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Factors affecting the use of improved chickpea seed among smallholder farmers in *Gondar Zuria Woreda*, Ethiopia

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ABSTRACT

Purpose: *The use of improved seeds is one of the most important factors among the others to increase the production and productivity of crops. However, the use of improved chickpea seeds by smallholder farmers remains low. These resulted in lower productivity of chickpea by smallholder farmers. The factors contributing to the low rate of use of improved chickpea seed in the study area are to be analyzed.*

Research Method: *To achieve the objective of the study, a multi-stage sampling technique was employed. The sample size was determined using the Yamane formula, and 140 sampled households were randomly selected. A proportionate sample of the population was used to determine the size of sample from each kebele. These data were analyzed using descriptive statistics and a binary logistic regression model.*

Findings: *The results revealed that 55.71% of respondents are users of improved chickpea seeds. The logistic regression result shows that the use of improved chickpea seed by smallholder farmers is determined by the availability and price of improved seeds, size of land holdings, participation in a field visit, frequency of extension service, proximity to the market, and attractiveness of the market price. The marginal effect result indicates that a unit change in access to improved seeds, participation in a field visit, land size, and seed cost increases the probability of using improved chickpea seed by 40.76%, 11.86%, 11.26%, and 4.27% respectively, among others.*

Research Limitations: *The study was conducted in one geographical area using cross-sectional data. This finding does not show the trends of adoption in the study area or its implications in different parts of the region.*

Originality/ Value: *The findings of the study are novel and relatively new to the given geographical area. This study reported specific and new findings on factors that affect the use of improved chickpea seeds in the study area. The findings are important as a source of information for decision-makers, development practitioners, and researchers.*

Keywords: *Chickpea, Determinants, Gondar Zuria, Improved seeds, Logistic regression*

INTRODUCTION

Pulses, such as chickpea, contribute a lot to the nutritional and food security of smallholders in the world (Burman *et al.,* 2010; Atnaf *et al.,* 2015; Considine *et al.,* 2017; Shari *et al.,* 2018). Chickpea provides various benefits to smallholder households as a source of protein, cash income, and soil improvement tool (Mazid *et al.,* 2013; Atnaf *et al.,* 2015). Chickpea grain

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is an important source of high-quality protein (Bhatia and Raghavan, 2016). Chickpea is grown worldwide in over 54 countries on 12.7 million hectares, with an annual production of 12 metric tons (Devasirvatham and Tan, 2018). The most important chickpea-producing countries are India, Turkey, Pakistan, Iran, Mexico, Australia, Ethiopia, Myanmar, and Canada (Abate *et al.,* 2012). Globally, India is the leading producer of Chickpeas (Rimal *et al.* 2015; Sengar *et al.,* 2018).

Ethiopia is the largest producer of chickpea in Africa that contributes 43% of the area coverage and 63% of total chickpea production in Africa (Ojiewo, 2016). In Ethiopia, in the 2015/2016 production season, about 282,216.28 ha of land were covered by chickpea and 496,302.78 tones were produced (CSA, 2016). Its productivity in Ethiopia during 2015 was near 1.8 t ha^{-1}, but the average on-station productivity potential was 2 t ha^{-1} (Atnaf *et al.,* 2015, Keneni *et al.,* 2016). This implies that the current productivity of chickpea in Ethiopia is below the average on-station productivity potential.

In order to increase the production and productivity of chickpea, the use of improved and quality chickpea seeds is of paramount importance together with other agronomic practices (ILRI, 2013). According to EIAR (2020) the use of quality seed contributes for 40% productivity increment, citrus paribus. However, the adoption and use of these improved varieties by smallholder farmers are very low (CSA, 2016). In addition, the adoption rate varies across locations and regions (Walker *et al.,* 2014).

Considerable studies have been conducted on factors affecting the production and marketing of chickpea crops. According to Keneni *et al*. (2016), inadequate adoption of improved production technologies is the major limiting factor for low productivity. The study conducted by Tefera (2014) in Ethiopia only addressed chickpea grain marketing determinants, and chickpea production determinants have not yet been analyzed. Moreover, Tegegne (2017) conducted a study in the Bale zone of Ethiopia regarding factors affecting the adoption of legume technologies. The results presented showed access to improved farm inputs, credit accessibility, wealth status of farm households, and education level of household heads had a significant influence on the adoption level of both improved seed and fertilizer technology. On contrary, the high price of improved technology and family size negatively affected the adoption level of improved farm inputs (Tegegne, 2017). Such types of studies have the limitation of identifying constraints and determinant factors for the adoption of a specific legume type; hence each legume has its own adaptive characteristics.

