

## Research Article

# Determinants of Seed Distribution System: The Case of Womberma District, North West Ethiopia

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Bread wheat also known as common wheat is one of the most important crops for food security and job opportunities for many smallholders as well as the urban population in Ethiopia. Farmers obtain seed from both formal and informal seed distribution systems. The informal seed sector in the study area is the major supplier of seed for many crops grown in the Womberma district. However, access to the formal seed sector was limited for the farmers. Hence, this study initiated to analyze seed distribution system and determinants of smallholder farmers in selecting seed of bread wheat distribution system in the study areas. The primary data was collected through distributing research questionnaires for the seed distribution systems of bread wheat. The study was based on the data collected from 150 households by using the multistage probability sampling method. The survey result shows that the contribution of public companies for supplying improved bread wheat seed was only 33% whereas 100% of producers confirmed that sources of bread wheat seed were from farm saved and local market which were uncertified leading to production deterioration. In line with these, conducted focus group and key informants confirmed that the major problems of formal seed distribution system were lack of timely supply, price fluctuation, limited quantity, and lack of certified seed suppliers while those of the informal seed distribution system were adulteration, high price, low quality, unable to get the right amount, and lack of timely supply, which concluded that the distribution system was inefficient. The econometrics model was used to analyze determinants of selection in seed distribution system of bread wheat in the study areas. Hence, the result of logit model shows that the level of education, access to credit, household income, extension services, and seed quality significantly and positively influenced farmers' selection of formal seed distribution system while distance to the nearest seed distribution area influenced negatively the selection of formal seed distribution system in the study areas. Therefore, any concerned bodies should give more attention to establish for farmers formal seed distribution systems of bread wheat seed so as to increase production and productivity of bread wheat in the study areas.

## 1. Introduction

Wheat is one of the most important cereal crops cultivated in Ethiopia that ranks fourth after Teff (*Eragrostis tef*), Maize (*Zea mays*), and Sorghum (*Sorghum bicolor*) in area coverage and the third in total production [1]. The total wheat area coverage and production in the Amhara region was 578,034.07 ha (32.30% of the countries area coverage) and 16,117,841.44 tons, respectively, with the productivity of 27.88-ton ha<sup>-1</sup> in 2019/2020 meher season [1]. From Amhara region administrative zones, West Gojjam Zone ranks the second in area coverage, production, and yield of

bread wheat which were 40,497.92 ha, 1,226,712.91q, and 30.29 q/ha, respectively. Thirteen million smallholder farmers account for 95% of total production, and so far, five to seven million households are chronically food insecure year-round [2]. Hence, agriculture in Ethiopia is the core driver for growth and long-term food security, which is in turn highly associated with the importance of economic growth. Ethiopian agriculture contributes 36% to the GDP, 75% to export, and 80% to employment [3].

More remarkably, seed sectors are contributing to the development of Ethiopia, through public and private companies, cooperatives, and smallholders' entities [4].

Bread wheat, which is also known as common wheat (*Triticum aestivum*), is a cultivated wheat species. About 95% of the wheat produced worldwide is bread wheat (common wheat) which is the most widely grown of all crops and cereals with the highest monetary yield. Small holder farmers received seed from different sources, i.e., informal seed sources such as farmers who own saved seed, purchased seed, and other sources. Purchased seed could not be certified seed from local seed producers, neighbors, other farmers, and local traders/markets. Certified seed is purchased from public and private seed companies as well as cooperatives [5]. In Ethiopia, bread wheat seed distribution remains largely informal, and farmer-to-farmer exchanges account for almost 90% of the wheat seed trade. The government-owned Ethiopian Seed Enterprise (ESE) is the only public sector organization that is involved in seed production, processing, and distribution. Ethiopian research institutions provide foundation seed and breeding lines for improved varieties to the Ethiopian Seed Enterprise, which then multiplies seed in response to demand projections from the regional bureaus of agriculture. The Ethiopian Seed Enterprise then distributes seed to farmers' cooperative unions via regional bureaus [6].

