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Determinants of Farmers Access to Information about Improved Wheat Varieties: *Case of farmers in major wheat growing regions of Ethiopia*

Kaleb Kelemu
Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia.
Corresponding author email id: kaleb_kelemu@yahoo.com

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Abstract **— Wheat plays crucial role in addressing food security problems in Ethiopia. Increasing wheat production and productivity depend on use of improved varieties in which farmer's access to information about improved wheat which involves, sources and availability of the different varieties, is critical factor. This study was, therefore, conducted with an objective of examining factors that influence probability of wheat growing farmer's access to information about improved wheat varieties using data collected from 1611 farm households from major wheat growing regions of Ethiopia. Logistic regression model were employed and several socioeconomic and institutional factors such as wheat growing experience, age, education level, family size, total livestock owned (measured in TLU), model farmer, farmers contact with extension workers, mobile telephone and radio ownership significantly influenced probability of farmer's access to improved wheat varieties. The study conclude proportion of farmer who don't have information about improved wheat varieties is very high therefore, it is recommended that the extension system has to expand span of its operation to reach all farmers with information about improved wheat varieties. For doing this targeted radio program on wheat to provide information for wheat farmers will have to be enhanced. Mobile telephone service has to be expanded and strengthened in areas where there is limited access as farmers who have owned mobile telephone have higher probability of accessing information about improved wheat varieties.**

Keywords **— Wheat, Wheat Varieties Information, Ethiopia.**

I. INTRODUCTION

Wheat is an important cereal crop constituting significant proportion of smallholder crop production in Ethiopia. Importance of wheat to smallholder farm households and to the entire economy manifested through large hectare of land allocated to wheat production, significant proportion of households that are engaged in the production of wheat and total volume produced every year. For the year 2014/15, the total amount of land allocated for wheat production is 1,663,845 ha and the total volume of wheat produced in the same year is about 4,231,588 tons (CSA, 2014/15). Ethiopia is the second largest wheat producer in Sub Saharan Africa next to South Africa. Wheat is one of the major staple crops in the country in terms of both production and consumption. In terms of caloric intake, it is the second most important food in the country behind maize (FAO, 2014).Despite the strategic importance of wheat to the national economy, the average productivity level is still very low which could be attributed to several factors among which farmer limited access to high yielding wheat varieties is the most important one.

Coupled with low level of wheat yield, the demand for wheat has been growing fast in both rural and urban areas in the country. Changes in dietary patterns and a rapid growth in wheat consumption have been noted over the past few decades in several countries in sub-Saharan Africa (Shiferaw et al., 2011). This situation demands the need to improving the productivity and production of wheat through generation and dissemination of improved wheat varieties. In this regard, the government of Ethiopia has already identified expanding availability of improved wheat varieties as key strategy for ensuring food security in the country (Bekele et al, 2014). However, ensuring availability of improved varieties does not necessarily leads to its adoption by farmers. This is because farmers must first be aware of the availability of the varieties themselves which necessitate the need to ensure information about the varieties available to the farmers. Many studies (Akudugu et al., 2012 and Adekambi et al., 2009) revealed lack of awareness is one of the key factors that affect adoption of improved wheat varieties. This study, therefore, aims at investigating what factors affect farmer's access to information about newly released improved wheat varieties. The findings of the study will help extension program planners and policy makers make informed decision in making information accessible to farm households in general and what growing farmers in particular. In this study information about improved wheat varieties entails information about availability of improved varieties that have better yield and disease resistance performance compared to varieties that farmers are currently using, it also includes information about sources of the variety which could be associated with the place where farmer can get the variety.

II. IMPORTANCE OF WHEAT IN ETHIOPIA

Wheat is one of the important cereal crops consumed in different forms in Ethiopia and the rest of the world. Ethiopia is the second wheat producer in sub-Saharan Africa (SSA) next to South Africa (Abu, 2012; Demeke and Marcantonio, 2013) and it ranked 4th after teff, maize and sorghum in terms of area coverage with 1,605,653.9 hectares and 3rd in terms of quantity production with 3,925,174.135 tons in 2013/14 cropping season in Ethiopia (CSA,2016). The last 15 years wheat production, productivity and total land area used for wheat production has shown relatively gentle growth. The average level of

wheat productivity for the period of 2000-2014 is about 1.73 ton/ha while the average growth rate in productivity is about 5.93%. During the same period total wheat production has been increasing at 10.14% growth rate per annum (Table 2).

