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Farmers' Varietal Perception towards Improved Bread Wheat Technologies in Ethiopia: an Implication for Bread Wheat Technology Development

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Abstract. This study was proposed to analyze farmers' varietal perception of bread wheat. From Meket district, four *kebeles* were randomly selected to achieve the above objective. The study uses cross-sectional data collected from randomly selected 214 farming households through an interview schedule. Fourteen Likert items were included in two categories as advantages and disadvantages of the technology. Five-point Likert scale was used to analyze varietal perceptions. One-way ANOVA was employed for testing the overall mean differences among bread wheat technology adoption categories. In addition, the Relative Importance Index (RII) was used to analyze item relative importance. Farmers supported improved bread wheat varieties for specific attributes such as, high marketability, early maturity, better grain yield, grain color, food quality, and storability were found to be taking the average score of 4.43, 4.43, 4.33, 4.01, 3.85, 3.45, and 3.26, respectively. Whereas, improved bread wheat varieties were perceived to be unsuitable for shattering problems, straw quality, and low yield performances in poor soil types. Therefore, breeding objectives should be oriented towards improving bread wheat variety traits related to shattering and straw quality. Limitation of labor is one of the major reasons for the low adoption rate of row planting. Hence, machinery should be carried out to promote row planting of bread wheat. Moreover, the study indicates the need to entertain farmers' perception of bread wheat technologies for creating wider adoption.

Keywords: Bread wheat; Likert scale; Meket; perception

INTRODUCTION

The contribution of new technology to economic growth can only be recognized when and if the new technology is widely diffused and used. It is undeniable that the generation and transfer of technologies is not an end in itself. The goal of increasing productivity and production of wheat will be realized if and only if the ultimate users, namely farmers, adopt the technologies that are developed by research. The reasons for low or no adoption of new agricultural technologies can be technical, socioeconomic, and/or institutional (Uaiene *et al*., 2009).

Understanding and addressing farmers' concerns about technology attributes determines the success of agricultural technologies. Clearly, understanding farmers' variety trait preferences is crucial to this end (Sinafikih *et al*., 2009). Since farmers view agricultural technologies as a complex of embodiment of several attributes, no single technology-specific attribute can cover the dimension of farmer's perception of technology specific attributes (Njane, 2007). Farmers' positive perception of seed affects their decision to practice different management approaches (Zewdie *et al*., 2010).

The choice of these attributes was based on the fact that they can be used to describe any agricultural technology as opposed to those technology-specific attributes that are very specific. For instance, taste, cooking quality, among others, which are only applicable to technologies whose end output is directly consumable. Farmer's perception of technology-specific attributes were measured by asking a farmer to express his/her opinion as either strongly agree, agree, uncertain, disagree and strongly

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disagree on perception statements presented to the farmer (Njane, 2007).

Zewdie and Dawit (2017) followed two steps in order to elicit farmers' preferences for bread wheat. First, they identified the list of attributes that helps farmers to characterize the different varieties of bread wheat through consulting wheat breeders and agronomists and then validating with farmers. Thus, grain yield, seed size, seed color, early maturity, drought tolerance, resistance to rusts, threshability, field establishment and crop stand, bread making quality, marketability, straw yield and straw quality were identified accordingly. Second, they elicited farmers' perceptions using these traits for the local and improved bread wheat varieties currently under cultivation (Zewdie and Dawit, 2017). Therefore, the current study was conducted with the objective of assessing adoption status and analyzing farmer's perceptions towards bread wheat varieties

METHODS

Description of the study area

North Wollo administrative zone is one of the eleven zones of Amhara Regional state. It is situated in the northern part of the country and geographically located at 11°50′N 39°15′E and 11.833°N 39.250°E. It shares a border with South Wollo, South Gondar, Waghemra, Tigray Region and Afar Region (Shimelis Hailu, 2013).

The major cereal crops in North *Wollo* include sorghum, teff, barley, maize, wheat and finger millet. In north Wollo, wheat is one of the four major cereal crops next to sorghum, Teff and barley. In terms of area coverage, wheat covers 32,783.83 hectares of land. Even in its productivity the crop is comparable with maize in north *Wollo* (CSA, 2017).

The study area, Meket is one of the districts in the Amhara Region of Ethiopia. Meket is located on the western side of north Wollo Zone, Meket is bordered on the South by Wadla and Dawunt, on the West by the South Gondar Zone, on the Northwest by Bugna, on the north by Lasta, on the northeast by Gidan, and on the east by Gubalafto. The administrative center of Meket is Filakit Geregera; other kebeles include *Agrit, Arbit and Debre Zebit*. Meket district consists of 34 rural kebeles (Meket District Office of Agriculture, 2018).

This district extends from the divide between the Tekezé and Bashilo watersheds northwards, with elevations ranging from about 1200 at the northwestern most point to over 3000 meters above sea level along the eastern part of its southern border Rivers include the *Checheho* which has its source in this District. Filakit Geregera lies on the main Debre Tabor Nefas Mewcha highway (also known as the Chinese road), and except for those of the eastern lowland Districts it is the only District capital with an all-year link to the Zonal capital of Woldiya.

Sampling Procedure

Meket district was one of the intervention sites where bread wheat technology generation, multiplication and promotion were conducted. In relation to technology generation and promotion, Sirinka agricultural research center has released and promoted two bread and durum wheat varieties at large scale clustered farms in the district.