Andualem (2012) examined factors determining farmers' adoption of Chickpea technology package in *Dembia* district of North *Gondar Zone*, Ethiopia. The finding of Andualem (2012) reveals that being educated and male head household are positively correlated with adoption of improved chickpea technologies. The author doesn't analyze the effect of extension approaches such as participation on field day, training, and demonstration on the use of improved chickpea seeds. Innovative partnership in chickpea seed production and technology dissemination in Ethiopia was assessed by Chichaybelu *et al*. (2018). The authors reported that innovative approaches such as Farmers' Participatory Variety Selection (FPVS) plays critical role in increasing chickpea productivity through facilitated access to quality seed using qualitative analysis (Chichaybelu *et al.*, 2018). However, the finding doesn't examine the effect of socioeconomic and institutional factors for the use of improved chickpea seeds.

Paul and Mausch (2017) also analyzed the impacts of improved Chickpea adoption on smallholder production and commercialization in Ethiopia. The authors reported that the decision to produce is driven by age, gender, input cost, distance to the cooperative, experience, area of cultivation, and the Tropical Livestock Unit (TLU). Moreover, Mwangi and Kariuki (2015) economic, institutional factors and human specific factors are found to be the determinants of agricultural technology adoption. The study recommend the future studies on adoption to widen the range of variables used by including perception of farmers towards new technology. Introduction Agriculture plays an important role in economic growth, enhancing food security, poverty reduction and rural development. It is the main source of income for around 2.5 billion people in the developing world (FAO, 2003 found that technological, economic, institutional, and human-specific factors are the determinants of agricultural technology adoption.

To the best of our knowledge, empirical studies on factors affecting the use of improved chickpea seed are missing. As mentioned above, some studies were conducted on factors affecting the adoption of legume and chickpea technologies. However, the previous findings missed analyzing factors specifically affecting the use of improved chickpea seed by smallholder farmers. In addition, those studies missed some important socioeconomic and institutional variables that are expected to influence farmers' decisions to use improved chickpea seed. Moreover, the factors could vary across locations and commodities. In this regard, as far as we are concerned, there are no empirical studies conducted in the study area. The rate of adoption of improved technologies widely varies from one district to another (Dadi et al., 2005).

Therefore, this study is aimed at analyzing factors affecting the use of improved chickpea seed by smallholder farmers in the study area. Specifically, the study is intended to analyze socioeconomic, institutional, and demographic factors affecting the use of improved chickpea seeds in Gondar Zuria Woreda, Ethiopia. Thus, the finding provides answers to the following research questions:

1) What are the factors that determine the decision of smallholder farmers use improved chickpea seed in the study area?

2) How do socioeconomic, institutional, and demographic factors determine the use of improved chickpea seed in the study area?

This study is significant for the following reasons. The results of this study will help governmental and non-governmental organizations, and decision makers identify major determinants and provide local-level solutions for such factors. A comprehensive understanding of farmers' behaviour towards the use of improved varieties in diverse agro-ecological and socio-economic environments is necessary to design appropriate strategies to harness their potential benefits in target domains (Shiyani *et al.,* 2002). Lack of adequate information on farmers' perceptions of new varieties often placed them in the wrong target regions, where they either failed or met with partial success. In addition, the study will be used as a reference for researchers who are interested in conducting further research in the study area or in the chickpea commodity.

MATERIALS AND METHODS

Study Area

This study was conducted in *Gondar Zuria Woreda*, which is one of the potential chickpea grower areas in the *Amhara* region, Ethiopia (Figure 01). The centre of *Gondar Zuria Woreda* is *Maksegnit*, which is located 706 km in North West of *Addis Ababa*. *Gondar Zuria* is geographically located between 37^0 26` 31``- $37^0$ 42` 53`` East and 12^0 07` 48``- $12^0$ 39` 07`` North, with an elevation ranging from 1800 to 2700 meters above sea level.

Basic data is collected from the Gondar Zuria Woreda Office of Agriculture (GZWOA). In Gondar Zuria Woreda, there are 40 rural and 4 urban kebeles with a total population of 212,537, of which 112,248 are males (GZWOA, 2017). In terms of households, there are 4068 female-headed households and 29,111 male-headed households, for a total of 33,179 rural households. Agro-ecologically, 78% of the area is Woyna Dega (mid-altitude), and the remaining 22% is Dega (GZWOA, 2017). The study area has a minimum of 950 mm and a maximum of 1035 mm of annual rainfall. It also exhibits a minimum of 24 ºC and a maximum of 33 ºC annual temperatures. According to the information obtained from the Gondar Zuria Woreda Office of Agriculture, the major soil types in the area are 45% black soil, 20% red soil, and 35% brown soil. Chickpea is adaptable to the black soil, and the study area has the potential for chickpea production while holding other factors constant.

