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Determinants of Farmers' Seed Demand for Improved Wheat Varieties in Ethiopia: A Double Hurdle Model Approach

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Abstract
Using the double hurdle model, the study empirically identifies the most important farm households socio-demographic characteristics that are affecting wheat seed demand and investigate their effects on wheat seed demand. The estimated results indicated that Geographic locational and farm size were significant in explaining both the decision to participate in purchasing wheat seed and the level of wheat seed purchase. Improved wheat variety use in the last five years has been found to have a negative relationship on farm households' decision to purchase wheat seed but it was not important on the quantity of wheat seed purchase. With regard to educational level, out of the education levels identified, farm households who only read and write have a less likelihood to participate in purchasing of wheat seed. In addition, economic factors such as income and livestock ownership were among the significant determinants of wheat seed purchase demand. Calculated non-farm income elasticties, for those who purchased wheat seed, indicated that farmers' wheat seed demand sensitive to changes in non-farm income.

Introduction
Availability of quality seed of improved varieties at required amount and affordable prices has been amilestone of developments recorded in wheat production. Assured supply of breeder's and pre-basic seed is crucial for public breeders to engage private companies to produce seed of public cultivars. In a regional seed market, companies may need breeders and pre-basic seed to produce and sell seed in several countries. Failure to use appropriate seed, while investing sufficiently on other inputs and management practices, usually yields against expectations. This can be observed in the improved seed coverage and national wheat productivity in Ethiopia. During the main rainy season of 2009/2010, of 1.68 million hectare of land covered with wheat, only 2.25% was sown with seeds from the formal sources (CSA, 2010)1[1] indicating that the vast majority of seeds used by small farmers in the country is obtained from the farmers' seed system. Moreover, DawitAlemu and Spielman (2006)[2]had summarized that only 20% of the demand for improved seed was covered in the main rainy season of 2005 demonstrating that nearly 3000 tons of improved wheat seed is required to satisfy the present demand.
Experience has shown that the predicted demand for wheat seed usually does not conform to the demand at planting times. When farmers revise their expectations of rainfall, prices and other factors, they incline to shift their interests. This frequently causes significant coordination problems for seed suppliers. This is well evidenced by the present national scaling up initiative by the EIAR and seed sales reports by seed suppliers. Hence, clearly defining demand dynamism for wheat seed has a crucial.
To this end, this paper was carried out with the objective of presenting the important farm household Socio-demographic characteristics that are affecting wheat seed demand and investigate their effects on wheat seed demand.

Methodology
Multi-stage purposive random sampling procedures were followed from higher to lower administrative levels, with farmers being the sampling units. The survey was carried out in three regional states such as Amhara, Oromia, and SNNP. A four-stage sampling procedure was adopted involving the selection of zones, districts, peasant associations and wheat farmers. Purposive selection of administrative zones, districts, and peasant associations was carried out based on area of wheat coverage. Ultimately, a total of 763 farmers were interviewed using a structured questionnaire.

Data Analysis
Descriptive statistics was used to describe the socioeconomics and demographic characteristics of the sample households. Means, percentage, frequency and graphs were analyzed using SPSS computer program and significance test was conducted using t-test, and Chi-square.

To analyze the demandof improved wheat varieties using farm household survey data, the Tobit and a more flexible parameterization to the tobit model (the double hurdle model) were considered.