Multi stage sampling technique was employed to select sample households for this study. Meket district has 34 rural administrative kebeles (Meket District Agricultural Office, 2018). From these, 15 of them were identified as potential bread wheat producer kebeles for selecting sample kebeles. Finally, sample respondents were selected using systematic random sampling techniques. The main reason for using this type of sampling method was: (1) the population in these kebeles is homogenous in socio-economic, institutional set up and livelihood structure in many ways. (2) Lists of the household heads (sample frame) is available at kebele leaders and DAs because of its importance for administrative and monitoring purposes (Lyman and Longnecker, 2016). Therefore, in the presence of sample frame and relative homogeneity in the population, using

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systematic random sampling method is more appropriate than other sampling methods. The number of respondents in each kebele[1] was determined by proportionate to size.

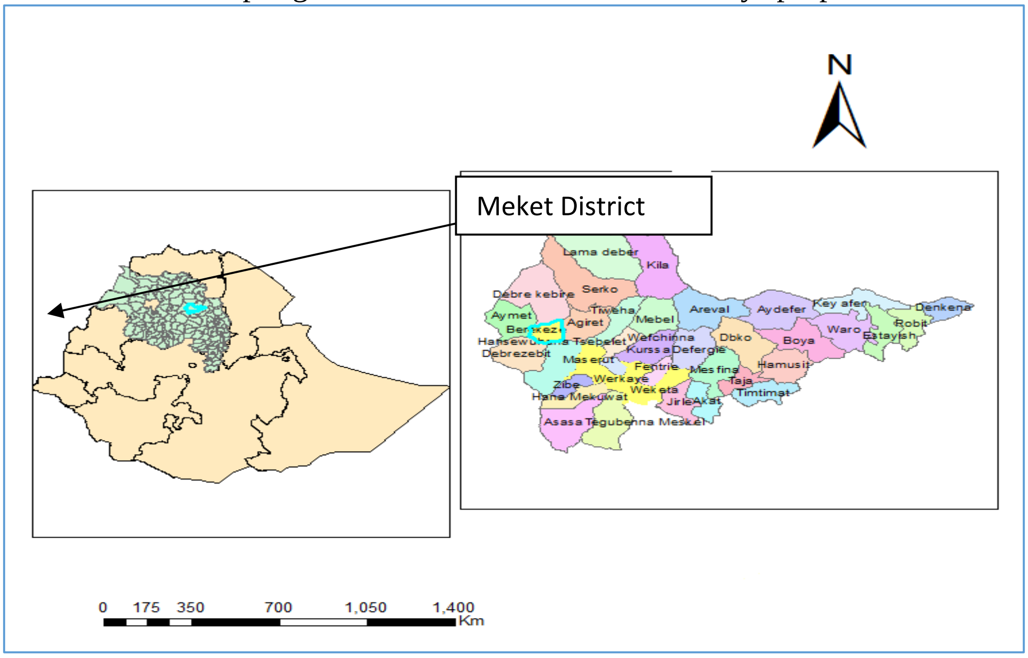

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Figure 1. Location of the study area (Source: CSA, 2011)

Sample Size Determination

There are several approaches to determining the sample size. These include using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas to calculate a sample size. All these approaches to determining sample size have assumed that a simple random sample is the sampling design. But more complex designs, e.g. stratified random samples, must take into account the variances of sub populations, strata, or clusters before an estimate of the variability in the population as a whole can be made (Israel, 1992).

Bread wheat growers households in the selected *kebeles* were used as the sampling frame and the sampling units were the household heads. Hence, based on the type of sampling design, the sample size for this study was determined based on the following formula given by Yamane (1967) as follows below:

$\frac{N}{1+N(e)^2}$**n**= $\frac{N}{1+N(e)^2}$ .....Equation 1

Where n is the sample size for the study, N is the population of interest (wheat grower farmers in the production year 2017/18) which is 4022, e is the precision level which will be 0.07 in this study due to the fact that the population in the study area is relatively homogeneous in the socioeconomic set up. The formula is valid for 95% confidence level. Based on the above formula 194 sample respondents were selected randomly. According to Israel (2012), it is common to add 10% of the selected sample for compensating absentees of contact of respondents; hence, 214 samples were selected. The sample size for each *kebele* was determined based on their proportion to total share of households residing in each *kebele*.

Type, Source and Method of Data Collection

Cross-sectional data were used for meeting the objective of this study. The data were collected both from primary and secondary sources. Primary data were collected from the sample farmers using structured questionnaire about bread wheat production, input utilization and demographic characteristics of the household. Secondary data were collected from published documents such as, books,

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proceedings and journals and unpublished documents like annual reports of different organizations. Before the formal data collection, the questionnaire was pretested for further fine-tuning. In addition, orientation was given for enumerators to have a common understanding regarding the data collection instrument. Finally, the questionnaire was administered by trained researchers of Sirinka agricultural research center in close supervision of the researcher.

Table 1. Distribution of sample respondents among selected *kebeles*

	Kebele	Name	Number of bread wheat Growers in 2017/18	Number of Samples selected (Using PPS)	Share (%)
1	029	Warkaye	1212	65	30.37
2	021	Maserut	1066	57	26.63
3	028	Weketa	966	51	23.83
4	017	Berekeza	778	41	19.15
	Total		4022	214	100

Source: Own survey, 2019

Data Analysis

Levels of adoption of improved bread wheat technology

In order to estimate the level of adoption of improved bread wheat technology (improved variety, row planting, recommended chemical fertilizer application (NPS and Urea) and herbicide/insecticide), adoption index was employed using the following formula.

$$AIi = \sum\left[\frac{AHi}{ATi} + \frac{FAUi}{FRU} + \frac{FANPSi}{FRNPS} + \frac{RP}{ARBi} + \frac{CAi}{CR}\right] / NP \quad \text{....................Equation 2}$$