A mixed farming system with crop-dominant farming is practised in the study area. The major crops grown are Teff, Chickpea, Wheat, Sorghum, Barley, Maize, Faba bean, Rice, potatoes, and lentils. On the other hand, the major livestock reared in the area are cattle, small ruminants, and poultry. Out of the total 114,983 ha of land in the study area, 38,830 ha are allocated for crop cultivation, 17,076 ha are grazing land, and 16,851 ha are covered with shrubs and bush land. In addition, 11,073 ha are covered with forest, 3,005 ha are covered with water bodies, 8,643 ha are allocated for construction, 16,852 ha are to be cultivated in the future, and the remaining 2,065 ha are allocated for other activities (GZWOA, 2017). Out of the cultivated land in the 2016–2017 production season, only 4,815 ha of land was covered with chickpea, with a productivity of 2.7 t ha1. In the study area, the major chickpea-growing kebeles are *Chinchaye, Lamba, S/Sarwuha, Tach Tseda,* and *Bahireginb,* among others. According to the Woreda office of agriculture report, chickpea is the second-most important crop next to Teff. Agricultural farming is the major source of livelihood in the area, and some individuals also earn their income from petty trade and daily labour such as weeding, harvesting, ploughing, and house construction.

Sampling Design and Data

Out of 25 potential chickpea producers in Woredas, Ethiopia, 15 are located in *Amhara,* while the remaining 10 are in *Oromia* (Warner *et al.,* 2015). According to Warner et al. (2015), the most chickpea-growing zones in the *Amhara* region are *north Gondar, south Gondar, east Gojjam, north Shewa, and south Wollo.* Therefore, in the first stage, *Gondar Zuria Woreda* was selected purposefully due to its potential in chickpea production. In *Gondar Zuria Woreda,* there are 40 rural *kebeles.* According to the GZWOA (2017) report, *Chinchaye, Lamba, S/Sarwuha, Tach Tseda,* and *Bahireginb kebeles* have great potential for chickpea production. Secondly, among these potential *kebeles,* two *kebeles,* namely, *Chinchaye* and *Tach Tseda*, were selected randomly using a simple random sampling technique.

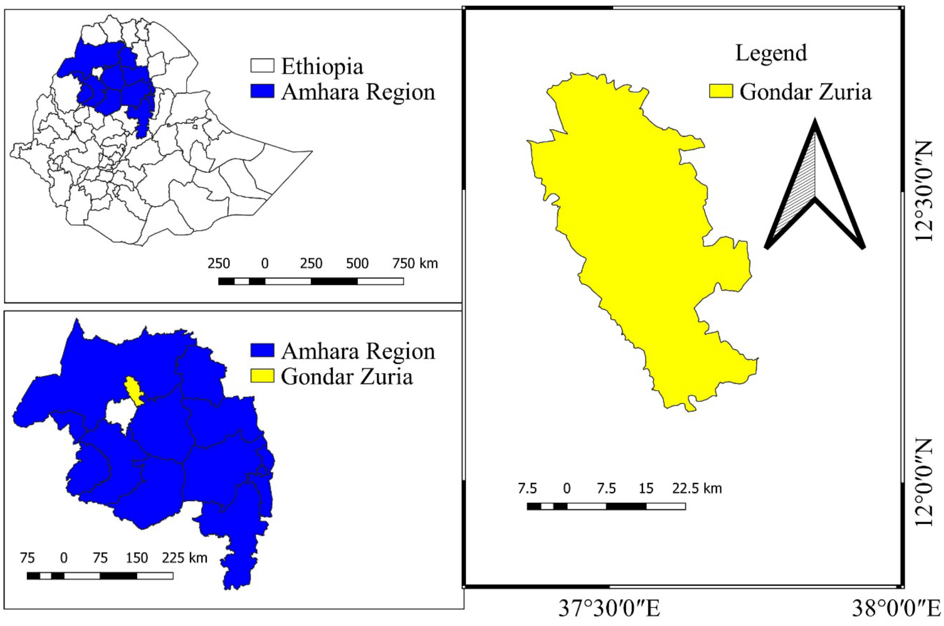

Figure 01: **Map of the study area**

The sampling units are all smallholder farmers who participated in chickpea production during the 2016–2017 cropping season. Therefore, the sample frame consists of a list of smallholder farmers who participated in chickpea production regardless of their gender. Hence, the inclusion criteria are participation in chickpea production, residence in one of the selected *kebeles,* and having the age of 18 years old and above. The sample size was determined using Yamane's (1967) sample size determination formula (Eq. 01).

$$n = \frac{N}{1 + Ne^2} \tag{1}$$

where, 'N' is the total population size (1314), 'n' is the sample size, and 'e' is the error of margin (8%) at the 95% confidence level.

$$n = \frac{1314}{1 + 1314\,(0.08)^2} = 140$$

Determining a representative sample size for survey studies remains the foundation for social science research (Story and Tait, 2019). For survey studies, the minimum level of precision is acceptable at 10% error of margin (Abebe *et al.,* 2018). Gamil and Alhagar 2020 stated that the maximum error of estimation can be 8 or 9%. So far, different authors have used different levels of error of margins. For example, Abebe *et al.* (2018) used an 8% error of margin to determine factors affecting the market outlet choice of wheat producers in the North *Gondar Zone*, Ethiopia. Gamil and Alhagar (2020) also used a 9% error margin to analyze the impact of the COVID-19 pandemic crisis on the survival of the construction industry. Therefore, it can be inferred that the error margin can be relaxed by 10% to get reliable and representative data. Thus, for this study, an 8% error margin is used, which can give a representative sample size.