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[1]C.S.A. 2010.Agricultural Sample Survey. FDRE Central Statistical Agency (CSA), Addis Ababa, Ethiopia
[2]DawitAlemu and David J. Spielman. 2006. The Ethiopian Seed System: Regulations, Institutions and Stakeholders. Paper submitted for ESSP Policy Conference 2006 "Bridging, Balancing, and Scaling up: Advancing the Rural Growth Agenda in Ethiopia" 6-8 June 2006, Addis Ababa, Ethiopia

The tobit (TOBIN 1958) model specification is defined as

$y_i = y_i^* \text{ if } y_i^* > 0$ (1)

$y_i = 0$ Otherwise

The latent function y_i^* that defines household participation decision and amount of purchased improved wheat varieties is given by:

$y_i^* = x_i'\beta + \varepsilon_i$, where $\varepsilon_i \sim N(\mu i, \sigma^2)$ and i = 1,…, n

The latent is defined variable y_i^* as a variable that may or may not be directly observable and y_i is the corresponding actual observed the purchase of an improved wheat variety measured in terms of proportion of wheat area allocated to improved wheat variety. x_i is a set of individual characteristics that explain both participation and the purchase of improved wheat variety, and β is vector of Tobit maximum likelihood estimates, µi the independently and normally distributed error term assumed to be normal with mean zero and constant variance σ. The value of y_i for all non-users equals zero (Alene, Poonyth and Hassan 2000). ε_i is assumed to be a homoskedastic, normally distributed error term. Equation (1) states that the observed purchase of an improved wheat variety becomes positive continuous values if only positive purchase of improved wheat varieties is desired, but zero otherwise. This shows the observed 0's on y_i can mean either a "true" 0 (i.e., due to the individual's deliberate choice) or censored 0 (i.e., those caused by survey design) (Wodajo unspecified).

The Tobit model is estimated using maximum likelihood methods. The log-likelihood function verifying equality of the coefficients in the participation equation to those in the purchase equation is

$$\text{LnL}_T = \sum_{y_{i=y_i^*}} \frac{1}{2}\left[\ln(2\pi) + \ln\sigma^2 + \frac{(y_i - x_i'\beta)^2}{\sigma^2}\right] + \sum_{y_{i=0}^*} \ln\left[1 - \Phi_i\left[\frac{x_i'\beta}{\sigma}\right]\right] \quad (2)$$

Where Φ_i denotes the standard normal distribution function evaluated at $\frac{x_i'\beta}{\sigma}$ and the summation indexes refer to the limit and the non limit observations. The first term on the right hand side of the equation (2) is the contribution of the non limit observations to the log-likelihood function, while the remaining terms represent the contribution of the limit observations (Reynolds 1990).

The D-H model is a parametric generalization of the Tobit model, in which two separate stochastic processes determine the participation decision to purchase and the amount of purchased of technology (Hailemariam, et al. 2006). The first equation in the D-H model relates to the decision to participate in purchase (y) can be expressed as follows:

$y_i = 1$ if $y_i^* > 0$ and 0 if $y_i^* \leq 0$ (3)

$y_i^* = x_i'\alpha + \varepsilon_i$ (Participation equation)

Where: y_i^* is latent participation in purchasing of wheat seed variable that takes the value of 1 if a household purchased improved wheat variety and 0 otherwise, x is a vector of household characteristics and α is a vector of parameters. Equation (3) is a probit model that examines the probability that the i^th^ farmer would make a participation decision to purchase improved wheat varieties.

The second hurdle, which closely resembles the Tobit model, is expressed as:

$t_i = t_i^* > 0$ and if $y_i^* > 0$ (4)

$t_i = 0$ Otherwise

$t_i^* = Z_i\beta + u_i$ (purchased amount of wheat seed equation)

Where: t_i is the observed response on how much Kilogram of wheat seed purchased, Zis a vector of the household characteristics and β is a vector of parameters (Mignouna, et al. 2011) . ε_i and u_i are error terms. $\varepsilon_i \sim N(0,1)$ and $u_i \sim N(0,\sigma^2)$.

