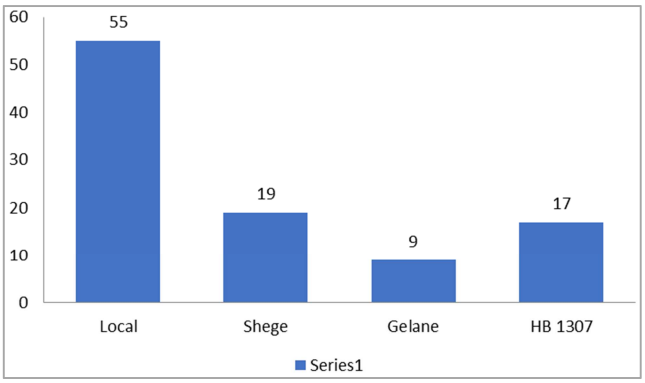


Figure 3. *Types of improved food barley seed planted in the sampled kebele.*

In the sampled areas both local seed and improved seed are practiced for production currently. See Figure 2 the types of food barley seed varieties used for seedling among farmers are described in percentage and frequency. 54.9% of local seeds used by farmer 19% shege seed used by farmers 9,2% of gelane seed used by farmers and 16.9% of HB1307 seed used by farmers practiced and populated in the areas of the district.

3.3. Adoption Practices of Improved Food Barley Technology in Study Area

The survey result shows that the adoption status of all three studies Kebeles is somewhat similar. The adopters of improved food barley technology in Ela fota 17.6% Telecho 14.1% and Dufa 9.9% are current practices of improved food barley technology and non-adopters 40%, 33.8%, and 25.4% for Ela fota, Telacho, and Dufa respectively not currently practices improved food barley technology in the sampled three kebeles. The chi-square test result shows there is no statistically significant difference between adoption and sampled three Kebeles (chi-square =.922, p=0.034).

Table 3. *Adoption Status of Sampled Kebeles.*

Variable	Adopter (n=59)		No-adopter (n=83)		Total.142			
Name of Kebeles	No	%	NO	%	No	%	chi-	p-value
Ela fota	25	17.6%	33	23.2%	58	40.8%		
Telech	20	14.1%	28	19.7	48	33.8	.163	.922
Dufa	14	9.9%	22	15.5%	36	25.4%		
Total	59	41.5%	83	58,5%	142	100		

Source: Survey result 2021

3.4. Land Preparation

Land preparation for timely and uniform germination of food barley and to avoid early weed infestation in barley fields should be well prepared. The barley field should be ploughed 2-3 times. Or 3-5 times depending upon the soil ploughing should be done in such a way that makes the seedbed/field suitable for germination and growth, to control weeds, and to drain excessive water as it is highly affected by water logging [15].

The survey result showed that adopters of improved food barley technology in the study areas are ploughed 2 times (0%), and 3 times (11.3%). 4 times (30.3%) and non-adopters plough 2 times (13.4%), 3 times (16.9%), 4 times (28.9%). This shows that non-adopters of improved food barley

technology did not fully implement package practices of food barley production compared to Adopters.

Figure 4. *Land preparation practice in the study area.*

3.5. Seed Preparation

The demand and supply of seed from the formal sector are often challenged by poor demand assessment methods, the production capacity of seed suppliers, and farmers' demand shifts in response to emerging production and marketing issues [16].

Table 4. *Seed preparation.*

Variable	Adopter (59)		Non adopter (83)		Total (142)	
Seed Preparation	**No**	**%**	**No**	**%**	**NO**	**%**
Certified seed	59	41.5	-	-	59	41.5
Local seed from neighbors	-	-	12	8.5	12	8.5
Local seed from local market	-	-	37	26	37	26
Own seed from previous harvest	-	-	34	24	34	24
Total	59	41.5	83	58.5	142	100

Source: Survey result 2021

Farmers prepare seed either locally produced or certified seed. The survey result showed that adopters of improved food barley technology used certified seed (41.5%) and non-adopters of improved food barley Technology used local seed that was gained through different mechanisms. The survey result showed that local seed from neighbors (8.5%), local seed from the local market (26%), and own seed from previous harvest (24%).

The practice of appropriate seeding rate is one of the most important uses in agricultural production. Excessive or underutilization of seed will result in poor production performance. Generally, research recommends a specified level of seeding rate for a given variety or crop with a given range of seed feasibility [17]. The extension also advises farmers based on this research recommendation. The recommended seeding rate of barley variety is 100-125 kg per ha vary from region to region [18]. Farmers' adoption of the recommended seeding rate is not a big difference between adopters and non-adopters in the study area.

3.6. Fertilizers

Barley production, like any other crop, requires the use of different inputs. Urea and NPS are the most important fertilizers used for various crops, to boost the production and productivity of crops. Fertilizer application is one of the most important practices that need to be adopted by barley growers [17]. Moreover, location-specific fertilizer recommendation has been developed by different research centers. Thus, the application of these fertilizer rates recommended by research institutes should be practiced for barley production. The Application rate of 182 kg NPS /ha and 56 urea/ha, all NPS and 1/3 of urea at planting while 2/3 of urea should be applied at the initiation of tillering (35-45 days after germination) after weeding practice. For the implementation of this practice, 182 kg/ha NPS and 56 kg/ha urea were used. [19]

The survey result shows that there is a significant difference between adopters and non-adopters of improved food barley technology in the use of fertilizer application rate (chi-square=15.315, DF=1, p 0.005). 7% of adopters used less than the recommended extension package, 21.1% of adopters used the recommended package, 13.4% of adopters used above minimum recommendation package and 22.6% of non-adopters used less than the minimum recommended package, 19.7% of non-adopters used minimum recommended package, 16.2% of non-adopters used greater than minimum recommended package (See Table 5).

