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A REVIEW ON FACTORS AFFECTING ADOPTION OF WHEAT IN ETHIOPIA: AN IMPLICATION FOR VARIETAL DEVELOPMENT

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ABSTRACT

The study is based on a narrative review approach using published sources in the area of agricultural technology adoption. Despite many improved varieties and agronomic practices have been released and recommended to the farmers, the adoption of these technologies remained below the expected figure. Hence it is pertinent to understand factors affecting wheat technology adoption in Ethiopia. Factors such as, Age of the farmer, farmers' learning and experience, family labor, field days, Sex, total active household labor in man equivalent, access to credit, livestock ownership, education of household head, trainings, demonstrations, extension contact, mass media, farm income, farm size and, access to all weather roads and market distance positively and significantly affect adoption of wheat by smallholder farmers. Therefore, measures such as, establishing better input supply, developing agricultural information system and availing farm machineries should be taken to overcome the above constraints of wheat technology adoption.

KEY WORDS

Adoption, technology, wheat, Ethiopia.

Agriculture is one of the central fields that shape the socioeconomic development of any country (Mohamad MRA and Gombe, 2017). Hence, the life of all human being is heavily dependent on agricultural products and its importance is going to increase day to day (Akhtar and Pirzada, 2014). Consequently, Agriculture has for many years been the backbone of Africa economy and the potential sources of economic growth despite all its weaknesses (Ajao et al., 2013).

Agriculture is a dominant sector of Ethiopian economy which makes a lion share contribution to the Gross Domestic Product, employment and foreign exchange earnings. It is still believed to remain a sector that plays an important role in stimulating the overall economic development of the country in the years to come (CSA, 2014). Agriculture has continued to retain its importance in Ethiopia's economic growth contributing about 42% of GDP, with 80% of employment and 70% of export earnings in 2014 (African Economic Outlook, 2015) as cited by (Lulit Mitik et al., 2016).

More specifically, Cereal production occupies the major share of agricultural production in Ethiopia, of which teff, maize, wheat and sorghum are most important cereals in terms of area cultivate, yield and consumption. Teff constitutes almost 24% of total grain production, followed by maize (17%), sorghum (15%) and wheat (14%) (CSA, 2014b) as cited in (Lulit et al. 2016). Most smallholder farmers are located in the moisture-reliable cereal based highlands accounting for 59% of all farm area; on the other hand, the farm area in the drought-prone highlands represents 27% of the total area cultivated (Lulit et al., 2016).

Ethiopia is the largest wheat producer in Sub-Saharan Africa with the cultivated land of 1.1 million ha (Mohammed *et al.*, 2011). Of the cereal crops, wheat is one of the staple crop in Ethiopia whose share in cereal acreage has remained constant since the 1980s unlike that of maize which has increased substantially over time (Abate et al., 2015). wheat is also among the most important staple food crops grown in Ethiopia (Shiferaw *et al.*, 2014). There

are two varieties of wheat grown in Ethiopia: durum wheat, accounting for 60 percent of production, and bread wheat, accounting for the remaining 40 percent (Bergh *et al.*, 2012) as cited in (Gashaw *et al.*, 2014).

Both bread wheat and durum wheat are grown in Ethiopia and. Of which, about 87% is grown during the main growing season (*meher*). While durum wheat is indigenous and mainly grown in the Central and Northern highlands bread wheat is a recent introduction to Ethiopia. Durum wheat was the main wheat crop both in terms of area and production, but this has altered dramatically since the mid-1980s with the release and diffusion of semi-dwarf, high yielding and adaptable bread wheat varieties (Bekele *et al.*, 2014).

In many developing countries, like Ethiopia, it has become obvious that generating new technology alone has not provided solution to enable poor farmers to increase agricultural productivity and achieve higher standards of living (CIMMIYT 1993) as cited by (Bezabih 2012). According to previous researches in Ethiopia, low adoption of improved production technologies was attributed to unavailability of appropriate technologies, unavailability and high cost of required inputs, lack of access to and high interest rates on credit, and policies that discourage improved technology adoption such as promotion of state farms (Hailu Abera 2008). Increasing the rates of adoption of improved production technologies is therefore considered critical for agricultural growth in Ethiopia. Therefore this study will add a value for literature on determinants of agricultural technology adoption specifically in wheat production packages.