Following (Cragg 1971) model, the study assumes independence between the two error terms. The log-likelihood function for the D-H model is as:

$$\text{LnL}_{dh} = \sum_{+} \ln\left[\Phi(Z_i'\beta)\frac{1}{\sigma}\emptyset\left(\frac{y_i - x_i'\beta}{\sigma}\right)\right] + \sum_{0} \ln\left[1 - \Phi[x_i'\alpha]\Phi\left[\frac{Z_i'\beta}{\sigma}\right]\right] \quad (5)$$

Where Φ and $\emptyset$ are the standard normal cumulative distribution function and density function, respectively. When either the assumption of normality or homoskedasticity is violated, maximum likelihood estimation produces inconsistent parameter estimates (Carroll, Siobhan and Carol 2005). However handling heteroskedsticity and non-normality violations are beyond the scope of this study.

The double hurdle model of equation (3) (i.e, the first hurdle) is a probit model that examines the probability that the i^th^ farmer would make a decision to purchase improved wheat varieties. Equation (4) (i.e, the second hurdle) is a truncated regression model that examines the amount of purchased improved wheat varieties (Bhunbaneswar, Hugh and Ross 2008).

Therefore, the log-likelihood of the D-H model is the sum of the log-likelihood from a probit model and the truncated regression model (Adam, et al. 2012).

Whether a tobit or a double hurdle model is more appropriate can be determined by separately running the tobit and the double hurdle models and then conducting a likelihood ratio test that compares the tobit with the sum of the log likelihood functions of the probit and truncated regression models (Greene, 1993 cited in (Berhanu and Swinton 2003) .

$$LR = -2[LogL_T - (LogL_P + LogL_{TR})] \sim \chi^2_k \quad (6)$$

Where $LogL_T$= log-likelihood for the Tobit model, $LogL_P$= log-likelihood for the Probit model, $LogL_{TR}$= log-likelihood for the Tobit model and k is the number of independent variables in the equations (Hailemariam, et al. 2006).

Results and Discussion

Descriptive Statistics

Table 1 presents the t-test and chi-square comparison of means of selected variables by participation in purchasing of improved wheat varieties for the surveyed households. Some of these characteristics are the explanatory variables of the estimated models we present further on. As shown in Table 1, the average amount of improved wheat seed purchases for the farm households who participated in purchasing was 130.84kg. Among all farm households surveyed, about 80.6% actually purchased improved wheat variety seed during 2012/13 cropping season. The farm size is about 2.2ha for wheat seed purchasers. The analysis of the data shows that there is a significant (P < 0.01) mean difference between the average farm size between wheat seed purchasers and non-wheat seed purchasers. In summary the result also depicts that the wheat purchaser farmer categories are distinguishable in terms of their Wheat seed prices, non-farm income, household head, educational levels and adoption of wheat varieties.. This simple descriptive statistics result implies the two groups of smallholders suggests that farmers who participated in purchasing of wheat seed and not participated in purchasing of wheat seed differ significantly in some proxies of socio-economic characteristics.

Table 1: Descriptive statistics variables used in estimations

Variables	Unit	Wheat seed purchasers (615)	Non-wheat purchasers (148)	t-stat (Chi-square)
Dependent Variable				
Wheat seed purchased	Kg	130.84	0	
Participation in Wheat seed purchase	Yes=1 No=0	1(80.6%)	0(19.4%)	
Independent Variables				
Family Size	Count	7.4780	7.0851	1.228
Age	Years	44.84	45.91	-0.952
Farm size	Ha	2.2	1.9	1.89*
Livestock ownership	TLU	8.0056	7.2731	1.49
Wheat seed price	Birr	854.77	995.14	-4.55***
Expected wheat grain price	Birr	707.0354	681.0228	0.833
Non-farm income	Birr	16522.728	10967.152	2.4**
Gender	Yes=1 No=0	0.75	0.16	5.8**
Read and Write	Yes=1 No=0	0.26	0.093	11.773***
Primary	Yes=1No=0	0.28	0.062	0.33
Secondary	Yes=1No=0	0.114	0.009	9.662***
Highschool	Yes=1No=0	0.11	0.01	7.1***
College/university	Yes=1No=0	0.012	0.001	0.562
Fertilizer adoption	Yes=1No=0	0.096	0.012	4.17**