Byerlee et al.[7] and Yu et al.[8] argue that increased private sector participation would strengthen the Ethiopian seed system, which is currently failing to meet the needs of the ever-growing demands of many farmers. The Ethiopian Seed Enterprise is not able to provide a sufficient supply of bread wheat seeds; in 2005, the quantity of bread wheat seed supplied by the Ethiopian Seed Enterprise was only 20% of the quantity demanded according to the regional bureau of predictions. Farmers have also reported problems with Ethiopian Seed Enterprise supplied seed quality, including poor cleaning, low germination rates, and the presence of mixed seeds. Finally, several surveys have found that the seed distribution system often occurs after the optimal planting time and is not coordinated well to ensure that the varieties distributed are appropriate to changes in the farmers' future expectations about their livelihoods. The seed distribution system was confronted with several problems such as lack of enough amounts of quality seed, transportation problems, and the required amount of seed being not reached at the right time.

Furthermore, the major challenges in this system were the inefficiency of seed distribution, which is attributable to untimely delivery of poor-quality seed, and a mismatch between supply and demand, which results in seed being left over in the stores. Seed is left over because of the inaccuracy of demand estimation, poor timing, and above all the lack of accountability in the distribution system [9–11]. The chain from demand estimation to the final sale of seed is very long, and the entire process involves many actors, blurring the accountability. To solve these problems, governmental and nongovernmental organizations have made efforts to buy the seed produced by all seed growers and distribute seed to farmers through unions and primary cooperatives to bring about change in the agricultural production system of farmers so as to increase crop productivity.

However, due to the ever-growing demands of smallholder farmers in the study areas, for improved wheat seed, the seed distribution system could not satisfy the needs of the farmers with the right quality and quantity and at the right time. Consequently, it affected the production of the crop, and 33% of the national demand is fulfilled by imports and food aids, despite substantial increases in wheat areas [12]. This indicates that there are different factors directly or indirectly influencing the seed distribution system believed to boost up production and productivity of the smallholder farmers. But the reasons why the seed distribution system failed to satisfy the needs of the ever-growing demand of farmers were not analyzed so far in the study areas. Therefore, this research initiated to analyze seed distribution system and determinants of smallholder farmers in selecting seed of bread wheat distribution system in the study areas. In addition, this study is also an important input for those scientific communities for further investigation in a similar topic.

## 2. Research Methodology

**2.1. Description of the Study Area.** The study was conducted in the selected District of West Gojjam Zone of Amhara National Regional State. According to the Amhara regional bureau of finance and economic development, the total population of West Gojjam in 2018 was estimated to be 2,641,240. From the total population, 85.30% live in rural areas and 14.70% in urban centers. West Gojjam Zone also had a total of 2,253,035 rural households, of which 1,119,086 were males and 1,133,950 were females [13]. And the total population of the study areas of the Womberma districts was estimated to be 126,242, and the district rural households were 52,713 males and 54,277 females with a total of 106,991 [13].

**2.2. Sampling Techniques and Sample Size.** By using a multistage sampling procedure, the researchers had selected the samples of respondents through three stages. The administrative levels were selected from higher to lower levels purposively First, East Gojjam Zone and Womberma district were selected based on larger area coverage and production potential through purposive sampling technique. In the second stage, three *kebeles* such as Marwoled, Wogedad, and Kentefin seed distributor multipurpose cooperatives have been selected purposively based on bread wheat production potential areas. In the third stage, a total of 150 sampled respondents were selected randomly from the 3885 population who are the common wheat producers. In order to decide the sample size of the study, the researcher had used the statistical formula [14], which is specified as follows:

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where  $n$  is the sample size the research uses,  $N$  is the total number of populations, and  $e$  is the level of precision or margin of error (8% (0.08)) taken.

In this study, to determine sample size, different factors were taken into consideration including research cost, time, accessibility, human and related resource constraints, and probability proportional to sample size. Table 1 depicted the sample size distribution of the respondents.

**2.3. Sources of Data and Data Collection Methods.** In this study, both primary and secondary sources of data were collected. The primary data were collected using semi-structured questionnaires of the face-to-face interview via translating into the local language which is called Amharic. The translated interview questionnaires and survey questionnaires were pretested for necessary modification, and further editing was made to ensure its clarity and fullness for generating important information from the respondents so as to generate valid findings.

