Original Research Article

**Determinants and Demand Elasticities of Improved Maize Seed Utilization in Halaba Zone, Central Ethiopia: An Almost Ideal Demand System (AIDS) Approach**

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ABSTRACT

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| Maize is one of the most important staple crops in Ethiopia, with greater production potential. Thus, its improved seed is critical for enhancing productivity and food security. However, a persistent gap remains between its demand and supply of seed, due to several factors. These issues often result in untimely availability and unaffordable prices, underscoring the need for a systematic demand analysis to inform holistic policy interventions. Based on data collected from 180 randomly selected households, this study examined farmers’ demand for improved maize seed using the Almost Ideal Demand System (AIDS) model. A multiple linear regression model was employed to identify factors affecting households’ budget share of improved maize seed, and we found that seed price, social status, seed availability, land size, pests and diseases, and household income were found to be significantly influencing. The estimated own-price elasticities were -1.392 (Marshallian), -0.596 (Hicksian), and 1.209 (expenditure elasticity), indicating that demand for improved maize seed is price-elastic in both the Marshallian and expenditure frameworks, though inelastic under Hicksian demand. This implies that a significant price increase reduces demand for improved maize seed. Furthermore, the analysis revealed positive cross-price elasticities with teff and finger millet seed, suggesting that these crops are substitutes for maize. Therefore, to reduce substitution and meet food demand, policymakers and development programs should scale up the multiplication and timely distribution of improved maize seed, which ultimately closes its seed demand gap and prevents maize production losses associated with crop switching. |

*Keywords: Elasticities, Improved seed, Hicksian demand, Marshallian demand*

1. INTRODUCTION

Agriculture is the foundation of the Ethiopian economy, contributing approximately one-third of the country's GDP, 75% of export earnings, and 80% of employment. It also serves as a major source of raw materials for industries and a market for goods and services (FDRE, 2021). It is predominantly composed of smallholder farmers, who cultivate 96% of the total agricultural land and produce 95% of the country’s major crops, including cereals, pulses, oilseeds, vegetables, root crops, fruits, and cash crops (Rosenstock et al., 2019). Despite its critical role, the sector's performance and productivity are hindered by several challenges, including weak market linkages, limited purchasing power for inputs, and low utilization of improved agricultural technologies such as quality seeds, fertilizers, and pesticides. In addition, declining soil fertility, low cereal yields, insufficient adoption of modern farming practices, and inadequate access to financial services and markets are also pertinent challenges (Khalil et al., 2017).

Improved seeds are vital for improving productivity and enhancing farmers’ livelihoods, as well as improving food security (Tarekegn & Mogiso, 2020). It also plays a critical role in building the resilience of smallholder farmers in Ethiopia, who face growing challenges from climate change, pests, and diseases (Girma et al., n.d.). However, the benefits of improved crop varieties cannot be realized without the consistent availability of high-quality seeds in sufficient quantities. In many sub-Saharan African (SSA) countries, including Ethiopia, farmers primarily obtain seeds through on-farm production, exchanges with neighbors, or purchases from local markets. Unfortunately, seed quality, particularly genetic integrity, deteriorates over successive generations of informal seed production. Over the past three decades, Ethiopia has struggled to produce enough crop seeds to meet the needs of its rapidly growing population. However, a pertinent shortfall of seed production and supply compounded by recurrent droughts has severely impacted food security and livelihoods (Chivasa et al., 2022; Simtowe et al., 2019).

Specifically, the performance of the seed system in Ethiopia is undermined by several structural issues, including slow varietal turnover (Shimeles et al., 2018), continued dominance of outdated varieties by seed companies (Rosenstock et al., 2019), inadequate promotion of new varieties, limited access to commercial seeds, and high seed prices (Simtowe et al., 2019), and weak seed transfer systems (Boddupalli et al., 2020). As a result, smallholder farmers in Ethiopia continue to face a persistent gap in access to improved seeds, which has resulted in a switch to non-dominant crop production.