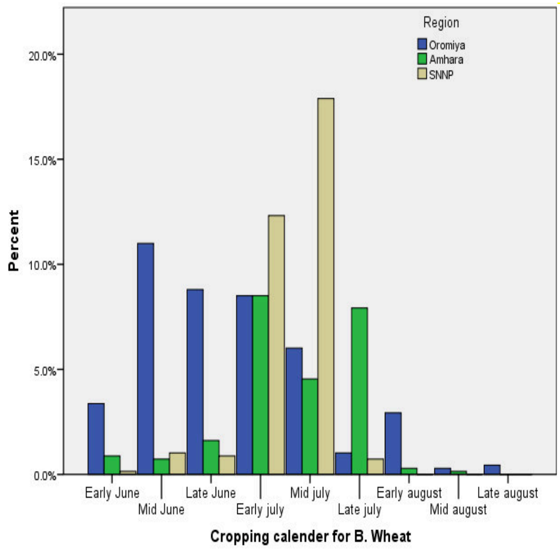
Crop production patterns

Mixed farming characterizes the farming system of the study area. The major crops grown in the study area are wheat, pulse, oil, teff and maize. From the total sample respondents, the average wheat area cultivated was 1.34 hectares, average pulse area 0.54 hectares, for oil crops average farm size is 0.51 hectares. In the survey area, wheat crop is the major crop grown with average farm size of 1.25ha. Out of the sampled regions, Oromia has the largest average wheat farm size (1.94ha) table 2. The ANOVA test shows that the average farm size for wheat, pulse, oil, teff and maize crops significantly different among the three regions.

Table 2: Cropping pattern

Type of Crops	Region	N	Mean	Std. Deviation	F
Maize	Oromia	25	.3736	.24986	12.299***
	Amhara	141	.6073	.47706	
	SNNP	46	.2460	.44806	
	Total	212	.5013	.47389	
Oil crops	Oromia	8	.7188	.52504	4.748**
	Amhara	18	.4167	.19174	
	SNNP	0			
	Total	26	.5096	.34986	
Pulse	Oromia	113	.5926	.48506	4.616**.
	Amhara	33	.5385	.37792	
	SNNP	21	.2767	.15651	
	Total	167	.5422	.44708	
Teff	Oromia	105	.5638	.35187	12.936***
	Amhara	131	.5095	.27847	
	SNNP	21	.1960	.12598	
	Total	257	.5061	.31651	
Wheat	Oromia	294	1.9355	1.61044	102.745***
	Amhara	171	.7632	.54957	
	SNNP	143	.4167	.22606	
	Total	608	1.2486	1.34404	
Barley	Oromia	128	.6083	.54793	17.170***
	Amhara	48	.2896	.26910	
	SNNP	37	.1928	.09526	
	Total	213	.4643	.47931	