**2.4. Method of Data Analysis.** Descriptive statistics and econometric analysis were used to analyze the data obtained from the seed distribution system to address each specific

objective. STATA 14 software was used to analyze data obtained from primary and secondary sources of data. Descriptive statistics were employed in the process of examining socioeconomic and demographic characteristics of sampled households of selected formal bread wheat seed distribution systems. Econometric analysis was used to estimate the causal relationship between the dependent variable and regressors. The economic outcome to the model is sometimes a discrete choice among a set of alternatives, rather than a continuous measure of some activity. The individual faces a pair of choices and chooses what provides greater utility [15]. There are dummy choice models that used to deal with dichotomous dependent variables. The binary logit model was applied in determining the bread wheat seed distribution system since the seed distribution system indicator, i.e., the dependent variable (bread wheat seed distribution system), is dichotomous. This is because the logistic regression analysis type does not necessarily require normality, constant variance, and random samples [16, 17]. It is also recommended when the explanatory variables are not only nominal or ordinal but also scale variables [18, 19].

$$S DS = \beta_0 + \beta_1 age + \beta_2 e dn + \beta_3 lasiz + \beta_4 hnicom + \beta_5 ext + \beta_6 inpc o + \beta_7 far exp + \beta_8 di st + \beta_9 accr + \beta_{10} trans + \beta_{11} sequ. \quad (2)$$

The following methods were estimated for the relationship of the bread wheat seed distribution system with determinant variables by using the binary logit model [20].

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10} \text{ and } X_{11})$$

Or

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_{11} X_{11} + \mu_i, \quad (3)$$

where  $Y$  is the bread wheat seed distribution system,  $\beta_0$  is a constant term,  $\beta_i$  is a parameter of explanatory variables,  $X_i$  is a set of explanatory variables, and  $\mu_i$  is error terms.

### 3. Results and Discussions

**3.1. Demographic and Socioeconomic Characteristics of Sample Households.** Table 2 indicates that the mean farming experience of the formal seed users was 19.12 years whereas the mean farming experience of informal seed users was 22.18 years. When the farmers were well experienced with each phase of farming activity and well aware of extension services in a year, it is believed that it leads to an increase in the use of improved bread wheat seed via formal channels in the study areas. In the study areas, the agriculture systems are dominated by mixed farming activities. Table 2 indicates that an average income of formal seed users of respondents was 44,443.12 Birr. However, the average income of informal users of sample households was 42,452.20 Birr. From the survey result, the mean age of the sample households engaged in the formal seed distribution system was 49.51 years

whereas the mean age of the informal seed distribution system was 52.45 years.

**3.2. Seed Distribution Systems of Bread Wheat.** Seed distribution is the process of estimating seed demand, seed supply, and seed dissemination to smallholder farmers. Kebele Development Agents in the district collect seed demand data from the community to the region, before planting time. The kebele submits the seed demand data to districts and then from districts to zones. After all, the zones allocated seed to the Bureau of Agriculture and then to MOA to be used as a basis for seed distribution. At the same time, both the Bureau of Agriculture (BOA) and the MOA collect data on the amount of seed produced in the country. Based on the demand from the regional states and the amount of seed available, the MOA allocates the seed to the regional states.

Seed distributed by cooperatives in the study area was started in 2000 EC via an extension program for increasing the production and productivity of farmer's yield. Before seed distribution by cooperatives, improved variety was distributed by Woreda Bureau of Agriculture (WBOA). According to the woreda agriculture office report, before this year, farmers used local varieties such as *Key Snide*, *Tekencher*, *key kebetu*, and *zembolel* which is local bread wheat variety and *Bale gofer*, *Shemetie*, and *Tikur sinde* which is local durum wheat from informal seed distribution system in the study area.

Multipurpose cooperatives in the study area were engaged to supply different seed varieties for smallholder farmers. Some of the improved seed varieties supplied by

TABLE 1: Sample size of the study.