Table 1 – Improved wheat varieties released in Ethiopia

Year	Released Improved Wheat varieties (Number)		
	Bread wheat	Durum wheat	Total
Before 1981	3	-	3
1981-1990	3	1	4
1991-2000	15	8	23
2001-2010	25	20	45
Total	46	39	85

Source: Chilot *et al.*, 2013.

The general objective of the study is to review factors affecting the adoption of wheat technologies and review farmers varietal perception towards improved wheat technologies.

Specific objectives:

- To identify factors affecting the adoption of wheat;
- To review farmers varietal perception towards improved wheat;
- To review existing models/theories of adoption.

METHODS OF RESEARCH

Narrative review approach was employed for meeting the above stated objectives. In this regard selected studies were compared and summarized on the basis of the author's experience, existing theories and models using tables and narrations. It was tried to present the latest researches in the given topic or field of research.

LITERATURE REVIEW

The focus of technology adoption studies is mainly on estimating adoption rates and its understanding the relationship between technology adoption, its intensity and relevant socioeconomic, and policy variables. Despite their importance in explaining some of the bottlenecks to technology adoption, the problem arises from biased estimates of both adoption rates as well as determinants of adoption when applied to a population that is not fully aware of the technology (Simtowe *et al.*, 2011).

As cited in (Feder *et al.*, 1985) the adoption process is defined by Rogers as "the mental process by an individual passing from first hearing about an innovation to its final

adoption. However, for detailed theoretical and empirical analysis, a specific quantitative definition of adoption is needed. Such a definition must distinguish between individual (farm level) adoption and aggregate adoption. Final adoption at the individual farmer's level is defined as the degree of use of a new technology in long run equilibrium when the farmer has full information about the new technology and its prospective. Through a process of learning and experimentation, new equilibrium levels can be achieved. From the aggregate adoption point of view, the diffusion process can be defined as "the process of transfer of a new technology within a region. Aggregate level of use of a specific new technology within a given geographical area or within a given population is measured in terms of Aggregate adoption is measured (Feder *et al.*, 1985).

Usually, agricultural technologies are introduced in the form of packages that include several components, for instance, high-yielding improved varieties, fertilizer, and corresponding agronomic practices. Even though the components of a package may complement each other, some of them can be adopted separately. Thus, farmers may encounter various distinct technological choices. They may adopt either full package of innovations introduced in the region or subsets of the package that can be adopted disjointedly.

The individual and the choices an individual makes to accept or reject a particular innovation can be examined by adoption theory. In some models, adoption is not only the choice to accept an innovation but also the level to which that innovation is incorporated into the appropriate context. Adoption theory, then, can be considered as a micro perspective on change, aiming not on the whole but rather the pieces that make up the whole. In contrast, diffusion theory represents how an innovation spreads through a population. It may consider factors such as, time and social pressures to describe the process of how a population adopts, adapts to, or rejects a particular innovation. Diffusion theory lies on a macro perspective on the spread of an innovation through time (Straub, 2009).

Adoption models embedded on a diversity of theories for example, Innovation Diffusion Theory (IDT) is from sociology, Theory of Reasoned Action (TRA) is from social psychology, and Theory of Interpersonal Behavior (TIB), Theory of Planned Behavior (TPB) and Social Cognitive Theory (SCT) are psychosocial theories. All three theories have proven their usefulness in predicting and explaining a variety of human behaviors in different contexts. Instead, TRA and TPB differ from DOI in the sense that the former emphasizes on explaining the behavior of individuals. While the latter concentrates on adoption decisions in which the organizational characteristics play a key role, not the individual. SCT and TPB integrate the notion of perceived outcomes when forecasting behavior while DOI and TAM focus solely on beliefs about the technology. DOI, TAM and TPB adopt a unidirectional outlook towards causal relationship, in which environmental constructs affect cognitive beliefs, which affect attitudes and behaviors whereas SCT relies on the bidirectional nature of causation in which behavior, emotional and cognitive factors and environment persistently and mutually affect each other (Taherdoost, 2018).