Maize is a key crop for food security and household income generation in Ethiopia (Marenya et al., 2017). Given its dietary significance, especially among rural households, increasing maize productivity can greatly impact food security. However, its seed system shares all seed system challenges that are recurrently facing Ethiopians (Gebre et al., 2019; Wasihun & Desu, 2021). Consequently, maize production faces persistent constraints, including limited access to improved seeds, market inefficiencies, financial barriers, and technical inefficiencies (Fola et al., 2025; van Dijk et al., 2020). It has also been estimated that farmers lose up to 35% of their potential crop productivity due to reliance on local seeds (Tarekegn & Mogiso, 2020).

Literature on the causes of maize production in the study area particularly and Ethiopia generally, was primarily focused on the effects of climate variability, market constraints, and the role of cluster farming on maize production climate (Endalew et al., 2024; Fola et al., 2025), 2020). Specifically, studies have identified institutional inefficiencies and insufficient seed availability as major obstacles across its seed supply chains (van Dijk et al., 2020). They also identified seed demand gaps and related challenges in the area (Tarekegn & Mogiso, 2020) and mostly relied on descriptive approaches, limiting their applicability for comprehensive policy recommendations. To address this gap, our study applies a parametric approach, specifically, the Almost Ideal Demand System (AIDS), to examine the demand for improved maize seed, which allows for the estimation of own and cross-price elasticities between improved maize seed and other major crops, providing insight into whether demand for improved maize seed is price-elastic or inelastic for comprehensive policy design. Consequently, this study provides critical information on what determines farmers' improved maize seed demand through a parametric demand analysis model. Accordingly, we identified how price and other socioeconomic variables influence improved maize seed demand, thus inferring means to address seed demand challenges for proactive agricultural policy design to improve the food security system through addressing the challenges of the seed system.