Where: AIi= Adoption index
AHi= Area under improved variety of bread wheat of the ith farmer
ATi= Total area allocated for bread wheat production (improved variety +local, if any of the ith farmer
FA_{Ui}= Amount of urea fertilizer applied per unit area of land in the cultivation of bread wheat by ith farmer
FR_U= Amount of Urea fertilizer recommended for application per unit of area in the cultivation of bread wheat (100 kg/ha)
FANPSi= Amount of NPS fertilizer applied per unit area of land in the cultivation of bread wheat by ith farmer
FRNPS= Amount of NPS fertilizer recommended for application per unit of area in the cultivation of bread wheat (100 kg/ha)
RP= Area under row planting of bread wheat
ARBi= Total area of bread wheat (both row planting and broadcasting if any)
HA_i =Amount of Herbicide Applied per unit of area of ith farmer
CR= Amount of herbicide Recommended for application per unit of area, ith farmer
NP = Number of practices

Operational definition of key terms

Adopters: farmers who were growing improved bread wheat variety with some of the recommended agronomic practices during the survey year (2017/2018 production season).

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Non- Adopters: farmers who were not growing an improved variety of bread wheat in the last crop production (study) year (2017/18).

Adoption index: Measures the extent of adoption at the time of the survey. It is used in the case of study of multiple practices to measure adoption and intensity of adoption. Adoption studies by (Almaz, 2008; Alemitu, 2011 and Ketema & Kebede, 2017) employed adoption index to measure intensity of adoption. Therefore, for this study, adoption intensity of improved bread wheat production was measured using the adoption index.

Farmers' perception towards improved bread wheat technologies

Descriptive statistics such as mean, standard deviation, percentages and graphs were used. One way ANOVA was employed for testing the overall mean differences among bread wheat technology adoption categories. Farmer's perceptions towards improved varieties and agronomic practices were analyzed using Likert scale. In addition, Relative Importance index (RII) was used to analyze item relative importance, which is calculated as follows

$$\textbf{RII}=\frac{\sum w}{AN}=\frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5N} \quad \text{……………………… Equation 3}$$

Where w is weighting given to each factor by the respondent, ranging from one to five. For instance, n_1 = number of respondents for little important, n_2= number of respondents for some important, n_3= number of respondents for quite important, n_4= number of respondents for important, n_5=number of respondents for very important. The Manny Whitney non-parametric test was employed to test perception differences among adopters and non-adopters in relation to row planting of bread wheat.

A is the highest weight (i.e. 5 for this study) and N is the total number of respondents. The relative importance index (RII) ranges from 0 to 1 (Le and Tam, 2007). Scales for measuring farmer's preference were given from 1-5, ''1'' for the lowest value and ''5'' the highest value in the case of positive statements and the reverse is true for negative statements. Improved technologies were compared with farmers' practices based on different attributes.

RESULTS AND DISCUSSIONS

Current status of bread wheat technology adoption

Adoption index was developed using five bread wheat production practices. These include improved variety, row planting, application of NPS fertilizer, application of urea fertilizer and Herbicide use. Then, the final adoption index scores of sample bread wheat grower households were categorized into three adopter groups namely: low adopter, medium and high adopter. The actual adoption index score ranges from 0 to 1. The non-adopter group was given an adoption index score of 0. This results in four distinct categories of adopters. Similar studies by (Almaz, 2008; Akalu *et al*., 2016 and Mesfin, 2017) also categorized adoption level in the same way.

As shown below in Table 2, the mean adoption indexes of adopter categories i.e. from non-adopter to high adopter are 0, 0.27, 0.54 and 0.88 respectively. Table 2 also highlights the percentage distribution of households within the adopter categories. The result indicates, 54.47 % of sample household's fall under high adopters' category while non-adopters (11.21 %), low adopters (0.03 %) and medium adopters (28.50) comprised the rest. The result of one way analysis of variance revealed that, there is significant difference (F=620.93, P=0.000) among adopter categories in use intensity of the package.

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According to the survey result shown in Table 3, the adoption rate of the improved varieties was found to be high at 88.78%. In relation row planting, the adoption rate was found to be low (26.16%). This low adoption rate is related to the labor demanding nature of row planting. Evidence from farmers' perception regarding row planting indicate that even though they are convinced about different merits including better yield, they couldn't apply the practice due to its time consuming. The result also indicated that the adoption rate of fertilizer is 100% (both NPS and urea) indicating that all the sample households apply fertilizer although the intensity varies.

Table 2. Distribution of households by adoption level

Adopter category	Adoption index range	N	%	Mean adoption index	SD	F	P
Non adopters	0.00	24	11.21	0.00	0.00		
Low adopters	0.01-0.33	6	0.03	0.27	0.04		
Medium adopters	0.34-0.66	61	28.50	0.54	0.07		
High adopters	0.67-1.00	123	54.47	0.88	0.17		
Total	0.00-1.00	214	100.00	0.67	0.31	643.44***	0.000

Source: Own survey data, 2019 ***= Mean difference is significant at less than 1% level

The intensity of bread wheat varieties is measured by the proportion of land allocated for improved varieties is found to be 74%, which is the highest compared with other packages. Fertilizer use intensity is relatively high which is 73 % and 63% for NPS and urea respectively. Meanwhile, herbicide use intensity is found to be low which is 6%.

The low adoption rate of herbicide use might be related with the decision of farmers to apply herbicide on the spots where weed intensity is relatively high for the sake of saving money. This result is consistent with Chilot Yirga *et al.* (2013) who reported low adoption intensity of herbicides.