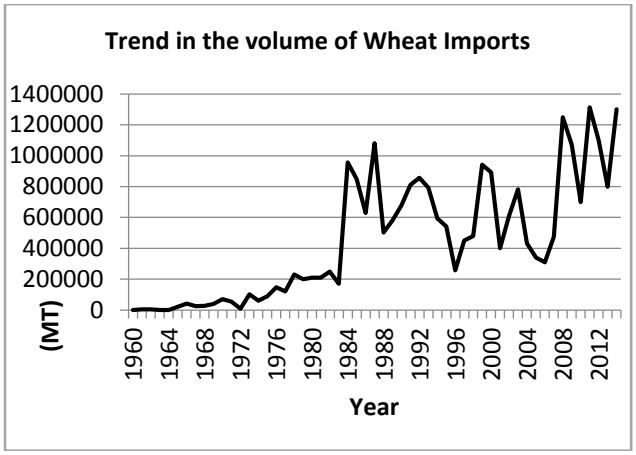

Figure 1: Trend in the volume of imported wheat (1960-2014)
Source: FAOSTAT, 2014

The domestic wheat consumption of the country for the past half century indicates the alarming rate of increment. The increment is very high for the past five years. According to USDA data, the domestic consumption of wheat shows the fastest growth trend (from 3.8 million tons in 2010 to 5.4 million tons 2014). Despite the county's attempt to increase domestic wheat production through improved wheat variety and area expansion, wheat self-sufficiency is still found to be an unattainable plan for the country due to this huge increment of wheat consumption resulted from fast population growth.

Wheat produced in Ethiopia is used mainly for domestic food consumption, seed, and industrial use. For instance, in 2012/13 household consumption accounted for 58 percent of the total wheat produced. Seed and sales represented about 19 percent each, and the remainder is used for animal feed and as in kind payments for labour. Of the total wheat sold, about 50 percent is commercialized within farmers' district to local retailers and consumers (Bregh et al., 2012).

The government of Ethiopia in its growth and transformation plan envisages that Ethiopia should soon being a position where it will be able to reliably satisfy its domestic grain requirements for several cereals primarily wheat and produce a surplus that can be exported for some. Of the cereals whose production is soon likely to exceed domestic demand requirements, wheat is the commodity that will most easily find an export market to supply (Shiferaw and Okelo. 2011). In view of this prospect, the need for increasing productivity of wheat is very crucial.

Table 1: Trend in wheat production, productivity and area covered under wheat production (2000-2014)

Year	Average Yield (Ton/Ha)	Annual Yield Growth (%)*	Total Production (Tons)	Annual Production Growth (%)*	Area Harvested (Hectares)
2000	1.1631	NA	1,235,270	NA	1,062,010
2001	1.3259	14	1,596,020	29	1,203,720
2002	1.4354	8	1,444,434	(9)	1,006,271
2003	1.3874	(3)	1,618,093	12	1,166,237
2004	1.4691	6	1,614,441	0	1,098,907
2005	1.5567	6	2,176,603	35	1,398,215
2006	1.5204	(2)	2,219,075	2	1,459,540
2007	1.6711	10	2,463,064	11	1,473,917
2008	1.6245	(3)	2,314,489	(6)	1,424,719
2009	1.8269	12	3,075,644	33	1,683,565
2010	1.8385	1	2,855,682	(7)	1,553,240
2011	2.0288	10	2,916,334	2	1,437,485
2012	2.1102	4	3,434,706	18	1,627,647
2013	2.4446	16	3,925,174	14	1,605,654
2014	2.5433	4	4,231,589	8	1,663,845
Average	1.73	5.93	2,474,708	10.14	1,390,998
Max	2.54	16	4,231,589	35	1,683,565
Min	1.16	(3)	1,235,270	(9)	1,006,271

Source: FAOSTAT
*Figures in parenthesis are negative numbers

III. Model Specification

In examining the determinants that affect farmer's access to information about newly introduced wheat varieties logit model were employed. In logit model we consider first the case where the response y_i is binary, assuming only two values that for convenience we code as "1" for farmers who have access to information about new wheat varieties (have awareness about new wheat varieties) or "0" for farmers who don't have access to

information about the varieties (no awareness) and we can define this as follows:

$$Y_i = \begin{cases} 1 \; if \; the \; i_{th} farmer \; have \; information \; about \; new \; varieties \\ 0 \; otherwise \end{cases}$$