The acceptable maximum margin of error for a 95% confidence level is checked according to Gamil and Alhagar (2020) as presented in eq. 02.

$$1.96/\sqrt{n} \tag{2}$$

Where 1.96 is the z-score value at the 95% confidence level and 'n' is the calculated sample size in eq. 01. According to Gamil and Alhagar (2020) the sample size is acceptable if the ratio from eq. 02 is greater than the margin of error used.

$$1.96/\sqrt{n}=0.16$$

Accordingly, 0.16 is greater than 0.08 hence the margin is acceptable.

Finally, by giving a proportionate sample to the total population, 65 households from *Chinchaye* and 75 households from *Tach Tseda* were selected randomly using a simple random sampling technique.

Data Collection and Analysis

The study employed a cross-sectional research design. In a cross-sectional study, the investigator measures the outcome and the exposures of the study participants at the same time (Setia, 2016). The main intention of this study is to analyze the determinant factors that affect smallholder farmers use improved chickpea seed during 2016-2017 cropping season. Therefore, the data were collected from sampled household heads through face-to-face interviews using a semi-structured questionnaire. The questionnaire was pre-tested on eight farmers and amended accordingly. Ten Enumerators were trained to improve efficiency and accuracy in data collection. The data regarding household demographic and socioeconomic characteristics, chickpea production determinants, and other institutional aspects of smallholder farmers were collected.

The data on household characteristics were analyzed using simple descriptive and inferential statistical tools. The independent sample t- test and chi-square statistics were conducted to check the significance of each predictor variable. An independent sample t-test was employed to compare the mean of users and non-users of improved chickpea seeds to determine whether there is statistical evidence that the associated population means are significantly different. Likewise, the chi-square test was employed to determine whether there was an association between categorical variables. Moreover, the binary logistic regression model was employed to analyze the determinant factors affecting the use of improved chickpea seeds by smallholder farmers.

Conceptual description of the variables:

We conceptualize that the decision to use improved chickpea can be affected by socioeconomic, institutional, and demographic factors. Accordingly, the decision to use improved chickpea seeds can be affected by demographic factors, resource ownership such as livestock ownership and land size, marketing conditions, cooperatives and other associations, and the use of extension services in general. It is hypothesized that seed access determines seed costs. If the seed is accessible in the local area either through markets, cooperatives, or seed producers in the required amount, its price would decrease. The presence of seed producer associations and farmers' cooperatives would play a significant role in the supply of chemicals, improved seeds, and dissemination of marketing information regarding the price of chickpeas. Contact with development agents enables farmers to access market information, training, and participation in fields, which are critical to influencing their decision to use improved chickpea seeds.

Econometric model specification:

The dependent variable is the status of using improved chickpea seed in the 2016-2017 cropping season. The respondents will either use or not use improved chickpea seed in the 2016-2017 cropping season. The responses are 1 (if used) and 0, otherwise; hence, it is a binary response variable. The binary response variables use limited dependent variable models, of which, the logit and probit models are the most common binary response models. As presented in Wooldridge (2013), the sign of the coefficients across the two models is the same, and the same variables are significant across these two models. For this study, the logit model is selected over the probit model because of its simplicity and mathematical convenience in interpreting the results in odds ratio. According to Gujarati (2004), the binary logistic regression model is derived from the linear probability model as;

$$L_i = \ln) = \beta_1 + \beta_2 X_{1i} + \beta_3 X_{2i} + \beta_4 X_{3i} + \text{---} + \beta_n X_{(n-1)i} \quad 03$$

Where, L_i = natural logarithm, P_i = Probability of being affected, 1- p_i = probability of being not affected, β_1 = constant term, $\beta_{2,}$ $\beta_{3...}$ β_n = coefficients of explanatory variables, X_i = explanatory variables which are hypothesized to be included in the model.

RESULTS AND DISCUSSION

Results of Inferential Statistics

This section presents and discusses the main inferential results that indicate whether there is a significant association and mean difference between users and non-users in relation to a particular independent variable or not. Among the total respondents, 55.71% used improved chickpea seed, and the remaining 42.9% did not use it during 2016-2017 cropping season. Table 01 presents the descriptive and inferential results for continuous variables. Seed cost determines farmers' decisions use improved technologies. The mean value of seed cost is 0.79 and 0.89 US$/kg for non-users and users, respectively. The t-test result shows the presence of a significant difference in the mean cost of seed between users and non-users (t= -8.105, p<0.001). The result implies that the mean seed cost for users is significantly greater than the mean cost for non-users. This value may be due to the fact that the seed source for most users may be from the market. Hence, the cost of improved varieties is higher than the cost of local varieties. Consistent with the present finding, the study conducted in India by Rimal *et al.* (2015) reveals that the average price of Kabuli chickpea was 31.17% higher than that of Desi-type chickpea.