Improved bread wheat varieties grown

As shown below in Figure 2, the most cultivated improved bread wheat varieties by adopters households were, *Dinknesh* (39%), *Digalu* (25%), *Denda* (16.89%), and *Kakaba* (10.14%). Apart from this, farmers in the study area cultivate more than one variety in a single crop production year. This might be related to risk aversion and differences among the varieties.

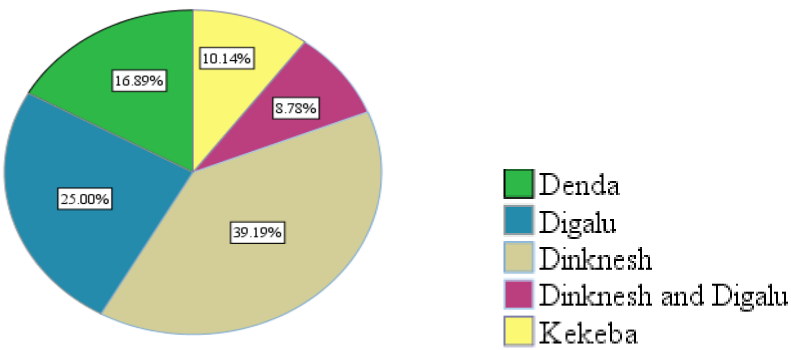

Figure 2. Improved bread wheat varieties grown by adopter farmers

The intensity of bread wheat variety adoption is measured as the area covered by the improved variety of bread wheat and it was found to significantly vary among bread wheat grower sample households. The result

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on intensity of variety adoption is provided in Table 4.

As illustrated below in Table 4, the average area covered by improved bread wheat variety across each adopter category was 0 for non-adopters and 0.21, 0.46 and 0.83 for low, medium and high variety adopters groups, respectively. This implies low, medium and high adopters categories covered 21%, 46% and 83% of bread wheat land with improved bread wheat variety respectively. There is a significant difference among adopter categories with respect to adoption intensity of improved bread wheat varieties (F= 477.84 and p=0.000). Comparatively, the land allocation of adopter households for improved varieties is relatively larger.

Table 3. Adoption of bread wheat technologies in Meket district

Technology Packages	Category of Adoption	N	%	Mean Adoption index	Standard Deviation	F
Improved Variety	Non Adopter	24	0.00	0.00	0.00	485.88 ***
	Low	8	4.21	0.28	0.03	
	Medium	46	24.21	0.51	0.08	
	High	136	71.58	0.92	0.15	
	Total	214	100.00	0.74	0.36	
Row planting	Non Adopter	158	0.00	0.00	0.00	2055.94 ***
	Low	33	58.93	0.21	0.08	
	Medium	12	21.43	0.51	0.13	
	High	11	19.64	0.95	0.08	
	Total	214	100.00	0.11	0.24	
NPS Fertilizer	Non Adopter	0	0.00	0.00	0.00	292.01***
	Low	44	20.56	0.24	0.05	
	Medium	70	32.24	0.40	0.13	
	High	100	47.20	1.10	0.31	
	Total	214	100.00	0.73	0.42	
Urea Fertilizer	Non Adopter	0	0.00	0.00	0.00	251.17 ***
	Low	59	27.57	0.22	0.06	
	Medium	73	34.11	0.49	0.04	
	High	82	38.32	1.05	0.36	
	Total	214	100.00	0.63	0.41	
Herbicide	Non Adopter	192	0.00	0.00	0.00	7415.27 ***
	Low	5	22.73	0.2	0.16	
	Medium	8	36.36	0.52	0.06	
	High	9	40.91	0.97	0.08	
	Total	214	100.00	0.06	0.23	

Source: Own survey data, 2019 ***= Mean difference is significant at less than 1% level

Table 5 provides the average area under the local variety of bread wheat. The average area under local variety is 0.147 ha with standard deviation of 0.211 whereas; the average area under improved variety was 0.36 ha with standard deviation of 0.259. This denotes that the sample respondents allocated more areas of their lands to improved varieties than for the local variety.

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Table 4. Area of land allocated for improved bread wheat varieties

Adopter Category	N	%	Mean of land	SD	F	P
Non adopter	24	11.21	0.00	0.00		
Low adopter	93	43.41	0.21	0.07		
Medium adopter	69	32.24	0.46	0.08		
High adopter	28	13.14	0.83	0.18		
Total	190	100.0	0.36	0.26	477.84***	0.000

Source: Own survey data, 2019 *** = mean difference is significant at less than 1%

Table 5. Land allocation of farmers for improved and local bread wheat varieties

Variable	Obs	Mean	Std.Dev.	Min	Max
Improved variety	214	.36	.259	0	1.5
Local variety	214	.147	.211	0	1.375

Source: Own survey data, 2019

Source of improved varieties

Different sets of actors can support technology promotion. Farmers were asked where they brought improved bread wheat varieties for the first time. The result showed that farmers got improved varieties from five sources. In the study area, the office of agriculture and farmers' cooperative are the major sources of improved varieties. Farmer's multipurpose cooperative and agricultural research centers are also another source of improved seed ranking second and third respectively. Zewdie *et al*. (2014) reported a similar result. Besides three major sources, farmers accessed improved seed via farmer-to-farmer seed exchange and universities see (Figure 3).