Everett Roger's grand work in 1960, named as the Diffusion of Innovation Theory is the foundation of research in diffusion. This theory has been widely applied by the researchers over the years. The main notion of the theory is that there are four basic elements that affect the spread of a new idea: the innovation, communication channels, time and social system. The process of diffusion comprises of five stages, i.e., knowledge, persuasion, decision, implementation, and confirmation. Adopter categories are the classifications of members of a social system on the basis of innovativeness. Based on social system and innovativeness, adopters can be categorized into five; (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards (E. M. Rogers, 1983a).

Social psychology setting served as the basis in the theory of Reasoned Action (TRA). The theory proposes three general concepts, i.e. behavioral intention (BI), attitude (A), and subjective norm (SN). According to theory of reasoned action, a person's behavioral intention depends on his attitude and subjective norms. Arithmetically, it can be understood that behavioral intention is the summation of attitude and subjective norms. Furthermore, intention of a person is likely to change to action if there is the intention to behave in a

specific manner is highly enough (Fishbein and Ajzen, 1975) as cited by (Assomption et al., 1993).

The Theory of Planned Behavior (TPB) was proposed by Icek Ajzen in 1991 and was emanated from the Theory of Reasoned Action. TPB includes the concept of Perceived Behavioral Control (PBC) to the basis attitudes and subjective norms which make up the TRA. Perceived behavioral control denotes to "people's perception of the ease or difficulty of executing the behavior of interest". It diverges from Rotter's (1966) concept of perceived locus of control because it is not constant and varies with different circumstances faced by the individual. The Locus of control is considered to be a more general expectancy of the individual which remains equally stable across situations. In this way, the critics faced by TRA that it is based on relatively static build of attitude and thus cannot be used for estimate of behavioral outcome has been addressed by TPB. The basis of concept of PBC are stranded in the Self Efficacy Theory (SET) proposed by Bandura (1977) which in turn came from the Social Cognitive Theory (Straub 2009).

The focus of the Social Cognitive Theory (SCT) is on the concept of self-efficacy which is defined as "the judgment of one's capability to use a technology to complete a specific job or task". According to SCT, behavior of the user is affected by anticipations of result related to personal as well as performance-related gains. Self-efficacy, in turn, effects the expectation of outcome of both types. Whereas, esteem of the person and his sense of success relate to personal outcome expectations, outcome expectations related to performance on the job lead to performance related expectations. According to SCT, there are two contrasting causes that influence behavior of the users. Encouraging impact is made by the factor "affect" which is the extent to which an individual likes his job. Instead, negative contribution to preferred behavior is made by the factor "anxiety" which is the anxious response of the person while performing a job such as trying to use a computer with which the person is not very familiar. This theory has been extensively employed in adoption studies (Bandura, 1986) as cited by (Straub, 2009).

Technology Adoption Model (TAM) has been intensively applied in technology adoption research. The strength of the model lies in its simplicity as it has only two basis, namely, "perceived usefulness" and "perceived ease of use" for predicting extent of adoption of new technologies at individual level as shown below (Venkatesh and Davis, 2000).

The Model of PC Utilization is built on the Theory of Human Behavior by Triandis (1977) which deviates in some ways from the Theory of Reasoned Action because it makes a discrepancy between cognitive and affective components of attitudes. Beliefs belong to the cognitive element of attitudes. According to this theory "Behavior is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have frequently done (habits), and by the anticipated consequences of their behavior"(Triandis, 1977) as cited by (Sharma and Mishra, 2014).

The key concept behind Motivation Model is Motivation theory of psychology (Davis, Bagozzi and Warshaw 1992). Several studies have examined motivational theory and revised it for specific situations and also applied it to recognize new technology adaption and use. The core constructs of the theory are extrinsic motivation and intrinsic motivation (Davis, Bagozzi and Warshaw 1992) as cited by (Samaradiwakara and Gunawardena, 2014).

Venkatesh & Davis modified TAM to include extra key factors of TAM's perceived usefulness and usage intention basis in their extended TAM model. The additional constructs incorporated social influence processes (subjective norm, voluntariness and image) and cognitive influential procedures (job relevance, output quality, result demonstrability and perceived ease of use) (Venkatesh and Davis, 2000).