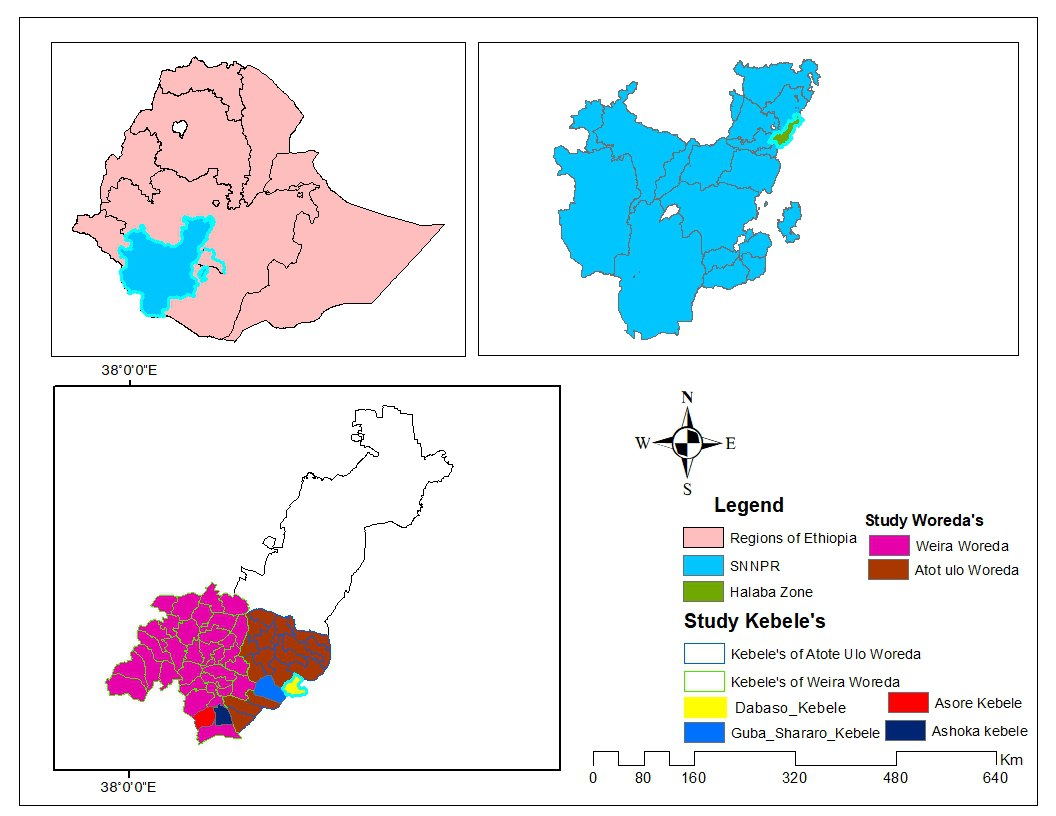
2. methodology

**Study areas, sampling, and methods of data collection**

This study has been conducted in Atoti Ulo and Woyra woredas, Halaba Zone, Central Ethiopia, as indicated in Figure 1. [The economy of both woredas is largely based on subsistence agriculture, with crops such as pepper, maize, teff, sorghum, haricot beans, and wheat being the main cash crops](https://en.wikipedia.org/wiki/Halaba). [The dominant land-use types in the woreda are sedentary mixed farming, with the cultivated land accounting for 89% of the total land area](https://www.frontiersin.org/articles/10.3389/fsufs.2021.739061/full). The mean land holding of the Woreda is two hectares, with a minimum of 0.25 and a maximum of 8ha.

Both qualitative and quantitative data were used through both primary and secondary sources from the survey of randomly selected sample farmers. To collect primary data, a household survey, key informant interviews, and direct field observations were used. Multi-stage sampling technique was employed to collect primary data from farmers. Firstly, two woredas were identified based on dominant maize production potentials, then two kebeles from each of them. Finally, data were collected from a randomly selected 180 farmers from both woredas.

Figure 1: Map of the study area



Source: Author’s sketch, 2023

**Data Analysis**

Both descriptive and econometric models were employed. The parametric Almost Ideal Demand System (AIDS) model was used to estimate the improved maize seed demand, and the Multiple Linear Regression (MLR) model was used to identify determinants of the improved maize seed demand of smallholder farmers.

**Multiple Linear Regression (MLR) Model**

The study employed a multiple linear regression (MLR) model to identify the factors affecting farm households' demand for improved maize seed. Let y denote the household’s demand share for improved maize seed, which is linearly related to explanatory variables.

Variables*X1, X2,…Xpi* through the parameters, 𝛽0, *β1, β2,…., βp* and we write

Y𝑖 = 𝛽0 + **𝛽pXk** + 𝑒i

Where Y𝑖 is a household's demand share for improved maize seed, 𝛽0, *β1, β2, β3…..βp* = are the regression coefficients related to the explanatory variables *X1, X2,…Xk* and *ε is the random error component.* Before regressing the multiple linear regression model, we tested multicollinearity, heteroskedasticity, omitted variable test, and satisfied all conditions of the diagnostic tests.

**Demand Estimation**

Usually, demand analysis is conducted for both consumable and non-consumable goods through the commonly applied systems approach relative to the single equation approach. Our analysis of maize seed demand is considered under the non-consumable item. Among system approaches Almost Ideal Demand System (AIDS) is preferred because it allows for approximate aggregation over buyers of improved seed while at the same time retaining the theoretical features of flexibility (Deaton & Muellbauer, 1980) and its linear approximate version, the LA/AIDS is more flexible, easy to estimate, and interpret (Alston & Chalfant, 1993). We employed the Linear Approximation- Almost ideal demand system (LA-AIDS) model to estimate demand for improved maize seed due to its advantage of giving an arbitrary first-order approximation to any demand system; satisfying the axioms of choice exactly; aggregating perfectly over seed users without invoking parallel linear Engel curves; having a functional form which is consistent with known household budget data; simplicity to estimate; largely avoiding the need of non-linear estimation; and can be used to test the restriction of homogeneity and symmetry through linear restriction on fixed parameters (Deaton & Muellbauer, 1980) (Deaton and Muellbauer 1980). We then used an Iterative Linear Square Estimation for the calculation of the variance, covariance, and the standard errors of the elasticities in AIDS. During the demand analysis, the weak separability assumption was considered viable and, therefore, tested. Our estimation model becomes