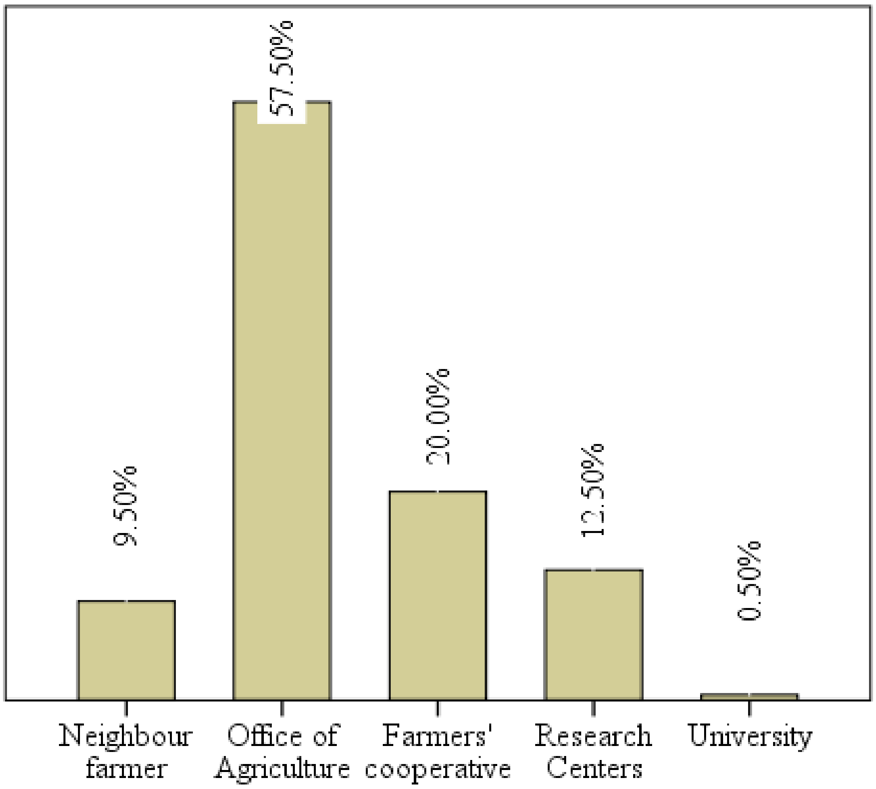

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Figure 3. Source of improved seed

Year of adoption by adopter households

According to Rogers (1962) theory of DOI[1], the rate of adoption can be explained by the number of individuals using the technology within a given time period. Rogers in his model indicated that adoption rate can be represented by either a bell-shaped (frequency) or an **S**-shaped (cumulative) curve. Adopter farmers were asked when they started growing improved bread wheat varieties. As indicated in Figure 4 below, farmers in the study area started to grow improved bread wheat varieties in the mid 1990s. The rate of adoption for improved varieties was substantially increased within the last 10 years (Figure 4). This might be related to decentralization of agricultural research in the country and introduction of different actors in transferring agricultural technology transfer.

[1] DOI denotes for diffusion of innovation

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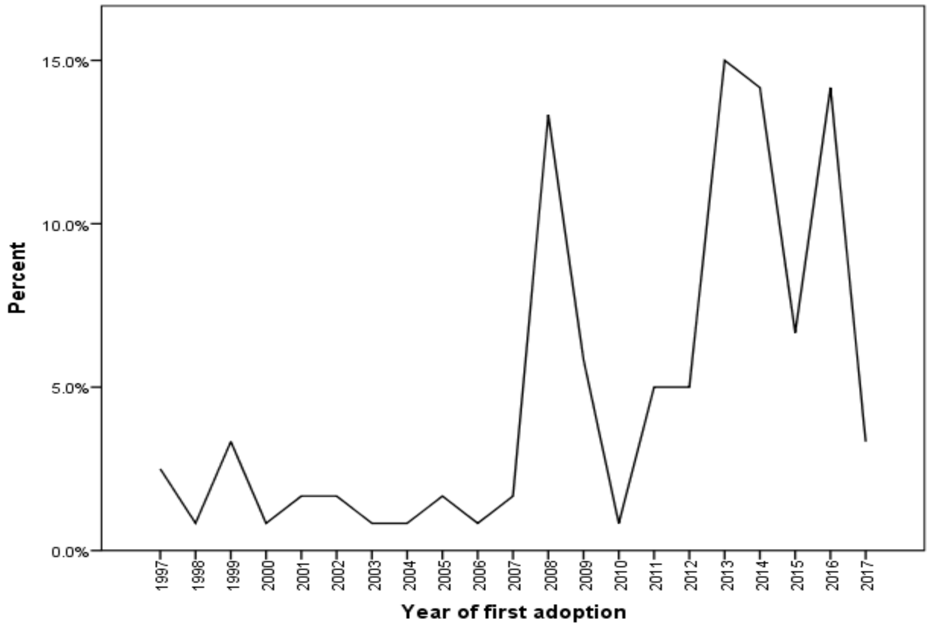

Figure 4. Year of first adoption

Adoption rate of NPS fertilizer

The average amount of NPS used by the high adopter group is 110.33 kg/ha, slightly above the recommendation rate of 100 kg/ha. There was significant variation among NPS fertilizer adopter categories in terms of the amount of NPS application. This is indicated by results of one-way ANOVA which revealed the presence of significant mean difference in NPS application rate (F= 292.01, P=0.000) at 1% significance level (Table 6). The variation in NPS fertilizer rate might be related to the discrepancy in farmer's socioeconomic (for instance, income) and physical (plot level) characteristics

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Table 6. Adoption rate of NPS fertilizer

NPS adopter Category	N	%	Average NPS applied(Kg/ha)	SD	F	P
Non adopter	0	0	0.00	0.00		
Low adopter	44	20.56	24.03	5.42		
Medium adopter	69	32.24	49.68	4.35		
High adopter	101	47.20	110.33	30.85		
Total	214	100	72.82	42.19	292.01 ***	0.000

Source: Own survey data, 2019 *** = Significant at less than 1 % level

Adoption rate of urea fertilizer

The recommended rate of urea fertilizer by the research system is 150 kg/ha. However, the extension system used a blanket recommendation of 100 kg Urea. As shown in Table 4.6, the average amount of urea used by interviewed farmers is 105.02 kg/ha which is less than research recommendation but a little bit more than the extension system. However, the overall adoption rate of urea fertilizer is 63.03%. The variation in urea application rate shows significant difference among urea adopter categories (F= 251.17, P= 0.000). Even though the rate of application significantly varies, all sample households apply urea fertilizer (Table 7).