Unified Theory of Acceptance and Use of Technology commonly referred as UTAUT was postulated in 2003 by Venkatesh et.al. By a systematic review and association of the constructs of previous eight models (TRA, TAM, MM, TPB, TAM2, DOI, SCT and model of personal computer use). It is meant to serve as an inclusive model that can be applied across a variety of applications. It comprised of four basic constructs namely "performance expectancy, effort expectancy, social influence and facilitating conditions. The unified theory is supposed to be superior as it is able to explain 70% of the variance while the former

theories were explaining only 30-40% variance in the adoption behavior. However, it confronts criticism on the grounds of being too complex, not being thrifty in its approach and its inability to explain individual behavior (Chiemeké and Ewuekpae 2011).

Model of Acceptance with Peer Support (MAPS) offers an integration of earlier research that was focused on individuals with pertinent constructs of social network in such a way that helps to extend the scope of earlier theories. There are two types of social ties which the authors proposed. First tie exists between employees relates to obtaining assistance from employees that can result in extension of knowledge for using the system. The second kind of tie between employees is related to providing support to co-workers for enabling better understanding of configuration and deployment of the system (Sharma and Mishra 2014).

Table 2 – Summary of Theories and Models of Technology Adoption

Year	Theory/Model	Developed by	Constructs/ Determinants of adoption
1960	Diffusion of innovation Theory	Everett Roger	The innovation, communication channels, time and social system
1975	Theory of reasoned action	Ajzen and Fishbein	Behavioral intention, Attitude (A), and Norm
1986	Social Cognitive theory	Bandura	Affect, anxiety
1989	Technical Adoption	Fred D Davis	Perceived usefulness and perceived ease of use
1991	The Model of PC Utilization	Thompson et al.	Job-fit, Complexity, Long-term consequences, Affect Towards Use, Social Factors
1992	The Motivation model	Davis et al.	Extrinsic motivation (such as perceived usefulness, perceived ease of use, and subjective norm) and intrinsic motivation
2000	Extended TAM2 model	Venkatesh and Davis	Social influence processes (subjective norm, voluntariness and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability and perceived ease of use)
2003	Unified Theory of	Venkatesh et al.	Performance expectancy, effort expectancy, social influence and facilitating conditions
2009	Model of acceptance with Peer Support (MAPS)	Sykes et al.	Behavioral intention, System use, Facilitating conditions, Network density, Network centrality, Valued network centrality, Valued network density

RESULTS AND DISCUSSION

There are various studies conducted in the area of adoption specifically in agricultural technologies. According to (D'Souza and Mishra, 2018) a study on 'Adoption and Abandonment of Partial Conservation Technologies in Developing Economies: The Case of South Asia', years of education, credit access and membership to different clubs significantly affect the adoption of partial conservation. For instance compared with heads of the households with primary education, household heads with secondary education and tertiary education household heads are more likely to adopt partial conservation technologies.

Another study (Akinola et al., 2010), Determinants of adoption and intensity of use of balance nutrient management systems technologies in the northern Guinea savanna of Nigeria; identified asset ownership and off farm income as significant factors in determining adoption of balanced nutrient management. Similar with (D'Souza and Mishra, 2018), Akinola *et al*, 2010) indicated access to credit as determinant factor of adoption.

According to (Solomon, Tessema, and Bekele 2014) a study conducted in Oromia region, Ethiopia, credit access, household head sex, field day participation, access to all weather roads, access to credit, active family force, district and market distance as being key determinants on the intensity and adoption of use of improved wheat varieties. Hence, the study recommended that emphasize should be given to this variables to improve adoption and intensity of wheat.

(Hailu Abera 2008) identified farm size, family labor and farmers' education as critical factors in determining adoption of tef and wheat technologies. Farm size has a positive influence on the adoption of tef and wheat technologies. The findings of this author indicated

that policies and strategies should be put in place in expanding primary education to improve the understanding of farmers towards herbicide application. In this study teff and wheat are identified as labor intensive technologies indicating that labor plays a paramount importance in adopting these technologies. Similarly (Manda *et al*, 2016) argues that, education level of the household head has a positive and significant influence on adoption of improved maize varieties. In addition to this, Manda and his colleagues result shows that access to extension services increases the likelihood of adoption of maize varieties.