Since chickpea is adaptable to black soil, the size of the potential and suitable land for chickpea determine the decision whether to use or not to use improved chickpea seed. The study hypothesized that the size of potential land for chickpea was expected to positively affect the decision to use improved chickpea seed by assuming that an increased size of land may minimize risks associated with the use of new technology. In the study area, the holding of potential land for chickpea ranges from 0-2.25ha, with a mean of 0.68ha for non-users and 0.9ha for users (Table 01). The t-test result showed that the mean of potential land for non-users is significantly less than the mean of users (t= -2.891, p=0.004). Chickpea seed production experience also determines the use of improved varieties. If a household has a successful prior experience in chickpea seed production, they will use improved chickpea seed for chickpea production. As presented in Table 01, the mean chickpea seed production experience is 0.71 years. The survey result shows that the mean chickpea seed production experience for non-users is significantly less than the mean for users (t= -4.054, p<0.001). Authors such as Shiyani *et al.* (2002) reported the presence of a positive and significant association between the experience of growing chickpea and the use of improved chickpea seeds. They argue that more experienced farmers may have better skills and access to new information about improved technologies through extension services.

The decision to use improved chickpea seed is also determined by the frequency of contact with Development Agents (DA). Frequent contact with DAs creates awareness and motivates farmers to use improved technologies. The result of the study showed that the mean DA contact is 0.73 and 2.18 for non-users and users, respectively. A statistical test of DA contact indicates, the mean of DA contact for non-users is significantly less than the mean of users (t= -3.567, p=0.001). The result from Table 02 also depicts that the mean market price for users is 0.76 US$ kg^{-1} and 0.66 US$ kg^{-1} for non-users. The result of the t-test indicates the mean market price for non-users is significantly less than the mean for users (t= -4.265, p<0.001). Such significant mean difference may result from the fact that the chickpea grain or seed supplied by users to the market is better suited to local chickpea varieties at the market due to the use of improved varieties. Consistent with this finding, Asfaw *et al.* (2011) reported that the adoption of improved agricultural technologies has a significant positive impact on farmers' integration into the output market. On the contrary, the mean differences of other variables such as age, educational level, family size, and tropical livestock unit (TLU) were insignificant between users and non-users (Table 01).

The test statistic of chi-square from Table 02 confirms the existence of a significant relationship between the status of using improved chickpea seed and some of the categorical variables (access to training, access to improved seed, participation in field visits, and membership in seed multiplication cooperatives). In the case of sex composition, 10% of randomly selected respondents were female. Among the 55.71% of improved chickpea seed users, 6.43% were female (Table 02). It is known that in Ethiopia, females are responsible for storing, managing, and saving seeds. However, the χ^2 test result shows that there is no significant relationship between the status of using improved chickpea seed and the gender of respondents. This result is consistent with the finding of Asfaw *et al.* (2011), reported the absence of significant variation in seed access across gender categories.

Utilization of good-quality seed that is adapted to different agro-ecological zones is crucial to increasing yield as well as the improving quality of grain accessible to a quality market (Bhatia and Raghavan, 2016). According to the explanation of smallholder farmers, *Arerti, Shasho* and

Natoli are the major adaptable improved chickpea varieties in the study area. Among the total respondents in the study area, 34.29% have access to improved seeds, of which 33.58% are users of improved chickpea seed. The evidence shows that farmers' lack of access to seed of new varieties is a major cause of the non-adoption of new cultivars (Gaur *et al.,* 2010). As depicted in Table 02, the result of the chi-square test shows the presence of a significant relationship between access to improved seeds and the use of improved chickpea seed (χ^2=52.726, p=0.001).

Table 01: Descriptive and inferential results of continuous variables.

Variables	Mean values		T- tests	
	Mean of user	Mean of non- users	t-value	Sig. value (2-tailed)
Age	47.23	47.77	0.266	0.791
Education	2	2	-0.131	0.976
Family size	5.23	5.26	0.078	0.938
Cost of seed (US$)*	0.89	0.79	-8.105	0.000***
Potential land	0.90	0.68	-2.891	0.004***
Experience	0.71	0.00	-4.054	0.000***
Frequency of DA	2.18	0.73	-3.567	0.001***
Market distance	37.56	45.16	2.509	0.013
Market price (US$)	0.76	0.66	-4.265	0.000***
TLU	5.19	4.46	-1.588	0.115

*Note: *: 1 US$ is equivalent to 27.57 Ethiopian Birr as of February 16, 2018, where the date is the mid time for data collection period.***, significant at 1% level of significance respectively.*

Source: own survey computation, 2018

Table 02: Descriptive and inferential results for categorical variables.