The model uses household, institutional and individual level characteristics as explanatory variables that affect farmer's access to information about improved varieties; where:

$$P_i = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1 + e^{-(b_1 + \sum b_k x_{ik})}}$$

P_i ...Probability that farmers have access to information about improved varieties;
b_1 ....Constant term
b_k ...Coefficients
x_{ik}…explanatory variables that affect farmer's access to information about improved varieties

$$\text{Let } Z_i = b_1 + \sum b_k x_{ik} \text{ then } P_i = \frac{1}{1+e^{-Z}}$$

As Z_i ranges from $-\infty$ to $+\infty$, P_i ranges from 0 to 1 and P_i is non-linearly related to Z_i. The model is estimated in the following form:

$$L_i = L_n\left(\frac{P_i}{1 - P_i}\right) = Z_i = b_1 + \sum b_k x_{ik}$$

Where L is the logit, which shows how the log odds in favour of farmers access to information about improved wheat varieties changes as the respective independent variable changes by a unit.

IV. Data

The study uses data collected from 1611 households collected from 61 major wheat growing districts of Oromia, Amhara, SNNP and Tigray regional states of Ethiopia. The data was collected by the Ethiopian Institute of Agricultural Research in collaboration with International Maize and Wheat Improvement Center (CIMMYT) in 2015. The sampling frame covered seven major wheat-growing agro-ecological zones that account for over 85% of the national wheat area and production distributed in four major administrative regions (Oromia, Amhara, SNNP and Tigray) of Ethiopia.

A multi-stage stratified sampling procedure was employed to select villages from each agro-ecology, and households from each kebele/village. First, agro-ecological zones that account for at least 3% of the national wheat area each were selected from all the four major wheat growing. In the second stage of sampling procedure, up to 21 villages in each agro-ecology, and 15–18 farm households in each village were selected using proportionate random sampling technique. Detailed and structured questionnaire were used to collect the data and trained enumerators were used to ensure collection of quality data. The data collection was supervised by experienced researchers which ensured the quality of data.Wide range of household, individual and institutional related explanatory variables were included in the logit model. The descriptive statistics of respondents against each of the different explanatory variables is summarized on table 3.

Wheat growing experience is an important variables which is hypothesized to positively affect farmer's awareness about improved wheat varieties. The average wheat growing experience of farmers who have awareness about improved wheat varieties and farmers that have not is 17.91 and 17.50 years, respectively. The two category of farmers have also differences in terms of literacy that the average literacy level for farmers who have awareness about wheat varieties is 0.67 while for farmers that do not have awareness in 0.49.Age is hypothesized to negatively affect probability of getting access to information about wheat variety. The average age measured in years for the whole sample farmers in 45.93 years and for farmers that have information is about improved wheat variety is45.36 and 47.62 years, respectively. Distance from main market and office of development agents are both hypothesized to negatively affect probability of getting information about improved wheat varieties.

Table 2: Status of households on awareness about improved wheat varieties

Regions	Proportion of HHs (%)	
	Have awareness	Don't have awareness
Oromia	84	16
Amhara	60	40
SNNP	81	19
Tigray	58	42
Total average	71	29

Source: Own computation from survey data set

V. Empirical Analysis

Description of variables

The dependent variable used in the logit model is a binary response on status of households on their awareness about improved wheat varieties and descriptive statistics of the dependent variable is summarized on table 2. In general, large proportion of households have awareness about improved wheat varieties. But the proportion of households who have awareness about improved wheat

varieties is higher in Oromia and SNNP constituting 84% and 81%, respectively.

Wide range of household, individual and institutional related explanatory variables were included in the logit model. The descriptive statistics of respondents against each of the different explanatory variables is summarized on table 3. Measured in km, the average distance of the total sample households from the main market and office of agriculture development agent is 9.05km and 3.01km, respectively. The average distance to the main market for farmers who have information about improved wheat variety and for those that don't have information is about 8.84 and is 9.12 km, respectively.Wealth status of household is hypothesized to positively influence access to information about improved wheat varieties. Land holding size and total livestock unit (TLU) are used as proxy indicators for household wealth status. The average land holding size and TLU of the total sample is 1.54 ha and 5.43, respectively.

Farmers that have information about improved wheat varieties own relatively higher amount of land which is about 1.60 ha compared to 1.36 ha of those who don't have access to information about improved wheat varieties. The average TLU for farmers that have information about improved wheat varieties and those that don't have is about 5.77 and 4.42, respectively. Family size is also an important household characteristics hypothesized to positively affect probability of getting information about improved varieties. The average family size for households that have information about improved variety is 6.75 and while for those households that don't have is about 6.07. Being model farmer or not have implication on probability of getting agricultural information from different sources. Large proportion of farmers who have information about improved wheat variety are model farmers.