According to (Ermias, 2013) a study conducted in North Wollo, the level of active labor ratio negatively and significantly affects adoption and intensity of improved sorghum varieties. Another determinant factor according to this study is the extent of livestock ownership which significantly and positively affects adoption and intensity of use of improved sorghum varieties. Contrary to (Hailu, 2008), (Ermias, 2013) found out that Farm size as determinant factor which negatively and significantly affects adoption and intensity of use of improved sorghum varieties.

The results of adoption studies by (Khonje *et al*. 2015), (Bezu *et al*. 2014), and (Rahman and Haque 2013), reveal that education level of the household head has appositve and significant effect on adoption of a given agricultural technologies. (Bezabih, 2012) found out that frequency of contact with extension agents, exposure of mass media and participation on extension events has a positive significant effect on adoption of wheat technologies.

Findings from (Arslan *et al.*, 2014) a research conducted on Adoption and intensity of adoption of conservation farming practices in Zambia, indicated that age of the household head and education level significantly increase the intensity of adoption of conservation farming practices, while cultivated land per capita decreases the intensity of adoption, resulted from labor constraints.

According to (Solomon *et al.*, 2014) factors such as, household head sex, credit access, active family force, access to all-weather roads, district and market distance had a significant effect on the intensity of use of wheat varieties at different significance levels.

Access to credit positively and significantly influences the adoption and use intensity of balanced nutrient management systems (BNMS). An additional source of credit results an increase of the probability of adoption of BNMS-manure by 11%. Hence, an improvement in access to formal or informal credit will enhance households' technology adoption according to the findings of this study.

A study conducted by (Ermias *etal*, 2014) indicated that field day participation, access to all weather roads, access to credit, active family force, district and market distance significantly affect the adoption wheat varieties. According to (Laduber *etal.*, 2016), Institutional factors overweighed than individual, economic and kebele level factors for the adoption of bread wheat.

On the other hand, a study conducted in southern Ethiopia by (Worku and Yishak, 2017) showed that education status, household size in adult equivalent, oxen ownership, and participation in agricultural training and demonstrations significantly affect the adoption of planting method of wheat.

Apart from household characteristics and farmers' knowledge (Hassen, 2014) in his study on the adoption of wheat seed, concluded that distance to different infrastructures such as (markets, roads, and input supply) play a significant role for technology adoption. This result is in agreement with the findings of (Degefu *et al*, 2017) conducted in Eastern Ethiopia, Hararghe.

The study by (Bedilu *et al*. 2015) revealed that, farming experience, distance to cooperatives, renting a tractor and combine harvester, Urea application, and net income from wheat grain sale positively and significantly affect wheat technology adoption.

Knowledge and information on farmers' perception and its influence on adoption of modern wheat varieties, awareness and source of new wheat production technology practices remain erratic in Ethiopia. There is an extensive adoption of new technologies: the majority of farmers grew modern wheat varieties (Zewdie *et al*, 2010).

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. Technology-specific attributes that were used in the current study were relative advantage, compatibility, trialability, complexity and observability (Njane and Wangare, 2007).