Variables	Responses	Status of Using Improved chickpea seed		χ^2-value	Sig.
		Non-user	User		
Sex	Female	5(3.57)	9(6.43)	0.463	0.496
	Male	57(40.71)	69(49.29)		
Access to improved seed	No	61(43.57)	31(22.14)	52.726	0.001***
	Yes	1(0.71)	47(33.58)		
Training on improved seeds	No	52(37.14)	46(32.86)	10.196	0.001***
	Yes	10(7.14)	32(22.86)		
Participation in field visit	No	57(40.71)	55(39.29)	9.908	0.002***
	Yes	5(3.57)	23(16.43)		
Access to market information	No	20(14.29)	22(15.71)	0.270	0.603
	Yes	42(30)	56(40)		
Membership to seed multiplication cooperative	No	62(44.29)	53(37.86)	24.192	0.001***
	Yes	0(0)	25(17.86)		

*Note: ***: significant at 1% level of significance; The numbers in parentheses indicate the percentage value from the total respondents.*

Source: own survey computation, 2018

Extension service is another factor that determines the decision of farmers to use improved chickpea seed. Extension service in the study area is provided in the form of short term training, awareness creation through day to day contact, and field days. As presented in Table 02, 30% of respondents have received training, and the remaining 70% did not acquire any form of training in the 2016-2017 production season. Households that used improved chickpea seed without getting any training made up 32.86% of the total respondents. The chi-square test shows the presence of a significant relationship between receiving the training and the use of improved chickpea seed (χ^2=10.196, p=0.001). The finding of Anyango (2016) supports the results of the present study that training before farming significantly influenced the farmer's decision to use improved chickpea seeds. Households' participation in field days is also minimal, accounting for only 20% of the total respondents (Table 02). But, the chi-square test is still significant, which implies the decision to use improved chickpea seeds significantly relates to participation on field days (χ^2=9.908, p=0.002). The study conducted in Kenya by Anyango (2016) revealed that the use of improved chickpea varieties could be increased by increasing field days.

Membership in seed multiplication cooperatives creates the opportunity to access seed of improved varieties. Private and public seed sectors have limited roles in multiplying chickpea seeds (Shiyani *et al.,* 2002; Gaur *et al.,* 2010). In the study area, there is one seed multiplication cooperative named *Tana* Seed Multiplication Farmers' Cooperative. The result of the study shows that only 17.86 % of respondents are members of this cooperative. The chi-square statistic is significant, indicating households' use of improved chickpea seed significantly relates to membership in seed multiplication cooperatives (χ^2=24.192, p=0.001).

Binary Logistic Regression Analysis Results

Before running the regression analysis, a test of econometric problems is conducted. In this study, multicollinearity test was conducted to test the presence of near-perfect linear combinations of two or more predictor variables with one another. As the degree of multicollinearity increases, the regression model estimates of coefficients become unstable, and standard errors for coefficients can get widely inflated. Accordingly, the Variance Inflation Factor (VIF) was used to check the existence of multicollinearity. As the rule of thumb, a VIF greater than 10 indicates the existence of a multicollinearity problem (Maddala, 1992). As it is presented in Table 03, the mean VIF value is 1.21 which implies the absence of multicollinearity; hence, the VIF value is less than 10.

Table 03: Test for multicollinearity

Variable	VIF	1/VIF
Age	1.15	0.87
Access to seed	1.35	0.74
Seed cost (US$/kg)	1.37	0.73
Potential land (ha)	1.19	0.84
Access to training	1.30	0.77
Frequency of DA contact	1.15	0.87
Participation on field visit	1.16	0.86
Market distance in minutes	1.18	0.85
Market price (US$/kg)	1.13	0.88
Livestock owned (TLU)	1.11	0.9
Family size	1.22	0.82
Mean VIF	1.21	

Source: Own computation, 2018

Table 04: Results of the logistic regression model

Status of using improved chickpea seed	Odds Ratio	Std. Err. Robust	Z	P>|z|	Marginal Effect
Age	0.976	0.025	-0.96	0.340	-0.002
Access to seed	88.091	114.721	3.44	0.001***	0.408
Seed cost (US$/kg)	0.06	0.206	3.64	0.000***	0.043
Potential land (ha)	3.447	2.467	1.73	0.084*	0.113
Access to training	0.948	0.788	-0.06	0.948	-0.005
Frequency of DA contact	1.517	0.357	1.77	0.076*	0.038
Participation on field visit	3.683	2.434	1.97	0.049**	0.119
Market distance in minutes	0.979	0.011	-1.97	0.049**	-0.002
Market price (US$/kg)	0.04	0.115	2.03	0.042**	0.018
Livestock owned (TLU)	1.002	0.092	0.03	0.979	0.001
Family size	1.097	0.166	0.61	0.543	0.0083
_cons	2.50e-07	9.86e-07	-3.85	0.000	
Logistic regression				Number of obs = 140	
				Wald chi2(11) = 40.34	
				Prob > chi2 = 0.0000	
Log pseudo likelihood = -40.83703				Pseudo R2 = 0.575	