No	Kebele	Population		Sample size = PBW $\times$ total sample/total PBW
		Total HHs	PBW	
1	Marwoled	1095	1089	42
2	Wogedad	1260	1250	48
3	Kentefin	1558	1546	60
	Total	3913	3885	150

Source: District BOA, 2019, HHs = households, PBW=Participation in Bread Wheat.

TABLE 2: Farm experience, household income, and age of the respondents by the seed distribution system.

Variables	Delivering system	Observations	Mean	Std.dev	t-value	p value
Farming experience	Informal	101	22.18	8.82	1.50	0.14
	Formal	49	19.12	9.72		
Household income	Informal	101	42,452.20	15546.27	0.57	0.57
	Formal	49	44,443.12	18718.15		
Age	Informal	101	52.45	15.53	0.63	0.53
	Formal	49	49.51	16.84		

Source: own computation from survey result, 2019.

multipurpose cooperatives to the farmers include teff, wheat, maize, and chickpea. In addition, farmers purchased and save some seed crops like teff, wheat, barley, chickpea, beans, *Guaya*, potato, *Noug*, and linseed from the local market whereas seed exchanged to other farmers includes teff, wheat, and maze.

*Demand and Supply.* Provision of the right agricultural input like improved variety was a prioritized issue by the government in Ethiopia. However, a limited amount of improved bread wheat seed varieties was supplied to the farmers in the study areas. As a result, the productivity of wheat per unit of land was low. In addition, demand-oriented improved wheat seed varieties were not supplied at the right time with the right quality and at the right place which did not satisfy farmers' ever-growing seed demand. Such vicious problems forced farmers to use their own saved seed, purchased seed from the local market, and exchanged it with other fellow smallholder farmers.

The supply and distribution of improved wheat seeds were also influenced through a formal seed distribution system depending on the agroecology zone of the study area (WBOA, 2019). The study area was separated into three agroecological zones such as *degas*, *woyena degas*, and *kola*. The survey result of this study showed that sowing time and seed supply time in the three-agroecology zone were not matched. For instance, the sowing time of *degas* is May, but improved seed suppliers in the study areas were supplied in June and the like. Multipurpose cooperative revealed that seed supplier union in the study areas does not timely deliver the required type and amount of improved wheat seed to the *kebeles*. As a result, multipurpose cooperatives did not supply improved wheat seeds for farmers timely. This is highly related to the logistic facility at national and regional levels.

Regarding seed provision, the supplied seed was not demand-driven, and mainly, it is based on the interest of few groups (farmers and DAs). The seed demand was primarily collected by 1 to 5 organizations, submitted to *lemate buden*, to DAs during September and October, and, finally, reported

to the *district* office of agriculture. This indicates that supplied seed was not in line with smallholder farmers' demand. In addition, seed suppliers provide seeds without considering the vicinity of agroecological zone and do not accept the preferred variety by smallholder farmers. Key informants revealed that there were not seed coverage problems; rather, there was a problem associated with seed variety. The major seed varieties supplied by unions and cooperatives were Damot union and Quiche primary cooperatives. On the other hand, FGD suggests that the seeds where unions and cooperatives supplied to farmers were not fit with farmer preferred variety. In addition, the small packed amount of seed and the right time and place were not supplied in the study area even if it has been expensive.

*3.3. Farmers' Bread Wheat Seed Suppliers.* Table 3 indicates major suppliers of improved bread wheat seed in the study areas. From formal seed suppliers, 33% of the respondents obtained improved bread wheat seed from a public company and null from private companies. On the other hand, farmer-to-farmer exchange, local market, and own seed were the major sources of seed from informal seed systems.

*3.4. Farmers' Bread Wheat Seed Suppliers' Selection Criteria in the Area.* From the list of criteria, the absence of other suppliers in the market was the major criterion to select the formal seed distribution system discussed in Table 4. The possible reason could be that cooperatives were the only formal seed suppliers in the study areas. However, Table 4 shows that the existence of low-price seed suppliers, provision of high-quality seed, short distance as compared to formal seed suppliers, and timely supply are the selection criteria of the informal seed suppliers.