Radio and mobile telephone are important means through which famers would get agricultural and other relevant information and are hypothesized to positively influence probability of getting information about improved wheat varieties. Radio is considered as an effective tool to disseminate agricultural information among the farmers and it is the most powerful mass media for broadcasting information quickly. Descriptive statistics of this variable indicate around 48% of the farmers who have information about improved varieties have radio whereas only 65% of those farmer who don't have information about improved wheat variety don't have radio. Similarly, larger proportion of farmers who have information about improved wheat variety owns mobile telephone. The average number of contact of farmer with extension worker for farmers who have information about improved wheat variety is 3.82 while the average number of contact for farmers who don't have the information is about 3.57. Number of contact with extension worker is hypothesized to positively influence probability of getting information about improved wheat varieties.

Number of relatives and non-relatives living both inside and outside the village that farmers rely on for information and farmer members to cooperative are important factors that positively affect probability of getting information about improved wheat varieties. The proportion of famers that belong to category of famers that have information about improved wheat varieties is higher than those farmers that don't have.

Major information sources about wheat varieties

The least expensive input for improved rural agricultural development is adequate access to knowledge and information in areas of new agricultural technologies, early warning systems, improved seedlings, fertilizer, credit, market prices etc (Blait, 1996).

The key reason restraining farmers to increase agriculture production and income is lack of information sources in rural areas. Improving provision of agricultural information in rural areas might efficiently fill the information gap, certainly facilitating farmers to enhance production and livelihood. As the approaches applied for delivery of agricultural information are limited, so the governments require efficient system to articulate the farmers' needs (Chen and Wu. 2009) using diversified information sources to congregate these needs (Farooq et al., 2007).

Wheat growing farmers in Ethiopia have multiple sources of agricultural information in general and wheat varieties information in particular. Government extension service, cooperatives, farmers groups, other farmer's relatives and NGOs, research centres and radio/TV as indicated on table 3 overwhelming majority of farmers (63% of respondent famers) acquired information about improved wheat varieties from government extension through development agents and woreda agricultural extension experts. Farmer's relatives and other neighbour farmers are also appeared as important essential source of information. Insignificant proportion of farmers (0.5% of respondent farmers) receive information about improved wheat varieties through radio and television.

Table 3: Proportion of respondents disaggregated by wheat variety information sources

Variety information sources	No of respondents	Proportion of farmers (%)
Government extension	739	62.6
Farmers' cooperative/union	84	7.1
Farmer's group	13	1.1
NGO	6	0.5
Research centres	4	0.3
Seed/grain stockist	3	0.3
Other farmers relative	161	13.6
Other farmers neighbour	165	14
Radio/TV	6	0.5
Total	1181	100

Table 4: Description of dependent and independent variables

VARIABLES	DESCRIPTION OF VARIABLES	AGGREGATE MEAN(SD)	Awareness about improved wheat varieties		χ^2/t-stat.
			Aware	Not-aware	
Dependent Variable					
VARIETY_AWARENESS	Dummy: 1 if HH is aware about improved wheat variety; 0 *otherwise*	0.75(0.43)	1	0	
Independent Variables					
EXPGRWWT	Experience in wheat farming measured in years	17.81(11.09)	17.91 (10.86)	17.50(11.78)	(6.24)***
HHEDU	Dummy: Literacy status of HH =1 if household head can read and write; 0 *otherwise*	0.63(0.48)	0.67(0.47)	0.49(0.50)	(14.11) **
HHAGE	Age of household head measured in years	45.93(12.6)	45.36(12.27)	47.62(13.73)	(8.34)
DSTMNMKT	distance from home to village market (km)	9.05(5.88)	9.12(6.03)	8.84(5.41)	(8.2) ***
DSTAGREX	distance from home to extension agent office (km)	3.01(2.77)	3.04(2.79)	2.92(2.73)	(8.12)
LANDSIZE	Amount of agricultural land owned (ha)	1.54(1.29)	1.60(1.32)	1.36(1.21)	(3.26) ***
TLU	Livestock holding size in Tropical Livestock Unit (TLU)	5.43(4.40)	5.77(4.50)	4.42(3.92)	(10.2) ***
FAMILYSIZE	Number of household members	6.58(2.22)	6.75(2.24)	6.07(2.07)	(7.2) **
MODELFARMER	Dummy: 1 if household head is model farmers;0 otherwise	0.42(0.49)	0.43(0.49)	0.39(049)	(11.2)***
RADIO	Dummy: 1 if household have radio; 0 otherwise	0.44(0.49)	0.48(0.50)	0.35(0.48)	(5.31) *
MOBILETELEPHON	Mobile telephone ownership status (1=owned)	0.48(0.49)	0.53(0.49)	0.35(0.49)	(2.14) **
EXTCONTACT	# of contact with extension worker in a year (2014)	3.62(3.48)	3.82(3.39)	3.57(3.74)	(11.2) ***
RLTOUTVLG	# of relatives living outside the village that farmers rely on	11.12(24.8)	11.06(20.90)	10.84(27.26)	(7.12) **
NORLTWITHVLG	# of non-relatives living within the village the household rely on for information	9.86(26.91)	10.37(29.48)	8.34(17.18)	(11.10) **
COOPMEMBER	Dummy: 1=if household head is member of cooperative; 0 otherwise.	0.99(0.09)	0.99(0.08)	0.98(0.10)	(12.1)
RLTWITHVLG	# of relatives living in the village that farmers rely on for information	9.01(17.24)	9.03 (18.72)	8.98(11.85)	(2.3)*
N	No of observations	1611			