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Table 7. Adoption rate of urea fertilizer

Urea adopter Category	N	%	Average urea applied (Kg/ha)	SD	F	P
Non adopter	0	0	0.00	0.00		
Low adopter	59	27.57	22.07	6.52		
Medium adopter	73	34.11	48.95	4.50		
High adopter	82	38.32	105.02	35.90		
Total	214	100	63.03	41.47	251.17***	0.000

Source: Own survey data, 2019 ***= significant at less than 1% significance level

Adoption rate of row planting

Studies regarding row planting of wheat proved that row planting has a significant impact on crop yield and income of the household (Negese Tamirat *et al*., 2016; unpublished). As shown in Table 10 below, the adoption rate of row planting was found to be 26.16 % while the intensity of the practice is 5%. Although farmers acknowledge the merits of row planting (yield, convenient for cultivation and harvesting), they are reluctant to adopt the practice mainly due to labor shortage during planting period (Table 8).

Table 8. Adoption rate of row planting

Row planting adopter category	N	%	Average land (ha)	SD	F	P
Non adopter	158	69.15	0.00	0.00		
Low adopter	46	21.49	0.15	0.07		
Medium adopter	8	0.04	0.44	0.06		
High adopter	2	0.01	0.75	0.00		
Total	214	100.00	0.05	0.12	786.27***	0.000

Source: Own survey data, 2019 ***= significant at less than 1% significance level

Table 9. Adoption rate of herbicide

Herbicide adopter Category	N	%	Mean herbicide (liter/ ha)	SD	F	P
Non adopter	192	89.71	0.00	0.00		
Low adopter	5	2.33	0.2	0.07		
Medium adopter	8	3.73	0.52	0.05		
High adopter	9	4.20	0.97	0.08		
Total	214	100.00	0.06	0.21	7415.27***	0.00

Source: Own survey data, 2019 ***= significant at less than 1% significance level

Adoption rate of herbicides

Herbicide is the second most well-known and commonly used input on wheat (Chilot Yirga *et al.*, 2013). The recommended herbicide of improved wheat technology is 1 L of 2, 4-D ha[1]. As shown in Table 9 below, almost 90% of sample households didn't adopt herbicide instead, only 10% of wheat grower farmers apply different rates of herbicide from 0.2 to 0.97 liter/ha. The intensity of herbicide use in the study area is 0.06 which is far below the recommended herbicide rate i.e. 1L ha[1]. The mean difference of use intensity among adopter categories is significant (F=7415.27 and P=0.000).

Relative importance index of attributes

Assessment of farmers' perception regarding improved varieties is mainly focused on the parameters of disease resistance, yield, Marketability and food quality. These Likert scale measurements

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employed composite (summated) scores derived from an individual's responses to the multiple items on the scale (Warmbrod, 2014). Farmers' perceptions towards improved bread wheat varieties specific attributes have its own implication on adoption and intensity of adoption (Njane, 2007).

As shown below (Table 10), 14 Likert scale statements were included to measure farmers' perception towards improved varieties. To measure perceived relative advantage and disadvantage of the attributes, both negative and positive Likert statements were equally included in the analysis. Statements were developed based on literature review and the author's previous experience on bread wheat participatory research. Accordingly, a relative importance index was developed to determine as to which items were more important and of less importance for the total attribute. The higher the relative importance index, the more will be its importance for farmers to select the technology. The rank was given for items separately for the perceived advantage and disadvantage. As shown in Table 10 below, perceived attributes such as marketability, early maturity, grain yield and color ranks first, second and third respectively. While from the perceived disadvantages side, performance in poor soils, low straw quality and shattering problems take the first three ranks. The result reveals that attributes in the first three ranks have relatively better importance for bread wheat varieties.

Perceived relative advantage of bread wheat varieties

The relative superiority of the technology in terms of its advantage will enable farmers to have a favorable perception about the technology, which enhances decision in favor of adoption of the technology. With regard to the assessment of perception, an index, which identifies how well certain attributes of improved varieties meet farmers' preference over the local variety, five-point scale, was used. Accordingly, the rating was (1) strongly disagree, (2) disagree, (3) not decided, (4) agree and (5) strongly agree and they were used to measure the respondents' perception of the technologies. The larger value (5) indicates how farmers perceive the characteristics being presented for evaluation are being embodied and 5, 4, 3, 2 and 1 in a decreasing manner. In the list of advantages, a value less than three indicates how the farmer perceives the characteristics under evaluation as poor or negative and in the list of disadvantages the reverse is true.

Based on the survey result shown in 4.18, the varieties were supported by farmers for certain attributes such as, high marketability, early maturity, better grain yield, grain color, food quality and storability were found to be taking the average score of 4.43, 4.43, 4.33, 4.01, 3.85, 3.45 and 3.26, respectively.

Perceived relative disadvantages of improved bread wheat variety

Perception on resistance to drought, straw yield resistant to diseases susceptible to frost, shattering problem, straw quality yield performances low in poor soils and less fertilizer attributes were assessed to get farmers' view on relative disadvantages of improved bread wheat varieties. The interpretation for the relative disadvantages somehow varies since the highest value in this case is 1 unlike that of the advantages where the highest value is 5 for the lowest value.