………….(1)

where mi is the budget share of maize seed from total improved seed expenditure and derived as m = (Pi\*Qi/)X, Pi is the price, Qi is the quantity of maize seed, X is the total expenditure for improved seeds, i and j are improved seeds farmers using (maize, teff, and finger millet), Zk represents demographic and socioeconomic characteristics of farmers, IMRi is inverse mills ratios, and εimplies disturbance. P is the stone price index for aggregate seed. This index will be corrected for units of measurement invariances following Maschini's (1995) approach

ln(P) = ……………………………………(2)

where represents the mean budget share for all improved seeds. To fulfill basic demand theory, adding up, homogeneity, and Slutsky symmetry restrictions were imposed as follows;

, , , and , j=1,…n (Adding Up)…(3)

The adding restriction ensures that the expenditure shares always sum to unity or one.

, j=1,…n (Homogeneity)…………….(4)

The homogeneity assumption ensures that there is no money illusion; that is, if all prices and income change at the same rate, then the purchased quantities of improved seed do not change.

(Symmetry)…………………….(5)

In addition, the negativity was tested after estimating the compensated own-price elasticity. Our estimation fulfilled all the adding-up, homogeneity, symmetry, monotonicity, and concavity conditions of the Almost Ideal Demand System (AIDS) model. Expenditure elasticity was estimated as:

The Marshallian/Uncompensated price elasticity was estimated using

and for own-price elasticity and cross-price elasticity, respectively. Where i,j = 1,…n, is a Kronecker delta that equals to 1, for all i=j, otherwise = zero, while the Hecksian Elasticity was obtained as follows,

Own price elasticity and Cross-Price Elasticity

All variables of analysis are summarized as follows:

Table 1: Summary of definition, measurement, and hypothesis of variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No | Variables | Nature of variables | Measurement unit | Signs |
| Dependent variables | | | | |
| Expenditure share of improved maize seed | | | | |
| Independent variables | | | | |
| 1 | Gender | Dummy | 1 if male, 0 if female | + |
| 2 | Age | Continuous | Number of the year | + - |
| 3 | Family size | Discrete | Number of family members | + |
| 4 | Social position | Dummy | 1 if have social position, 0 otherwise | + |
| 5 | Educational level | Continuous | Number of grades completed | + |
| 6 | Credit access | Dummy | 1 if accessed credit, 0 otherwise | + |
| 7 | Farm size owned | Continuous | In hectare | + |
| 8 | Total livestock unit | Continuous | Number of livestock owned | + |
| 9 | Farm experience | Continuous | Number of years in farming | + |
| 10 | Received training | Dummy | 1 if received, 0 otherwise | + |
| 11 | Distance to farmers training center (FTC) | Continuous | In Kilometers | -+ |
| 12 | Extension contact frequency | Continuous | Number of days | + |
| 13 | Farm income | Continuous | In Ethiopian Birr (ETB) | + |
| 14 | Improved maize seed price | Continuous | In Ethiopian Birr (ETB) | + |
| 15 | Market distance | Continuous | In kilometers | - |
| 16 | Improved seed availability problem | Dummy | 1 if availability problem, 0 if not | - |
| 17 | Seed quality problem | Dummy | 1 if there is problem, 0 otherwise | - |
| 18 | Pests and diseases | Dummy | 1 if pests and diseases prevailed, 0 otherwise | - |

3. results and discussion

**Descriptive statistics results of categorical variables**

From both woredas, we collected 180 random samples as shown in Table 2 below. From the total sample of households, 18.33% were female-headed, whereas 81.67% were male-headed households. This dominance of males is mainly due to a culture in which male undertakes agricultural activities and are considered as household head in Ethiopia. Among sample household heads, 92.22 percent were married, and the remaining 7.82 percent were single. Social position in the community is also linked with agricultural production performance, and our sample distribution shows 23.34% of households had a social position, and the rest 74.66% had no social position.