Cropping Calendar Farmers' wheat seed demand and Procurement



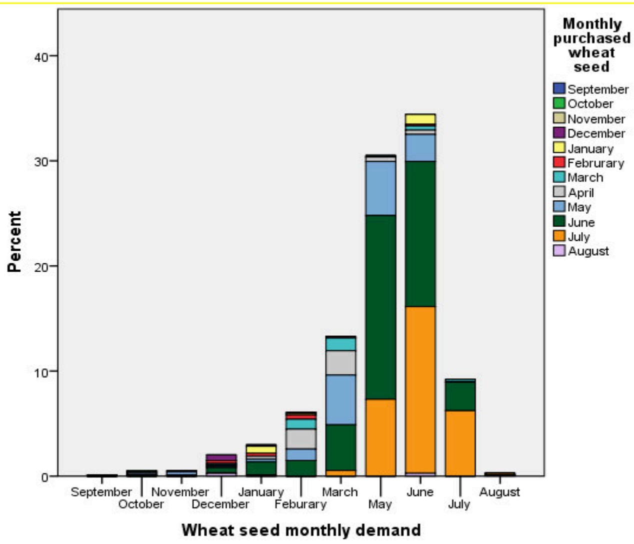


Figure 1 Figure 2

Figure 1 suggests that in major areas of Oromia region, wheat cropping stars from Mid-June to Mid-July. In the case of Amhara the wheat cropping is mainly from Early-July to Late-July. While for SNNP region the wheat cropping calendar is mainly from Early-July to Mid-July. The result of figure 2 depicts in which months farmers' wheat seed demand arises and the different months farmers participate in purchasing those seeds. As the figure shows, the majority of farmers need wheat seed from the months of January to July. However, they fulfill their wheat seed demand only in the two months of June and July.

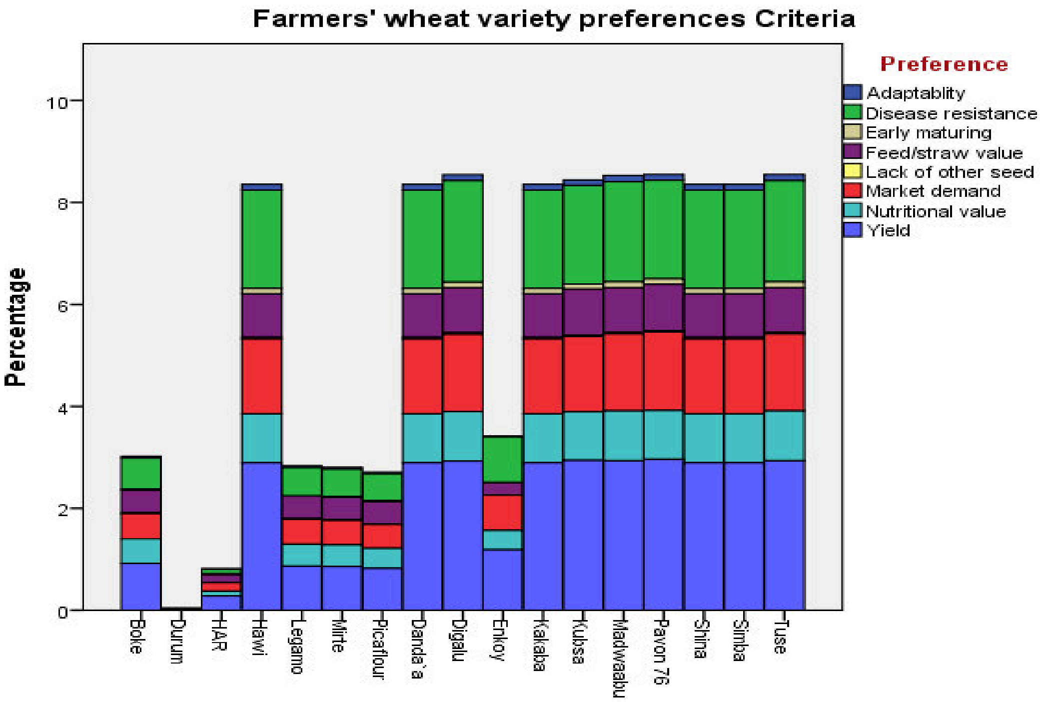


Figure 3: Wheat variety preferences

Farmers' subjective preferences on the characteristics of the technologies affect their adoption decisions. In this regard, the surveyed farmers used improved wheat varieties as per their preference criteria. The major farmers' preference criteria on the characteristics of wheat varieties are Adaptability, Disease resistance, Yield, Nutritional value and Feed/straw quality. To this end farmers widely used Hawi, Danda'a, Digelu, Kakaba, Kubsa, Madawalabu, Pavon, Shina, Simba and Tuse wheat varieties.