St.dev in parentheses and *, ** and *** denote significance level at 10%, 5% and 1%, respectivel

Table 5: Determinants of awareness about improved wheat varieties

Variables	Coefficient	t-statistics
WHEATEXP	0.022***	(1.99)
MKTDST	-0.011	(0.93)
DSTAGREX	-0.0257	(0.48)
HHAGE	0.057***	(-2.07)
HHEDU	0.430***	(3.18)
TLU	0.396***	(1.87)
FAMILYSIZE	0.053*	(1.67)
MODELFARMER	0.024***	(-0.70)
LANDHOLDING	0.122	0.59
EXTCONTACT	0.0118**	(-2.07)
MOBILETELEPHONE	0.362**	(2.64)
RADIO	0.247*	(1.87)
COOPMEMBER	-0.14	(-0.23)
RLTWITHVLG	-0.0029	(-0.71)
NORLTWITHVLG	0.005	(1.41)
RLTOUTVLG	-0.003	(-1.13)
Constant	0.113	(0.17)
N	1611	

Source: Own computation

t statistics in parentheses; *, ** and *** denote significance level at 10%, 5% and 1%, respectively

VI. Econometric Estimate

Several socioeconomic and institutional variables that were hypothesized to potentially affect farmer's access to wheat variety information were identified and included in the econometric model for analysis. Sixteen variables were included in the model out of which nine variables proved significantly affect probability of farmer's access to wheat varieties information from any sources indicated in table 4.

Mobile telephone an important variables that were hypothesized to positively affect probability of farmer's access to information about improved heat varieties. Mobile telephone is powerful communication media and expansion of mobile phones' coverage is considered one of the remedies for an information problem that famers face (Getaw and Godfrey, 2014). With the advent of mobile phones, many rural communities can easily communicate on social affairs such as funeral services, wedding ceremonies, and religious matters. Similarly, access to mobile phones eases the process of farmers' market information searching at a lower cost than other mechanisms (Aker, 2011; Jensen, 2010). In this study, the role of mobile telephone in facilitating farmer's access to information about improved wheat varieties is proved as econometric estimate on effect of mobile ownership indicated positive and significant (5% level) influence on probability of farmer's access to improved wheat variety information. This might be specifically attributed to the fact that mobile telephone help farmers communicate withdifferent individuals such as other famers, agriculturalextension workers, and traders who might have information about improved wheat varieties.Similarly, radio has also positively and significantly influenced (10% level) the probability of improving farmer's access to improved wheat varieties. Positive and significant influence of radio and mobile could be due to the power of these two electronic media in accessing information from different sources.Wheat growing experience affect probability of accessing information about wheat variety positively and significantly at 1% level implying that farmer who have long years of experience in wheat production have better access to information. This might be associated with extensive exposure that farmers experience with different agricultural information sources overtime so that the longer wheat growing experience farmers have the broader network of information sources they establish which provide them with better opportunities for accessing information about newly released wheat varieties. Both age (measured in years) and education level (dummy variable literate/not literate (can read and write/can't read and write) affect probability of accessing information about improved heat varieties positively and significantly at 1%level.As age increase farmers broader social ties that farmers establish both within and outside community members become an important mechanism that ensure better farmers access to agricultural information.In a similar fashion famers who can read and write have relatively better position to read and understand different information dissemination materials such as leaflets, brochures, posters etc. More educated farmers are typically assumed to be better able to process information and search for appropriate technologies to alleviate their production constraints.