Before analyzing demand for improved seed, we qualitatively assessed availability status, and 44.45% of households indicated availability of improved maize seed shortage, and the rest 55.55% did not face. Analogously, we assessed the presence of improved seed quality problems, and 66.66% of the sample households were acquainted with the maize seed quality problem, and the rest 33.34% of households had not faced the improved maize seed quality. This reveals that even if a greater proportion of sample households access improved seed, they mentioned the pertinent existence of seed quality, which in turn has a huge effect on productivity.

Furthermore, we assessed whether the household has received training about improved seeds, including maize, and 48.33% indicated that they have received it, and the remaining 51.67% did not receive any training on improved maize seed. This shows that there is limited coverage of awareness on improved seed, which will have an impact on its demand. Finally, we asked prevalence of pests and diseases on maize production. The intention behind this evaluation is that improved seed has the potential for resistance to pests and diseases compared to local seeds. Accordingly, 55.56% of households were acquainted with the prevalence of pests and diseases at maize farms, and 44.44% of households in maize farms were not affected by pests and diseases.

Table 2: Summary of categorical variables.

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Indicators | Frequency | Percentage |
| Gender | Female | 33 | 18.33 |
| Male | 147 | 81.67 |
| Marital status | Single | 13 | 7.78 |
| Married | 167 | 92.22 |
| Social position | Yes | 42 | 23.34 |
| No | 138 | 76.66 |
| Seed availability | Yes | 80 | 44.45 |
| No | 100 | 55.55 |
| Seed quality | Yes | 111 | 66.66 |
| No | 69 | 33.34 |
| Training | Yes | 87 | 48.33 |
|  | No | 93 | 51.67 |
| Pests and diseases | Yes | 100 | 55.56 |
| No | 80 | 44.44 |

Source: own survey 2023

**Descriptive statistics results of continuous variables**

Table 3 below presents the descriptive statistics of the continuous variables. The average age of sampled household heads was 39.58 years, and the average education enrollment level of the household head of all sample observations was 2.99 years of schooling, approximately grade 3. This age and educational status are consistent with national averages that the educational status of most farmers is not greater than primary level education. Farming experience also affects farmers' production performance, and our data shows that the average farming experience of the household head was 18.65 years. Compared with age, farming experience is half of their age, implying the starting period for farming is at least 20 years.

The average number of extensions contact frequencies from development agents during the cropping season was 4.25. Agricultural development agents' visitation of farmers depends on the distance of farmers' training centers, and the average distance to the farmers' training center (FTC) is 3.51 km. Market access also determines farmers' demand for improved crop seed, and the average walking distance to the nearest market in walking hours for the combined sample observation was 0.419 minutes.

The area of land cultivated measures the availability of land for agricultural production; a household with more landholding has the opportunity to produce more crops and thereby generate more income. The average cultivated landholding of all sample households was 1.725 hectares of land. In addition to land, livestock ownership is also a main asset of farmers that determines their wealth status. We scaled the number of livestock units available for farmers in terms of Ethiopia. Accordingly, the average livestock holding of all sample households in tropical livestock units was 2.05 tropical livestock units (TLU). Moreover, we estimated the average annual income of a farm household, which is measured in thousands of Ethiopian Birr. The average annual income for all sampled households was 14,625 Birrs.