*3.5. Improved Bread Wheat Varieties in the Study Area.* In Ethiopia, the most popular improved common wheat varieties were ET-13, HAR-1685, and HAR-604. According

TABLE 3: Farmers' bread wheat seed suppliers.

Seed suppliers	Formal		Informal	
	Frequency	Percent	Frequency	Percent
Public companies	49	33		
Private companies	0	0		
Farmers to farmers exchange			101	67
Local market			150	96.7
Own saved seed			150	93.3

Source: own computation from survey result, 2019.

TABLE 4: Farmers' bread wheat seed suppliers' selection criteria in the area.

Suppliers' selection criteria	Formal		Informal	
	Frequency	Percent	Frequency	Percent
Low price			150	90
High quality			150	96.7
Near to home			150	93.7
Timely supply			150	100
Absence of other suppliers Services	150	100		

Source: own computation from survey result, 2019.

to WBOA and multipurpose cooperatives, Triticale which is known to farmers was primarily supplied by multipurpose cooperatives in the study areas. Likewise, multipurpose cooperatives and unions provide improved wheat seeds which are similar to seeds supplied by the woreda office of agriculture. During the discussion with smallholder farmers, there was different improved wheat seed varieties in the study areas such as ET-13, HAR-1685, and HAR-604. However, Damot union and Quich were the only seed varieties supplied to smallholder farmers in the study area.

**3.6. Source of Information.** The major source of information about improved bread wheat varieties was extension agents and *kebele* leaders for smallholder farmers. Even though extension agents in the Womberma district were the major source of information, they are also highly engaged in the distribution of input for smallholder farmers via 1 to 5 and development group (*lemate buden*) organization of the area.

**3.7. Whys of Bread Wheat Seed Distributed to Farmers.** As the office of agriculture and development agents explained seed needs in terms of crop variety and quantity from individual farmers and submits them to the district agricultural office, an improved variety would be supplied to farmers via a formal seed distribution system (BOA, 2019). The usual problem in the study area was that seed suppliers supply an improved variety of bread wheat seeds when they have at hand regardless of what the producers demand. To do so, the union delivered seeds to multipurpose cooperatives which are in turn supplied to farmers in the district. Farmers could obtain the required amount of seed in terms of credit and cash base. DAs assess and identify whether

farmers can purchase seeds in cash or credit base by collaborating with other development teams and rural *kebele* administrators. Then, a list of farmers based on their purchasing ability would be submitted to multipurpose cooperatives.

Before 2016, cooperatives provide seeds for smallholder farmers on both credit and cash bases. Farmers who took seed in credit base are allowed to pay from 0 to 50% of the total cost. After the 2016 production season, the multipurpose cooperative submits the list of farmers who could purchase seed in cash or credit base. The one who had purchasing power on a cash basis could obtain coupons from ACSI and is allowed to take seeds from cooperatives. The one who had the ability to pay 50% of the total cost could be supported by ACSI to get seeds in credit base from cooperatives. In formal system seed distribution, DAs collect seed needs in terms of crop variety and quantity from individual farmers and submit them to the cooperatives. Economically, incapable farmers who obtained seeds via the support of governments or NGOS development team were identified and submitted to cooperatives via *kebele* leaders. After all, cooperatives distribute improved seed for verified economically poor farmers.

The regional government compares and selects unions that deliver improved bread wheat seed for multipurpose cooperatives at low transportation costs. The government allocates seeds produced by private and government-owned seed companies as well as cooperative unions for farmers. DAs in *woreda* office of agriculture collect farmer demands on improved seed varieties which fulfill the level of the standard submit to the regional government. After all, the regional government allocates the company and writes the letter to the union and the union takes seeds and distributed them to cooperatives. Regional unions know seed suppliers' companies that have an agreement with the regional government. Finally, cooperative unions purchase or facilitate the purchase of this seed and distribute it to smallholder farmers through multipurpose cooperatives. This result is in line with the finding by Dawit Alemu and Rob Tripp [21].