Econometrics Model

Model specification

To identify the model that best identifies the determinants of purchasing decision and volume of purchase of improved wheat varieties, a model specification test was conducted. Therefore, the D-H model is tested against the Tobit alternative using a likelihood-ratio test. The result for the model specification test is presented in Table. The LR Result rejects the null hypothesis that the Tobit model is appropriate and indicates that the estimated D-H model is preferred .The test statistic for log likelihood is 423.87 which exceed the critical chi-square value of 30.144at 19 degrees of freedom and at a less than one percent level of significance in favor of the D-H model. This shows that the existence of two separate decision making stages during the purchasing process. This result provides an empirical result of farmers' independent decisions making regarding the purchasing and volume of purchase improved wheat in the study area.

Table 3:Test statistics of double hurdle and Tobit models

Test Statistics	Probit	Truncated Regression	Tobit Regression
Chi2()	156.38***	101.27***	2.79***
Log-L	-226.29	-381.76	-819.97
Number of observation (N)	665	434	478
LR-statistics	**423.87*** **	**χ2(19)= 30.144**	
AIC (-Log-L+k)/N			

*Source: model output, ** *** significant at 5% and 1% respectively*

Determinants of wheat seed demand

To identify the determinants of the decision to purchase wheat seed, a probit model (the first hurdle) was estimated (Table 4). The results in table reveal that the variables improved wheat variety use in the last five years, location variables, read and write education level and farm size found significant in influencing the purchasing decision of wheat seed. The log likelihood for the fitted model was -226.29 and the χ2 value of 156.38 indicates that all parameters are jointly significant at 1%.

Improved wheat variety use in the last five years has been found to have a negative relationship with the decision to purchase wheat seed implying that farmers who used improved wheat varieties in the last five years are unlikely to purchase wheat seed than other farmers. This implies once farmers purchased a given wheat variety they recycle it for more than at least one year. Looking at the marginal effects, we find that farmers who have experiences in improved wheat varieties in the last five years, the probability of purchasing wheat seed is less by 0.32 compared to those who did not use improved wheat varieties in the last five years.

Oromia farm households are less likely to purchase improved seed in 2012/13 cropping season relative to SNNP region farm households. The likelihood of Oromia's farm households (Oromia dummy) decreases by 0.15 relative to the SNNP region farm households. For Amhara farm households, the probability of purchasing improved wheat seed is lower by 0.20 relative to SNNP farm households. Consequently, farm households from SNNP region are the most likely to purchase improved wheat seed controlling for other socioeconomics and demographic factors.

Regarding the level of education of farmer household, it was found that farmers who can read and write read have a negative effect on the probability of wheat seed purchase. According to the marginal effects, for farmers who read and write the probability of purchasing wheat seed decreases by 0.17 relative to farmers who cannot read and write.

The effect of farm size was found to be positive and significant suggesting that the larger farm size the farmer is the more likely the farmer is willing to purchase wheat seed. This means the probability of wheat seed purchasing increases by 0.041 as farm households farm size increases by one unit.

Table 4: Parameters and Estimated Marginal Effects of purchasing decision of wheat seed

Variable	Double hurdle method			
	Probit		Marginal effect	
	Coef.	Z	Coef.	t
Age	-0.033061	-0.79	-0.00646	-0.8
Agesqur	0.0003807	0.88	7.44E-05	0.9
Extension Access	0.2337736	1.41	0.049709	1.3
Pulse rotation dummy	-0.0425382	-0.29	-0.00828	-0.29
Gender	0.4589621	1.55	0.110339	1.3
Married dummy	-0.2071268	-0.59	-0.03617	-0.67
Never married dummy	-0.0799772	-0.09	-0.01636	-0.09
Family size	-0.0088972	-0.37	-0.00174	-0.37
Dependency ratio	0.0567892	1.1	0.01109	1.1
TLU	-0.0062772	-0.33	-0.00123	-0.33
Improved wheat use in last five years dummy	-1.663392	-10.71***	-0.32484	-9.63***
Oromia dummy	-0.7121715	-3.08***	-0.15359	-2.9***
Amhara dummy	-0.8463951	-3.64***	-0.20128	-3.22***
Read and write dummy	-0.768872	-2.13**	-0.1683	-1.91*
Primary dummy	-0.516417	-1.43	-0.11114	-1.29
Secondary dummy	0.126352	0.3	0.023303	0.32
High school dummy	-0.057078	-0.14	-0.01144	-0.13
Farm size	0.2086207	2.34**	0.040741	2.45**
Fertilizer adoption	0.2111215	0.89	0.037235	0.99
_cons	4.008955	3.61***	-	-