Table 3: Summary of continuous variables

|  |  |  |
| --- | --- | --- |
| Variables | Mean | St. Dev |
| Age | 39.58 | 7.21 |
| Education | 2.99 | 3.58 |
| Family size | 6.73 | 2.49 |
| Farm experience | 18.65 | 21.35 |
| Extension contacts | 4.25 | 4.95 |
| Distance to FTC | 3.51 | 2.43 |
| Distance to market | 0.419 | 0.23 |
| Land size | 1.725 | 0.95 |
| TLU | 2.050 | 0.96 |
| Farm income (1000th of ETB) | 14.625 | 9.16 |

Source: Own computation, 2023

**Uncompensated (Marshallian) Compensated (Hicksian) Price Elasticities, and Expenditure Elasticities**

In Table 4 below, we summarized own and cross price elasticities of both Marshallian and Hicksian demand of improved seeds of maize, finger-millet, and teff. Marshallian Uncompensated own-price and cross-price elasticities for the improved maize seed, finger millet seed, and teff seed are presented in Table 4. In general, the elasticity coefficients obtained in this study conform to economic theory. All Marshallian (Uncompensated) own price elasticities were negative as expected, and greater than one. A negative sign on the price elasticity itself means that the demand for the improved maize seed, finger millet seed, and teff seed apply a demand law and, this elastic nature indicates that the responsiveness of demand for price change and demand for improved maize seed is very sensitive to the price change of own price with large elasticity value (-1.392) compared to finger millet seed and teff seed. The finger millet had the least own-price elasticity compared to maize and teff in absolute terms, and this indicates that as the price of maize and teff improved seeds increase, more income will be allocated to finger millet seed. The elasticities for maize seed, finger millet seed, and teff seed lie between -1.342 and -1.392; therefore, the price is elastic. The elasticities put forward quantity demand for improved maize seed, finger millet seed, and teff seed are sensitive to price change. For instance, if the price of improved maize seed increases by 1%, the quantity demanded for improved maize seed will decrease by 1.392%. Own-price elasticities of all the improved seeds considered were elastic, in addition to coming up with a negative sign as expected. This is consistent with the findings by Akinbode (2015), who found that own-price elasticities of agricultural products were elastic and had a negative sign, meaning that every price increase of a commodity will decrease the number of requested commodities.

All the Marshallian cross-price elasticity carries positive signs that conform to the economic theory. Positive Marshallian cross-price elasticities imply that two goods are substitutes, while negative cross-price elasticities suggest the two goods are complementary, and the elasticity of cross-prices represents a change in the percentage of the demand quantity of an item consumed as a result of a 1% change in the price of other goods. For instance, a 1% price change in improved maize seed increases the quantity demanded for finger-millet seed and teff seed by 0.705% and 0.789% respectively.

The Hicksian (compensated) own-price elasticities came up with negative signs as expected. The compensated elasticity values were generally lower than the uncompensated elasticities. The improved maize seed had elasticities less than unity (-0.596); so, the price is inelastic. This implies that the quantity demanded for improved maize seed is not sensitive to a price change. For instance, a 1% increase in the price of improved maize seed results in less than a 1% (0.596%) decrease in improved maize seed demand. The compensated own price elasticity for finger millet seed (-1.256) is the most elastic, indicating that finger millet seed is sensitive to prices, followed by the compensated own price elasticity for Teff seed (-1.250). All the cross-price elasticity carries positive signs, meaning they are substitutes, not complements, which means an increase in the price of one commodity increases the quantity demanded for the other commodity. Regarding the cross-price elasticities, the demand for teff seed shows the strongest substitution response for the price of finger millet seed (0.086), followed by the finger millet seed substitution response for the price of teff seed (0.132). For instance, this study found positive cross-price elasticities between maize seed and finger millet seed, meaning that the two are substitute seeds, and this is consistent with the findings by Nuani et al., (2022). The signs shift from negative to positive for some cross-price elasticities, implying greater income effects on households (Ansah et al., 2020).