Table 5. *Fertilizer Application rate.*

Variable	Adopter (n=59)		No-adopter (n=83)		Total		
Fertilizer Application rate	**N0**	**%**	**N0**	**%**	**No**	**%**	**Chi-square**
< 238kg/ha	10	7	32	22.6	42	29.6	15.315
238kg/ha	30	21.1	28	19.7	58	48.8	P-value
>238kg/ha	19	13.4	23	16.2	42	29.6	0.000
Total	59	41.5	83	58.5	142	100	DF=2

Source: Survey result 2021

The application of fertilizers in the study areas differs from farmland to other farmland. It depends on the soil nutrient content of the soil. The survey result showed that there is an unbalanced use of fertilizer in the sense of soil fertility which is assessed according to recommended extension package and type of fertilizer application rate. The use of fertilizer in the study areas is believed to increase production and replace the lost soil nutrients needed for food barley production.

Figure 5. *Farmer Questioner interview.*

3.7. Top Dressing

The survey result shows that adopters applied one time (68.3. %), two times (10.6%) and 10.6% of adopters ~~of~~ did not applied top dressing. Non-adopters applied one time (56.9. %), applied two times (5.6%), and 14.6% of non-adopters not applied top dressing (see Table 6). Top dressing is one the process of urea application to the plants of food barley. Row plantation is makes comfortable environments for top dressing.

Urea is split in three from given recommended package and halve of the urea is applied during plantation The remaining urea is applied for top dressing after plantation within 35-45 days and third top dressing is applied after weed is controlled in stage of starting initial flowering. There is difference between adopters and non-adopters of sampled respondents in applying top dressing. Non-adopters did not applied urea as adopters.

Table 6. *Top dressing.*

Variable	Adopter (n=59)		Non-Adopter (n=83)		Total	
Top Dressing	**NO**	**%**	**NO**	**%**	**NO**	**%**
One Times	45	31.7	52	56.9	97	68.3
Two Times	11	7.7	4	5.6	15	10.6
Not top dressed	3	2.1	27	14.6	30	21.1
Total	48	41.5	83	58.5	142	100

Source: Survey result 2021

3.8. Weeding and Protection of Food Barley

Weeding of food barley productions Weed infestation is one of important biotic factors that is responsible for low barley grain yield. Generally weeds reduce crop yields by competing for light, nutrients, water and carbon dioxide as well as interfering with harvesting and increasing the cost involved in crop production. Weeding frequency of barley field depends of the infestation level. Two times of hand weeding is recommended at 25-30 days after sowing and 45-55 days after sowing. Besides, post-emergence application of 2, 4-D 1 L/ha controls broad leaf weeds. Survey results showed there is difference between adopters and non-adopters in weeding practices of food barley productions. 7.7% of adopters practice weeding three times and 26.8% of farmers practiced weeding two times 7.0% of farmer's practiced one time 0, 0% no weeding. Non-adopters practiced weeding 7.7% no weeding, 36.6% one times, 14.1% two times, 0.0% three and above times (see Table 7)This result indicates that adopters are better practice than non-adopters.

Table 7. *Weeding practice.*

Variable	Adopter(n=59)		No-adopter (n=83)		Total	
Weeding	**No**	**%**	**No**	**%**	**No**	**%**
No weeding	0	0	11	7.7	11	7.7
One times	10	7.0	52	36.6	62	43.7
Two times	38	26.8	20	14.1	58	40.8
Three times	11	7.7	0	0	11	7.7
Total	59	41.5	83	58.5	142	100

Source: Survey result 2021

4. Conclusions

Agricultural technology adoption is assumed to improve the welfare of adopters through higher crop yields, reduced per unit cost of production and disposable income However, agricultural technology adoption and practice remains very low in Ethiopia. One of the factors that affect improve agricultural technology utilization is their farm practices. The finding indicates that a significant difference is observed between adopters and non-adopters in the practices of food barley production. In land preparation, non-adopters of improved food barley technology did not fully implement package practices of food barley production as compared to adopters. on fertilizer application Adopters applied more fertilizers, applied urea for top dressing, and looked for inspections from time to time against insects and weeds as compared to non-adopters. On the other hand, farmers prepare seed, either locally produced or certified. The survey result showed that adopters of improved food barley technology used certified seed compared to non-adopters; similarly, there is a difference between adopters and non-adopters among the sampled respondents in applying top

dressing. Non-adopters did not apply urea as adopters. This may be due to their belief that the local seed did not need as many practices as certified seed, and this result indicates that there are differences between adopters and non-adopters in the weeding of food barley productions in the study area., In future research, it is recommended that the extension and research system should address these factors to provide solutions.

Conflicts of Interest

Authors declare no conflict of the interest.

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