Table 3 – Summary of literatures on adoption of wheat technologies in Ethiopia

No	Author(s), year	Model used	Kind of technology	Study Areas	Important findings
1.	Hailu Abera (2008)	Xtprobit and Xttobit random effect	Tef and wheat technologies	Northern and Western Shewa, Amhara Region	Age of farmer, farmers' learning and experience, family labor and credit
2.	Tariku Bezabih, 2012	Tobit model	Wheat and production technologies	Gesha District, Kaffa zone, SNNP	Sex, education of household, trainings, field days, demonstrations, extension, mass media, farm income, farm size and livestock ownership
3.	Tesfaye etal, (2014)	Double Hurdle	Wheat varieties	Robe and Digelu Tijo Districts of Arsi Zone in Oromia Region	Hh sex, field day participation, access to all weather roads, access to credit, active family force, district and market distance
4.	Zegeye, T. <i>et al.</i> (2001)	logistic model	Wheat varieties and inorganic fertilizer	Yelmana Densa and Farta district Amhara Region	Farm size, on-farm demonstration, Contacts with extension agent, cooperative representatives
5.	Laduber et al., 2016	Logistic regression	Bread wheat	Yilmana Densa District, West Gojam, Amhara region	Institutional factors overweighed than individual, economic and kebele level factors
6.	Worku and Yishak, 2017	Binary logistic regression	Planting method	Sodo Zuria Woreda, Southern Ethiopia	Sex of the household, education status, household size in adult equivalent, oxen ownership, and participation in agricultural training and demonstrations
7	Hassen Beshir, 2012	Double hurdle	Wheat seed	Dessie Zuria and kutaber districts of Wollo	Distance to markets, roads, and input supply play a significant role for technology adoption
8	Belay, 2017	Logit	Improved wheat technology	Gozzamen District, East Gojjam Amhara region	Education, farm size, total active household labor in man equivalent, crop income, input, contact extension agent, off farm income (+)
9	Degefu, 2017	Two-limit Tobit model	Wheat Production Technology Package	Eastern Ethiopia Hararghe	District, gender, age of the household, education status of the household, farm size, distance to market, and FTC, Cooperative membership, dependency ratio, and annual income
10	Bedilu, <i>et al.</i> , 2015	Tobit model and Double-hurdle model	improved bread wheat varieties	Southeastern Highland of Ethiopia	farming experience, distance to cooperatives, renting a tractor and combine harvester, Urea application, and net income from wheat grain sale
11	Chilot, <i>et al</i> 2013	Tobit	Improved wheat technologies	In Ethiopia	Education of the household head, ownership of oxen and corrugated roofed house(as proxy for wealth) (+)

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. Any new idea may be classified on the complexity-simplicity continuum. Some innovations are clear in their meaning to potential adopters while others are not.

The complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption.

Trialability is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the installment plan will generally be adopted more rapidly than innovations that are not divisible. An innovation that is trial able is less uncertain for the adopter. Some innovations are more difficult to divide for trial than others. Laggards move from initial trial to full-scale use more rapidly than do innovators and early adopters. The more innovative individuals have no precedent to follow when they adopt, while the later adopters are surrounded by peers who have already adopted the innovation. These peers may act as a psychological or vicarious trial for the later adopters, and hence, the actual trial of a new idea is of less significance for them.

Observability is the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others. A technology has two components: (1) a hardware aspect that consists of the tool that embodies, the technology as material or physical objects, and (2) a software aspect that consists of the information base for the tool. Usually the software component of a technological innovation is not so apparent to observation, so innovations in which the software aspect is dominant possess less observability, and usually have relatively slower rates of adoption.

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage is often expressed in economic profitability, in status giving, or in other ways. The nature of the innovation largely determines what specific type of relative advantage (such as economic, social, and the like) is important to adopters, although the characteristics of the potential adopters also affect which dimensions of relative advantage are most important.

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

A study by 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 (*Puccinia striiformis* f. sp. *tritici* and *P. graminis* f. sp. *tritici*), threshability, field establishment (germination, seedling emergence and growth) 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).

CONCLUSION

This paper reviewed the determinants to adopt improved wheat production packages. Although wheat is among the most important staple food crops grown in Ethiopia, the rate of adoption and dissemination of the technology is found to be very minimal. As result, the country still remained a net importer of wheat despite its potentials. The adoption of wheat technology has very significant effect on yield improvement.

Even though many micro studies have been conducted on adoption of wheat in Ethiopia, most of them are based on cross sectional data. But adoption by its nature is a dynamic process which can't be fully addressed by using a cross sectional data. Literatures in the area of agricultural technology adoption have come up with different results in identifying determinants of wheat technology adoption by smallholder farmers. These factors fall into four categories; demographic, economic, institutional and psychological. Hence after reviewing relevant literatures above, the following policy implications can be drawn:

- Provision of adequate and relevant agricultural extension services (such as training on improved bread wheat agronomic practices and demonstration) should be given to enhance farmer's awareness about the technologies;
- Input supply systems (seed, chemical fertilizer and farm machineries) should be improved to increase the adoption of wheat technology packages;
- Access to infrastructures (such as roads and markets) should be given great attention;
- Agricultural information system should be established well to increase farmers' exposure for improved agricultural practices and market information (institutional factors);
- Wheat variety development strategies should be incorporate farmers' preferences.

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