The belief is that education gives farmers the ability to perceive, interpret and respond to new information much faster than their counterparts without education.TLU is used an important proxy indicator for wealth status of household and it was hypothesized that wealthier households (TLU) can afford transaction costs necessary for accessing information from different sources. Wealthier farmers can afford costs associated with mobile telephone, an important means farmers use to communicate and obtain farm related information from different sources (Getaw and Godfrey, 2014). In this study, TLU is found to positively and significantly (1% level) influenced probability of farmer's access to wheat variety information.Knowledge and information are traditionally passed between generations and among family members, and this knowledge and information transfer may play a role in influencing the adoption of technologies and information. As family size increase the probability of getting information increase and finding of this study indicate family size has influenced probability of accessing information about improved wheat variety at 10% significance level. This is because bigger family size may directly imply, but may not necessarily, bigger social network which increase the probability of getting new information from different sources.

The Ethiopian agricultural extension system heavily depend on the use of model farmers to disseminate agricultural information and technologies to other farmers that are regarded as followers. Model farmers are widely believed to play instrumental role by serving as an agent or disseminating agricultural information they received from agricultural experts, development agents and other

sources of agricultural information and technologies (Kaleb, 2016). Econometric estimate indicate being model farmer positively and significantly (1% level) influence probability of accessing information about improved wheat varieties. This is directly attributed to their position in the country's agricultural extension system which identify and use model farmers and information needed to be disseminated to wider farming community is most often communicated first to model farmers.Farmer's contacts with extension agents was measured in terms of number of actual contacts made in the year 2015 between the farmer and extension workers is hypothesized to have a positive effect on farmers access to information about improved wheat varieties.Such contacts, directly expose farmers to information about the different available improved wheat varieties in terms of their productivity potential, agronomic characteristics and specific merits compared to local varieties etc.The finding of this study indicate contact with extension workers have positive and significant influence (5% level) on the probability of getting information about improved wheat varieties.Similar finding were reported by Abudulai& Huffman (2014) on their maize adoption study that maizetechnology adopters who had access to information about improved maize variety and associatedtechnologies had more access to extension services through increased contact with extension services agents.

VII. Conclusions and Recommendations

The study focused on investigating the factors that influence probability of wheat growing farmer's access to information about improved wheat varieties. For this purpose data was collected from 1611 farm households from major wheat growing regions of Ethiopia.

To analyse determinants of factors that affect probability of farmer's access about improved wheat varieties logistic regression model were employed. Several socioeconomic and institutional factors were hypothesized to significantly influence farmer's access to improved wheat varieties related information were included in the model. Wheat growing experience, age, education level, family size, total livestock owned (measured in TLU), model farmer, farmers contact with extension workers, mobile telephone and radio ownership are variables that significantly influenced probability of farmers access to improved wheat varieties.

Proportion of farmer who don't have information/awareness about improved wheat varieties is very high implying that that lack of access to information about heat varieties is an important reason that contributed for low level of wheat related technologies in general and varietal information in particular. This study therefore recommend that the extension system has to expand span of its operation to reach all farmers with information about improved wheat varieties. In this regard, an effective and cost efficient mechanisms for reaching multitude of farmers with informant meant to create wider awareness about improved wheat varieties is use of radio programs. Despite positive and significant impact of radio ownership on probability of farmer's access to improved wheat varieties, the proportion of farmers who used radio as source of agricultural and wheat related information is very low. The national extension program should therefore design targeted radio program on wheat to provide information for wheat farmers so that adoption of improved wheat technologies will be enhanced. Mobile telephone expansion has to be expanded and strengthened in areas where there is limited access as farmers who have owned mobile telephone have higher probability of accessing information about improved wheat varieties, leading to positive change in the adoption of wheat technologies and increased agricultural productivity.

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AUTHOR'S PROFILE

Kaleb Kelemu, currently working as researchers in the Ethiopian Institute of Agricultural research. He has got his BSc in the field of Agricultural extension from Haramaya University and MA degree in development studies from Addis Ababa University in 2008.He is currently working as deputy director for externally funded research projects and partnerships at the Ethiopian institute of Agricultural Research.