**3.8. Challenges of Formal Seed Distribution System.** Some of the challenges faced by the formal seed distribution system after conducting a focus group discussion (FGD) were planning problems by cooperatives, skyrocketed price of improved seed, lack of timely supply, lack of certified seed suppliers, late delivery of improved seed, and shortage of seeds amount. Challenges of seed distribution explained by cooperative unions are that cooperatives plan less quantity of improved seed due to farmers' demand from the year-to-year decrease. This is because cooperatives did not supply improved seed on time. Other challenges explained during focus group discussion were in line with challenges described by the woreda office of agriculture which includes an unpreferred supply of seeds, high price, late delivery of seeds, voluntary absence of cooperative workers during farm season, and the like. Late delivery of seed resulting in overstock of improved seed in the store which exposes cooperatives to high storage cost and the seed being left over

in the store were the frequent challenges faced by formal seed distribution channels. The reasons for seed being left over in the storage area were demand-driven seed not being supplied for smallholder farmers, lack of on-time seed supply, lack of committed cooperative workers during farm season, and unfair price of improved wheat seed.

**3.9. Major Problems of Purchased Seed from Local Market (Informal Seed Distribution System).** The major problems that producers faced from purchasing of informal suppliers were poor quality, being mixed with other grains, high and unfair price, and lack of sufficient amount which was the major one (Table 5). Table 5 shows that 93% of the respondents confirmed that the local seed market price existed with not only the problem of the seed quality but also high and unfair seed price. There was also a clear market price difference between the local seed market and the local grain market. The price of the local seed market was 1440 Birr per quintal whereas the price of the grain market was 1224 Birr per quintal. The price difference between the seed in the market was 216 Birr. Another finding indicates that obtaining the required type and quantity of seed in the market was not a problem for smallholder farmers in the study areas but the quality was a matter. This finding shows that the limited supply of formal seed supplies and the informal seed suppliers were dominated; as a result, productivity is dropped and producers were discouraged to improve their livelihoods.

**3.10. Evaluation of Seed Distribution System in the Study Area.** Some of the criteria to evaluate the seed distribution system in the study areas were conducted by incorporating all concerned bodies including DAs, WBOA, and all cooperative workers. In addition, whether farmer demand for improved seed is submitted to WBOA by DAs, seed supply time, and cooperative working structure within seed distribution system were also evaluated. As compared to the previous seed distribution system, the current distribution system was good and sprightly. In addition, whether the seed variety allocated by WBOA is based on farmers' demand, supply time, cooperative plan to supply seed, price of seed, and current seed distribution system were evaluated. Among these evaluation criteria, the current seed distribution system was not efficient because it is a long chain; as a result, the seed distribution system should be changed to direct seed marketing (DSM).

**3.11. Seed Distribution Time in the Study Area.** A large proportion (68.7%) of sample respondents revealed that improved seed was not distributed timely in the study areas (Figure 1). This indicated that a large number of sample respondents did not use improved seed because bread wheat or common wheat seed was not distributed timely.

Table 6 indicates that seed quality problem occurs in the study areas in both formal and informal seed distribution systems. The major problems faced by sample households in both formal and informal seed distribution systems were

TABLE 5: Major problems of purchased seed from the local market.

Problems	Frequency	Percent
Poor quality and mixed with other grains	150	90
High and unfair price	150	93
Unable to get the right amount	150	13

Source: own computation from survey result, 2019.

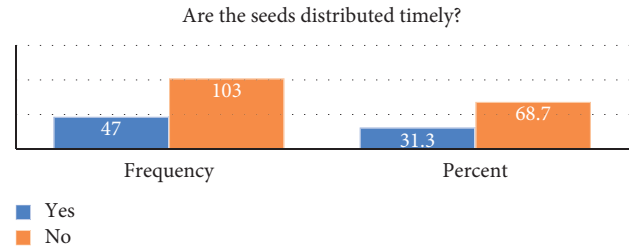


FIGURE 1: Seed distribution time in the study areas.

TABLE 6: Seed quality problem occurring in the study areas.