Table 4: Marshallian and Hicksian price and expenditure elasticities of improved seeds

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Seeds | Maize seed | | Finger-Millet seed | | Teff seed | | Expenditure elasticities |
| Marshallian | Hicksian | Marshallian | Hicksian | Marshallian | Hicksian |
| Maize | **-1.392** | **-0.596** | 0.067 | 0.230 | 0.112 | 0.366 | 1.209 |
| Finger-Millet | 0.705 | 1.123 | **-1.342** | **-1.256** | 0.001 | 0.132 | 0.635 |
| Teff | 0.789 | 1.164 | 0.009 | 0.086 | **-1.368** | **-1.250** | 0.569 |

Source: own estimations, 2023

As summarized in Table 4 above, computed expenditure elasticities for all maize seed, finger millet seed, and teff seed are positive, implying all seeds are normal goods. The expenditure elasticity coefficients of improved maize seed are positive, larger than 1. This suggests that improved maize seed is a superior good, in that an increase in household income would result in a more than proportional increase in the buying of the improved maize seed. More specifically, a 1% increase in household income would result in a 1.209% increase in improved maize seed demand. In other words, improved maize seed can be considered a luxury good, relative to finger millet seed and teff seed. On the contrary, the positive, lower than 1(0.635 and 0.569), suggesting that they are necessities. Changes in household income would result in less than proportional changes in the consumption of finger millet seed and teff seed. This is consistent with the findings by Ahmed Ali, (2020), and Nuani et al., (2022b) who found that an increase in expenditure (income) increases the demand for luxurious commodities.

**Factors affecting the demand for Improved maize seed**

The output of the Multiple linear regression model in Table 5 below shows the factors affecting households’ improved maize seed demand. The result indicated that seven variables, price of improved maize seed, social position, cluster participation, improved maize seed availability, land size owned, pests and diseases, and farm income, are the variables that affect farm households’ improved maize seed demand significantly. The rest, gender, age, education level, family size, frequency of extension contact, improved seed quality, and total livestock unit, didn’t significantly influence the demand share of improved maize seed.

The price of improved maize seed was found to negatively and significantly influence the demand for improved maize seed at a 10% level of significance. The result indicates that the increase in the price of improved maize seed by one Ethiopian Birr would decrease the share of improved maize seed demand by 0.057 %, so it affects the demand for improved maize seed negatively while keeping other variables constant. Household head’s social position was found to be statistically significant at a 1% in affecting the household's demand share for improved maize seed. This implies that the farm households that have a social position have better access to different capacity-building, training, meetings, and social affairs in the community, and they have better awareness about the improved seeds. Due to this, it increases the demand share of improved maize seed.

Household cluster-based production of maize (cluster participation) was found to be statistically significant at 1% and affects the share of improved maize seed positively. The result implies that the households that participated in cluster farming have more information about the advantages of using improved seeds since the cluster participants use a full package in crop production, and this full package includes using improved seeds and the recommended rate of fertilizers, than those who are non-participants. The result reveals that when a farm household head participates in maize cluster farming, the household’s improved maize seed demand share increases by 5.5%, and the result is consistent with the findings reported in Nigeria on the effect of membership in group farming cooperatives on food production and productivity of farmers (Adunea & Fekadu, 2019). This finding is also consistent with the impacts of clustering vegetable farmers in the Philippines Real et al., (2013).

Improved seed availability was found to be a statistically significant variable at a 5% level, and it affects the improved maize seed share negatively. The result of the study indicates that improved seed unavailability would lead to a decrease in the share of improved maize seed demand. This is consistent with the findings by Adunea & Fekadu, (2019) shows provision of improved wheat seed to farmers in the required quantity and at the right time increases the probability of adoption of the improved wheat variety.