*Note: ***, **, and *: significant at 1%, 5% and 10% level of significance respectively.*

Source: own survey computation, 2018

Table 04 presents the results of the binary logistic regression model, and the econometric meaning of the significant variables is discussed as follows:

Access to the required amount of seed*:* Access to the required amount of improved chickpea seed determines the status of using households positively and significantly at the 1% level of significance. This result is consistent with the expected hypothesis. The odds ratio of 88.091 (Table 04) shows that the likelihood of utilizing improved chickpea for households that accessed the required amount of seed is 88.091 times better than for households that did not access the required amount of seed. Access to the required amount of improved chickpea seed encourages farmers to utilize improved varieties rather than local varieties. This result is consistent with the findings of other authors (Eshetu, 2009; Rao *et al.,* 2013; Verkaart *et al.,* 2017)The findings of Asegie *et al.* (2022) indicate that access to improved varieties of chickpea seed is the main input-related constraint that hinders smallholders in using improved varieties. The marginal effect of 0.408 (Table 04) implies that a unit increase in access to improved chickpea seed increases the likelihood of using improved seed by 40.8%.

Seed cost (US$): Seed cost is one of the determinant factors for making decisions regarding the status of using improved varieties of chickpea. In contrast to the expected hypothesis, seed cost affects the farmers' decision to use improved chickpea seeds positively, and it is significant ($P<0.001$). The odds ratio of approximately 0.06 (Table 04) implies that as seed cost increases by 1 USD kg^{-1}, the likelihood of utilizing improved chickpea seed increases by a factor of 1.6 units. Its marginal effect of 0.043 indicates that the unit change in the cost of improved chickpea seed increases the probability of using improved chickpea seed by 4.3%. This may be due to the short supply of improved chickpea seeds in the study area. If there is a shortage of improved seeds and the demand for improved varieties gets high, the farmers may be forced to buy them at a high cost. In such cases, only farmers with access to financial capital can purchase the improved seeds. This requires accessing adequate financial resources to sustainably empower smallholder chickpea producers (Falcone, 2020). Authors, including Mwangi and Kariuki, (2015)economic, institutional factors and human specific factors are found to be the determinants of agricultural technology adoption. The study recommend the future studies on adoption to widen the range of variables used by including perception of farmers towards new technology. Introduction Agriculture plays an important role in economic growth, enhancing food security, poverty reduction and rural development. It is the main source of income for around 2.5 billion people in the developing world (FAO, 2003 reported contrasting findings with the results of this study.

Potential land for chickpea (ha): Land size determines farmers' decision to use improved chickpea seeds. As hypothesized, it affects the status of using improved chickpea seed positively and significantly ($p<0.1$). The odds ratio of approximately 3.447 (Table 04) indicates that the probability of utilizing improved chickpea varieties increases in the unit of 3.447 as the land size of households' increases by 1 hectare, keeping other factors constant. The marginal effect of 0.113 indicates that a unit change in potential land for chickpea increases the probability of using improved chickpea seed by 11.3%. The increased size of land for households enables them to diversify the risks associated with using improved chickpea seeds. The previous findings on the determinants and impact of modern technology adoption coincide with the results of this study (Challa and Tilahun, 2014; Olumba and Rahji, 2014) On the contrary, the study conducted in India by Shiyani *et al.* (2002) reported that the size of land holdings was found to be negatively related with the adoption of new chickpea varieties. They justified the reason that small fanners, in comparison to large fanners, replace local varieties with new varieties at a faster rate if additional gains are substantial.

Frequency of Development Agent (DA) contact in a year: This indicates the number of days that an individual household contacts development agents in a year. It has consistent result with the previous hypothesis. The frequency of DA contact determines the status of using improved chickpea seed positively and significantly ($p<0.1$). This means that farmers with more contact with DAs are more likely to use improved chickpea varieties. The odds ratio of 1.517 (Table 04) shows that as the DA contact with farmers increases by one day in a year, the probability of utilizing improved chickpea seeds increases by 1.517 units, keeping other factors constant. Access to relevant agricultural information makes farmers aware of and informed about improved agricultural technologies. The marginal effect of 0.038 implies that a unit increase in the frequency of DA contact with smallholder farmers increases the probability of using improved chickpea seeds by 3.8%. The findings of some previous authors, Tura *et al.,* (2010) and Chandio and Yuansheng, (2018)the study provides insights into the key factors associated with adoption of improved maize seed and its continued use. The result revealed that human capital (adult workers, off-farm work and experience in hiring labor agree with the results of this study.