Seed quality problems	Formal		Informal	
	Frequency	%	Frequency	%
Attacked by insect			101	100
Infected by mold			101	100
Not fully matured			101	100
Mixed with weed	49	100	101	100
Seed germination	49	100	101	100
Broken seed	49	100	101	100

Source: own computation from survey result, 2019.

broken seed, lack of seed germination, being attacked by insects, being infected by mold, not being fully matured, and adulterated seed with weed. In addition, broken seed and lack of seed germination were the major seed quality problems faced by sample households. Seed distribution by the formal system was a long chain, and there was no accountable person when seed quality problems occurred.

**3.12. Econometric Data Analysis.** In this section, selected explanatory variables were used to estimate the binary logistic regression model. The binary logistic regression model was fitted to estimate the effect of hypothesized explanatory variables on the probability of farmers to select/use formally or informally seed distribution systems.

**Goodness-of-Fit Test.** Goodness-of-fit (GOF) tests help to decide whether the model is correctly specified. If it is high, then your model passes the test. Before using the relation of explanatory variables in the logit model, the fitness of the data was checked by using the Hosmer-Lemeshow test. After conducting the logit model, the result of the goodness-of-fit test of the data was undertaken by the Hosmer-Lemeshow test. Then, the Hosmer-Lemeshow test of the result shows that  $\chi^2(8) = 5.23$ , the number of observations = 150, and  $pro > \chi^2 = 0.7328$ .

Being statistically significant in the Hosmer-Lemeshow test is not an indication of the goodness of fit of the model; rather, it shows that the logit model has zero goodness of fit.



This means that if the Hosmer-Lemeshow test result of  $\text{pro} > \chi^2$  value is greater than 0.05 (5% of significance), it indicates that the null hypothesis is accepted and rejects the alternative. Therefore, from this study, as shown, the Hosmer-Lemeshow test of  $\chi^2$  (8) = 5.23 and  $\text{pro} > \chi^2 = 0.7328$  is greater than 0.05 (5% of significance), where the null hypotheses accepted and proved that the logit model has the goodness of fit and is adequate for the data.

**3.13. Determinants of Farmers to Participate in Bread Wheat Seed Distribution System.** This section defines the response and potential explanatory variables employed in the econometric model (bivariate logit model). There was a list of responses and explanatory variables whether or not the farmer selected a formal bread wheat seed distribution system. Eleven explanatory variables were selected and used in this study. Based on the model results, out of eleven hypothesized variables, six variables were statistically significant at 0.01 (1%), 0.05 (5%), and 0.1 (10%) probability level in the model while the rest were not significant (Table 7). Table 7 shows that education, access to credit, distance, household income, extension service, and seed quality were the six variables that were significant in the model.

Number of observations = 150; Log likelihood = -20.90; wald  $\chi^2(11) = 58.20$   $\text{prob} > \chi^2 = 0.000$ ; pseudo  $R^2 = 0.7785$ ; Note: \* significance at 10% level, \*\* significance at 5% level, and \*\*\* significance at 1%.

**Education (Edu).** The model results indicate that the education category of the sample household positively and statistically influences selection decisions in the formal seed distribution system at a 5% significant level. It suggests that being literate increases the likelihood of selecting a formal seed distribution channel by 72% as compared to illiterate sample households. Ersado et al.[22] in their study on productivity and land enhancing technologies in northern Ethiopia have found that more educated household heads were well informed and receptive, which translates into a higher likelihood of engaging in new technologies. Hence, their result revealed that education would help households to perceive the problem of not selecting an informal seed distribution channel and encourage them to select a formal seed distribution system. Hence, the higher their education level, the more likely the farmers to select a formal seed distribution system.

**Access to Credit.** Access to credit in the study areas positively and significantly influences the selection of formal seed distribution system at a 1% significant level. If the sample household had access to credit, the probability of selecting a formal seed distribution channel would increase by 33.4% as compared to those households lacking access to credit keeping the effect of another variable constant. The result was in line with Anik and Salam [23] which revealed that farmers with access to credit are more capable of accumulating capital than their counterparts who do not have access to credit which help them to select formal seed distribution channel.

**Distance (dist).** The logit regression model result revealed that distance from the seed distribution area statistically and

TABLE 7: Estimation results of bivariate logit mode.