Determinants of the amount of purchase of improved wheat variety seed

The determinants of the amount of purchase of improved wheat variety seedwas estimated using the second double hurdle (Truncated regression) model. The empirical result from table of truncated regression model indicated livestock ownership, regional variables, farm size and off-farm income had a significant effect on the quantity of improved wheat seed purchased.

Once the decision to purchase improved wheat seed has been made, from Table 5, Ceteris paribus, for every unit increase in the livestock ownership for a given farm household nearly a 3% increase in the quantity of wheat seed purchase on average.

The effect of regional variable on the amount of purchase of wheat seed is positive and significant for the two regional dummy variables. Among those farmers who purchased wheat seed, relative to SNNP region farmers Oromia region farmers purchase 4% more amount of wheat seed on average. In a similar fashion, Amhara region farmers purchased nearly 1% more amount of wheat seed on average. Thus the results suggest that SNNP region farmers purchase less volume of wheat seed compared to Oromia and Amhara regions farmers. The plausible explanation for this is Oromia and Amhara regions have easy access to improved wheat seed and wheat seed Market. Because the wheat research centers and seed enterprises are found in the two regions.

The results of the study provided empirical evidence of a positive impact of farm size on amount of wheat seed purchased. The result of the truncated model revealed that the amount of improved wheat seed purchased is positively and significantly affected by farm size at 1 percent significance level. Of the farm households that buy wheat seed, farmers who have one more unit of farm size purchase 5% more volume of wheat seed.

The role of farm household non-farm income has a positive and significant effect on the volume of wheat seed purchase. Higher non-farm income is associated with a higher volume of wheat seed purchase. Once the farmers have made the decision to purchase wheat seed, ceteris paribus, a 1% increase in non-farm income will result in a 6% increase in the quantity of wheat seed purchase on average.

Table 5: Parameters and Estimated Marginal Effects of purchasing decision of wheat seed

Variable	Truncated Coef.	t	Coef.	t
Age	-0.0239581	-1.42	-0.23454	-1.42
Agesqur	0.0002478	1.46	0.116201	1.46
Extension Access	0.0685047	0.7	0.0126	0.7
Pulse rotation dummy	-0.0620692	-0.94	-0.00749	-0.94
Gender	0.0167851	0.12	0.003374	0.12
Married dummy	-0.0120226	-0.51	-0.01866	-0.59
Never married dummy	0.011755	1.32	-0.00044	-1.26
Family size	-0.0910006	-0.59	0.019843	1.31
Dependency ratio	-0.441859	-1.26	-0.00396	-0.51
Livestock ownership	0.0165237	2.27**	0.028844	2.27**
Improved wheat use in last five years dummy	-0.1172979	-1.21	-0.028	-1.21
Oromia dummy	0.4587644	4.66***	0.043343	4.67***
Amhara dummy	0.1546228	1.6*	0.008858	1.61*
Read and write dummy	-0.0675369	-0.33	-0.00479	-0.33
Primary dummy	0.1077046	0.52	0.008119	0.52
Secondary dummy	0.1117247	0.52	0.00365	0.52
High school dummy	0.0542945	0.25	0.001664	0.25
Farm size	0.1016566	2.79***	0.050796	2.79***
Wheat seed price2012/13	-0.0000982	-0.53	-0.01839	-0.53
Expected Wheat grain price2013	-0.0000492	-0.53	-0.00766	-0.53
Fertilizer adoption	-0.0533823	-0.56	-0.00126	-0.56
None farm income	0.0314148	2.14**	0.060304	2.14***
_cons	4.43641	7.76***		

Conclusions

This study was conducted with the main objective of identifying the determinants of farmers wheat demand for improved wheat varieties. Using survey data in the three regions, namely Oromia, Amhara and SNNP, the study provides results of wheat farm household characteristics that contribute to the farmers' wheat seed demand in Ethiopia.