The result presented in Table 12 also reveals that low resistance to drought, low straw yield, less resistant to diseases and susceptible to frost were perceived relative disadvantages with an average score of 2.56, 2.73, 2.34 and 2.47. On the other hand, the perception of shattering problems, low straw quality and low yields in poor soils were some of the relative disadvantages having average scores above the median value of the Likert scale (3.60, 3.54, 3.68 and 3.76).

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Table 10. Relative importance index of variety attributes

List of advantages	Relative importance index	Attribute Rank
It has good grain storability	0.65	6th
It has good food quality	0.69	5th
It has ideal grain size	0.77	4th
It's grain color is good	0.80	3rd
The grain yield is better	0.87	2nd
It is early maturing	0.89	1st
It is high marketable	0.89	1st
List of disadvantages		
It is low resistant to drought	0.51	7th
Its straw yield is low	0.55	6th
It is less resistant to diseases	0.47	5th
It is susceptible to frost	0.49	4th
It has shattering problem	0.72	3rd
It has low straw quality	0.71	2nd
It yields low in poor soils	0.74	1st

Source: Own survey data, 2019

Hence, the mean of items related to perceived relative disadvantages, it can be revealed that the improved variety of bread wheat was perceived to be suitable for its drought tolerance, straw yield, disease resistance, and better skipping from frost. Whereas improved bread wheat varieties were perceived to be unsuitable in relation to the shattering problem, straw quality low yield performances in poor soils. This result is in agreement with Zewdie Bishaw and Dawit Alemu (2017) who reported that attributes related to disease resistance and grain yield are more embodied in improved varieties.

Perceived total attributes of the varieties

As shown in Table 12 below, summated scores of Likert items in the perceived relative advantages of varieties have shown significant differences among adopter categories (F= 10.28, F= 0.000). In addition, there is a significant mean perception difference among adopter categories in relation with perceived relative disadvantages (F= 2.68, P=0.04). Moreover, there exists a significant mean perception difference among adopter groups in relation with overall perception of bread wheat varieties.

Table 11. Farmers' perception towards improved varieties

Items	Distribution of respondents based on perception of improved varieties (frequency)

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List of advantages	SA	A	ND	D	SDA	Item Mean	St. Dev
It has good grain storability	4	65	130	13	2	3.26	0.64
It has good food quality	25	101	42	38	8	3.45	1.03
It has ideal grain size	29	137	35	12	1	3.85	0.74
It's grain color is good	46	128	37	2	1	4.01	0.68
The grain yield is better	81	128	2	1	2	4.33	0.62
It is early maturing	113	88	7	5	1	4.43	0.64
It is high marketable	105	98	8	3	0	4.43	0.71
List of disadvantages							
It is low resistant to drought	9	38	44	95	28	2.56	1.16
Its straw yield is low	34	47	14	65	54	2.73	1.16
It is less resistant to diseases	4	48	26	75	61	2.34	1.06
It is susceptible to frost	4	52	38	66	54	2.47	1.45
It has shattering problem	27	97	72	14	4	3.60	1.04
It has low straw quality	28	110	34	33	9	3.54	0.91
It yields low in poor soils	32	110	46	23	3	3.68	2.18

Where SA= strongly agree, A= Agree, ND= Not decided, D= Disagree, SDA= Strongly Disagree
Source: Own survey data, 2019

Table 12. Perceived total attributes of bread wheat varieties

	Category of Adoption	**Mean Perception**	**Standard Error**	**F**	**P value**
Perception on the Advantages (PA)	Non Adopter	21.625	0.8160805	10.28***	**0.000**
	Low	18.83333	1.249444		
	Medium	22.19672	0.6766276		
	High	20.61789	0.3202525		
	Total	27.76168	0.148031		
Perception on the Disadvantages(PD)	Non Adopter	21.625	0.8160805	2.68**	**0.047**
	Low	18.83333	1.249444		
	Medium	22.19672	0.6766276		
	High	20.61789	0.3202525		
	Total	21.13084	0.2875267		
perception Total (PT)	Non Adopter	50.91667	0.9889181	3.73**	**0.012**
	Low	49.5	1.565248		
	Medium	49.90164	0.8223998		
	High	47.96748	0.3601011		
	Total	**48.89252**	**0.341071**		

Source: Own survey data, 2019

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Farmers' perception of towards row planting of bread wheat

As shown below in Table 13, no variation was seen among the adopter group's perception regarding labor intensiveness of row planting. This might contribute to the low adoption of row planting as it has been highlighted in the previous discussions. However, There was no significant difference among adopter groups regarding the merits of row planting in relation to its convenience for fertilizer application, weeding. Table 13 also reveals that, there is a significant difference among adopters in their perception regarding yield increment of row planting. This result is consistent with Tegegn Daniel (2013) who indicated the limitation of labor for practicing row planting of wheat.

Table 13. Manny Whitney Test for comparison of adopter groups

Items 1= row planting is better 2= broadcasting is better 3= same	Rank sum		
	Adopter	Non adopter	Z- value
Labor saving	20389	2616	0.409ns
Convenient for cultivation	20242	2763	0.741ns
Convenient for weeding	20773	2232	-2.049**
Convenient for fertilizer application	20793.5	2211.5	-1.919**
Convenient for harvesting	20649	2356	1.360ns
Yield	20745.5	2259.5	-1.743**

Source: Own survey data, 2019 **= significant at 5% level

As shown in Figure 5, farmers were asked to compare the merits and demerits of row and broadcast planting. The comparison was also made among adopters non-adopter groups regarding the two practices using percentages. Responses were assigned as 1= row planting is better, 2= Broadcasting is better and 3= same.