Land affects the household’s improved maize seed demand share positively at a 5% significance level. The result indicates that as the land size owned increases by 1 hectare, the household head’s demand share for improved maize seed increases by 1.69%. Pests and diseases were found to be statistically significant at 1% significance level, and affect the improved maize seed demand share negatively. For instance, if a maize farm was affected by pests and disease last year, the farmer could shift to other major crops (finger-millet and teff) produced in the community and decrease the demand for improved maize seed. The result revealed that the occurrence of pests and diseases on maize farmland decreases the demand share of improved maize seed by 8.97%. The household’s farm income affects the improved maize demand share positively, and the variable is statistically significant at a 5%. For instance, an increase in the farm income of the household head by one Ethiopian Birr increases the demand share of improved maize seed by 0.2%. The result implies that the farm household that got income from their annual agricultural production could invest his/her proportion of income to purchase improved maize seed.

Table 5: Determinants of improved maize seed demand using MLR model

|  |  |  |
| --- | --- | --- |
| Improved maize seed share | Coefficients | Standard Error |
| Price of maize seed | -0.00057\* | 0.0003 |
| Sex | 0.019 | 0.0190 |
| Age | 0.0010 | 0.0009 |
| Education | 0.0004 | 0.0019 |
| Social Position | 0.0460\*\*\* | 0.0149 |
| Family size | -0.002 | 0.0026 |
| Cluster Participation | 0.0550\*\*\* | 0.01683 |
| Seed Availability | -0.0293\*\* | 0.0124 |
| Seed Quality | -0.0311 | 0.02535 |
| Extension contact | -0.0002 | 0.00141 |
| Land | 0.0169\*\* | 0.00743 |
| Pest and diseases | -0.0897\*\*\* | 0.02260 |
| Tropical livestock unit | 0.0040 | 0.00580 |
| Farm income | 0.0020\*\* | 0.00092 |
| Constant | 0.6595 | 0.06633 |

\*, \*\*, and \*\*\* implies significance level at 10%, 5%, and 1%.

4. Conclusion

The multiple linear regression model shows that the price of improved maize seed, the social position of the household, cluster farming participation, improved seed availability, land size owned, pests and diseases, and farm income are the major factors that affect farmers’ improved maize seed demand. The demand estimates of this study are consistent with economic theory, similar to many other studies that applied the AIDS model. Marshallian price elasticities show that own price elasticities carry a negative sign and are greater than unity (one), and cross-price elasticities carry positive signs as expected. Demand for improved maize seed is very sensitive to the change of own price with an elasticity value of (-1.392). The elasticities for improved maize seed, finger millet seed, and teff seed lie between -1.342 and -1.392 and are sensitive to price change. According to compensated (Hicksian) price elasticities, improved maize seed had elasticity less than unity (-0.596) and price inelasticity, meaning own price change does not affect its demand. Expenditure elasticities estimates are all positive, and hence, all seeds are normal inputs. An increase in rural households’ income increases the demand for them. Improved maize seed is a luxury with expenditure elasticities greater than unity (1.209), while finger millet seed and teff seed are necessities with their coefficients less than unity, 0.635, and 0.569, respectively.

Based on the results, the study recommends the following: The prices of improved maize seed and the availability of improved seed were found to be important variables negatively affecting the demand for improved maize seed. So, policymakers should give strong attention to providing enough improved maize seeds at the right sowing season to enhance productivity. The result also reveals that the negative effect of pests and diseases on households improved the maize demand share. So, the stockholders or policymakers should focus on the provision of pesticides to smallholder farmers. In addition, the land size and annual farm income of the household affected the improved maize seed positively. Therefore, policymakers and project managers should focus on increasing the income level of households to enable them to afford the improved maize seed. The social position of the households and Cluster farming is found to be positive and significantly affecting the improved maize seed demand. Therefore, it is important to strengthen the existing clusters, scale up the experience, and encourage the participation of farmers by raising awareness through field visits, experience sharing, training, strengthening education, cooperatives, and off-farm income.

**Disclaimer (Artificial intelligence)**

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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