Using the double hurdle model the study empirically distinguishes possible separate decisions on wheat seed marketing participation decision and quantity of wheat seed purchase decision.

The estimated results indicated that Geographical location and farm size were significant in explaining both the decision to participate in purchasing wheat seed and the level of wheat seed purchase. Improved wheat variety use in the last five years has been found to have a negative relationship on farm households' decision to purchase wheat seed but it was not important on the quantity of wheat seed purchase. With regard to educational level, out of the education levels identified, farm households who only read and write have a less likelihood to participate in purchasing of wheat seed. In addition, economic factors such as income and livestock ownership were among the significant determinants of wheat seed purchase demand. Calculated non-farm income elasticties, for those who purchased wheat seed, indicated that farmers' wheat seed demand sensitive to changes in non-farm income. Further study should be conducted especially using panel data in order to assess farmers' seed demand variation over time.

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Table 6: MLE estimates of the double hurdle and Tobit models

Variable	**Double hurdle method**				**Tobit**	
	Probit		Truncated		Tobit	
	Coef.	Z	Coef.	t	Coef.	t
Age	-0.033061	-0.79	-0.0239581	-1.42	-0.0450863	-1.31
Agesqur	0.0003807	0.88	0.0002478	1.46	0.0004691	1.34
Extension Access	0.2337736	1.41	0.0685047	0.7	0.2049885	1.06
Pulse rotation dummy	-0.0425382	-0.29	-0.0620692	-0.94	-0.4563281	-3.05***
Gender	0.4589621	1.55	0.0167851	0.12	0.3347915	0.84
Married dummy	-0.2071268	-0.59	-0.0120226	-0.51	-0.5007805	-1.23
Never married dummy	-0.0799772	-0.09	0.011755	1.32	0.2854563	0.47
Family size	-0.0088972	-0.37	-0.0910006	-0.59	0.0039387	0.21
Dependency ratio	0.0567892	1.1	-0.441859	-1.26	0.0392949	0.86
TLU	-0.0062772	-0.33	0.0165237	2.27**	0.0271382	1.87*
Improved wheat use in last five years dummy	-1.663392	-10.71***	-0.1172979	-1.21	-1.101621	-3.84***
Oromia dummy	-0.7121715	-3.08***	0.4587644	4.66***	0.0467014	0.21
Amhara dummy	-0.8463951	-3.64***	0.1546228	1.6*	-0.1453219	-0.66
Read and write dummy	-0.768872	-2.13**	-0.0675369	-0.33	-0.6087359	-2.08**
Primary dummy	-0.516417	-1.43	0.1077046	0.52	-0.2634484	-0.9
Secondary dummy	0.126352	0.3	0.1117247	0.52	0.0268408	0.09
High school dummy	-0.057078	-0.14	0.0542945	0.25	-0.3867785	-1.21
Farm size	0.2086207	2.34**	0.1016566	2.79***	0.199899	3.33***
Wheat seed price2012/13	-		-0.0000982	-0.53	-0.0017545	-4.04***
Expected Wheat grain price2013	-		-0.0000492	-0.53	0.0001319	0.7
Fertilizer adoption	0.2111215	0.89	-0.0533823	-0.56	-0.0770988	-0.41
None farm income			0.0314148	2.14**	0.0616994	1.67*
_cons	4.008955	3.61****	4.43641	7.76***	7.1514	6.28***

*Source: model output, * ** & *** significant at 10%, 5% and 1% respectively.*