Farmers must often make trade-offs in the management of their resources, and labor often presents a particular challenge. Farmers in the study area were encouraged to switch from broadcasting to row planting of wheat by different agents such as the ministry of agriculture and Agricultural research centers. However, according to this study, farmer's opinions on row planting of bread wheat showed that the greatest limitation to further adoption of the recommendation was the extra labor required by row planting. Of the adopter households, 96% of them reported that row planting of bread wheat is labor intensive while 100 % of non-adopter households also have the same opinion on the labor intensiveness of row planting. Almost both adopter and non-adopter households have similar opinions regarding the convenience of row planting for cultivation (61 % and 63% respectively). Of the six opinion statements on the merits and demerits of row and broadcasting, sample households have a positive opinion for row planting of bread wheat except the first statement, i.e. Labor intensiveness of the technology. Besides this, the opinion of adopter groups on row planting of bread wheat follows the same pattern across the comparison statements.

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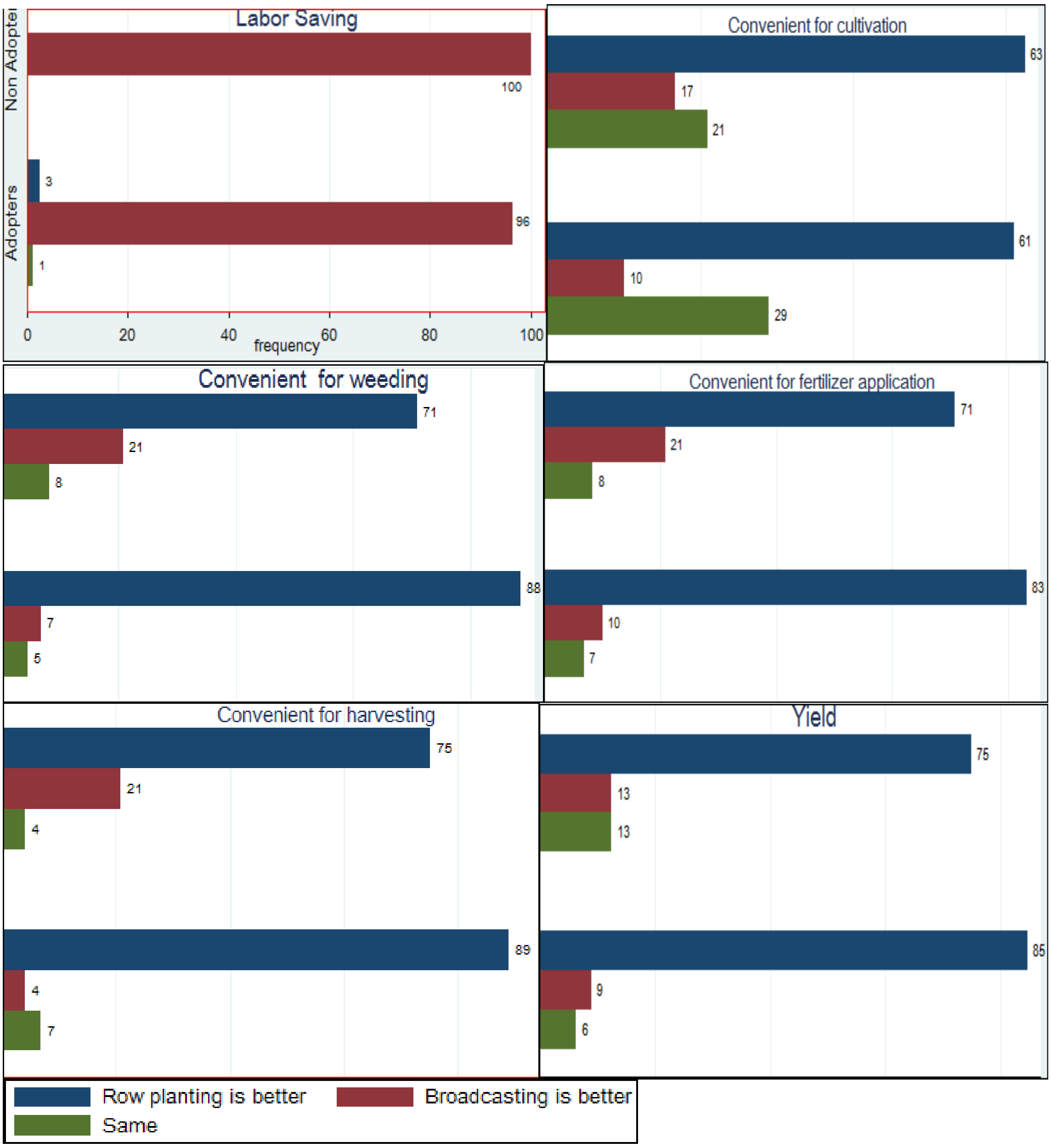

Figure 5. Farmer's perceptions towards row planting of bread wheat

CONCLUSION

Farmers' perception towards the perceived relative advantages demonstrated that; marketability, early maturity, better yield and color were perceived to be the most important technology attributes for bread wheat varieties by farmers. The low adoption rate and intensity of row planting was related to extra labor required compared to broadcast planting.

Apart from grain yield, researchers in the area of bread wheat varietal development should consider farmers' varietal perception towards marketability, seed color, food (bread) quality and shattering problems. Increasing the efficiency of row planting related to labor could increase the adoption rate of the technology. Hence, measures related to improving labor efficiency of farm implements should be developed and promoted in the study area.

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