Participation in field visits: Field visits are one of the methods used to create awareness about the existence and general situation of existing technology. In the study area, participation in field visits determined farmers' decisions to use improved chickpea varieties positively and significantly ($p<0.05$). The odds ratio of 3.683 (Table 04) implies that the likelihood of utilizing improved chickpea for households that participated in field visits was 3.683 times better than for those who did not participate in the field visits. Its marginal effect of 0.119 indicates that the one-day participation of households on field visits increases the likelihood of using improved chickpea seed by 11.9%. The results of this study agree with the previous findings (Eshetu, 2009). Similarly, Anyango (2016) came up with the finding that the use of improved chickpea varieties could be increased by increasing field days, demonstrations, and farmer group meetings.

Market distance in minutes: As expected, market distance determined the status of using improved chickpea positively and significantly at the ($p<0.05$) level of significance. The odds ratio of 0.979 (Table 04) indicates that the probability of utilizing improved chickpea varieties increases by a factor of 0.979 units as the walking distance decreases by 1 minute. The marginal effect of -0.002 implies that a unit increase in walking distance to the market decreases the probability of using improved chickpea seed by 0.2%. Individuals who live near urban areas are closer to new information and better informed about the advantages and disadvantages of new technologies in general. The findings of other authors are consistent with the results of this finding (Eshetu, 2009; Tura *et al.,* 2010). However, the findings of Shiyani *et al.* (2002) in India reported the absence of a significant relationship between the use of improved chickpea seed and output market distance due to the assured output marketing facility within the village through the 'KRIBHCO' project intervention.

Market price in US\$ kg^{-1}: It positively and significantly determines the status of using improved chickpea seed at the ($p<0.05$) level of significance and is consistent with its hypothesized sign. The odds ratio of 0.04 (Table 04) indicates that the probability of utilizing improved chickpea seed increases by a factor of 0.04 as the market price of chickpea increases by 1 US\$ kg^{-1}. This implies that improved chickpea varieties are more preferable to local varieties in the market, which encourages farmers to use improved varieties. The marginal effect of 0.018 shows that a unit change in the price of chickpea products increases the probability of using improved chickpea seed by 1.8%. The results of this study are consistent with the findings of other authors (Erko, 2014; Paul and Mausch, 2017) populasi, kesehatan, pendidikan, pekerjaan, konsumsi, perumahan, dan sosial budaya. Jika kita menggunakan indikator akan timbul pertanyaan apakah pemenuhan indikator bahwa seseorang harus mendapatkan kesejahteraan, mengapa beberapa orang sudah memiliki rumah mewah, kendaraan, deposito dan berbagai bentuk properti lainnya harus merasa gelisah, takut, bahkan ada yang mengakhiri hidupnya dengan bunuh diri. Berdasarkan fakta di atas, tampaknya ada yang kurang dalam mengukur kesejahteraan masyarakat. Dalam ekonomi Islam, kebahagiaan diberikan oleh Allah kepada siapapun (pria dan wanita.

CONCLUSIONS

This study analyzed socioeconomic, institutional, and demographic factors that determine the decision of smallholder farmers to utilize improved chickpea seeds. The study reveals that the use of improved chickpea seed significantly correlates with access to improved seeds, participation in field days, training on chickpea production, membership of seed producer cooperatives, seed cost, frequency of DA contact, farming experience, land size, and market distance.

The short supply of improved seeds has caused farmers to incur higher seed costs. Moreover, participation in extension services such as field days, training on chickpea production, and frequency of DA contact has encouraged smallholder farmers to utilize improved seeds. The extension service is used to create awareness and increase demand for particular technologies. In this regard, farmers who participated in field days better used improved seeds after observing the success of the improved varieties of chickpea. Accessing large plots of potential land for chickpea production also encouraged farmers to use improved seeds. Hence, chickpea is adaptable to the black soil, and farmers owning large areas of land most probably used improved chickpea seeds. Moreover, proximity to the market helps farmers get updated information regarding improved technologies, market demand, and its price.

Most of the demographic variables, including the sex of the household head, do not vary in accessing and using improved chickpea seeds. In general, socioeconomic and institutional factors significantly determine the utilization status of improved chickpea seed in the study area. Thus, the status of using improved chickpea seed is determined by the availability and price of improved seed, the size of potential land, the frequency of extension service, proximity to the market, participation at field visits, and the attractiveness of the market price.

This study provided evidence based, first-hand information for policymakers, development practitioners, and researchers. The finding shows that there is a need for governmental and non-governmental organizations to design mechanisms for access to affordable, improved chickpea seeds at the local level. The supply mechanism of breeders and pre-basic seeds for agricultural research centers and seed producer cooperatives at the local level should be improved.

Limitations of the Study

The study is limited to one geographical area. This study is also conducted using cross-sectional data. This implies that the findings don't show the trends in the use of chickpea seed by smallholder farmers in the study area over a period of time. It is also evident that the recommendations couldn't be applicable across different parts of the region with different socioeconomic, institutional, and demographic settings.

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Author's statement

The authors declare that they have no competing interests.

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