Variables	dy/dx	St. error	Z- value
Age	-0.309	.3080475	-1.003
Education	0.72**	0.3237457	2.223
Access to credit	0.34***	0.0950	3.579
Distance	-0.82***	0.2280111	-3.596
Household income	.747***	.292	2.558
Extension contact	0.65*	.3582695	1.8143
Farmer experience	-0.20	.1995967	-1.002
Transport access	0.15	.126307	1.1876
Seed quality	0.712***	0.16367	4.35
Land size	-0.46	.8014001	0.57428
Input cost	.117	.9152867	0.1278
Constant	-3.80	1.413016	

Source: own computation from survey result, 2019.

negatively influences the selection of households on formal seed source at a 1% significant level. The result of the model shows that a unit change of the distance from the seed distribution area would decrease the selection of formal seed distribution system by 82% keeping other variables constant. This implies that when the distance of the respondents is far apart from the formal seed distribution area, the adoption of a new seed variety from the formal seed distribution system would decrease. As confirmed by Hassen Beshir et al.[24] and Bayissa Gdefa [25], an increase in the market distance between farmers' residences and the market center decreases the adoption and intensity of the use of improved technologies.

**Household Income (hhincom).** Household income was strongly related to selection decisions in the formal seed distribution channel. The logit model result revealed that household income statically and positively influences the household preference of formal seed distribution system at a 1% significant level. If the household heads' income increases by a unit, the probability of selecting a formal seed distribution system would increase by 0.002% keeping other variables constant. The possible reason could be that the household income was found to be the main source for purchasing improved agricultural technology in the study areas. According to Hassen Beshir et al.[24] and Brkalem Sewatek [26], households with relatively higher off/non-farm income are expected to better adopt improved agricultural technologies.

**Extension Contact (ext).** The logit regression result revealed that extension contact was the factor that significantly and positively affects the household decision on selecting a formal seed distribution system. If the extension contact increases by a year, the probability of selecting a formal seed distribution system would increase by 65% keeping other variables constant. This is due to the fact that extension service is the backbone of Ethiopian agriculture and determines the benefit of smallholder farmers derived from extension service in the study areas. The frequency of extension contact with extension agents also increases the availability of information about improved technologies and affects positively and significantly the adoption of the decision of farmers [27].

*Seed Quality (sequ).* The results from the logit regression model suggested that seed quality of bread wheat seed was a factor influencing the participation of farmers in the formal seed distribution system. Farmers who had access to quality seed had a 71.20% more probability of selecting a formal seed distribution system than others, keeping all other factors constant. In order to make use of the technologies, farmers should be able to get seeds either in the formal or informal distribution systems. Ghimire [28] showed that institutional variables such as quality seed availability significantly and positively affect the incidence of adoption of improved technologies.

#### 4. Conclusions and Recommendations

*4.1. Conclusions.* The use of different critical inputs in farms like fertilizer, improved seed, and farm equipment will bring improvement of crop productivity. Among these, seed is one of the most important inputs. So as to improve the productivity of agricultural produces, farmers need to have easy access to improved seeds of the right type, at the right time, at the right place, at a reasonable price, and with the right formal seed distribution system. Various exogenous and endogenous factors were affecting the selection of the bread wheat seed distribution system in the study areas. Therefore, this study is initiated to analyze the seed distribution system and determinants of smallholder farmers in selecting seeds of bread wheat (common wheat) distribution system in Womberma district. The survey result shows that the contribution of public companies for supplying improved bread wheat seed was only 33% whereas the 100% of producers confirmed that sources of bread wheat seed were from farm saved and local market which were uncertified leading to production deterioration. In addition, other challenges faced by formal seed distribution system were planning problems by cooperatives, skyrocketed price of improved seed, late delivery of improved seed, and shortage of seed quantity whereas the major problems that producers faced from purchasing of informal suppliers were poor quality, being mixed with other grains, high and unfair price, and unable to get the right amount which was the major one. Due to this reason, the current seed distribution system was not efficient because it is a long chain; as a result, the seed distribution system should be changed to direct seed marketing.

In addition to these, the result of the binary logit model indicates that seed quality, educational level, extension contact, access to credit, and household income were statistically and positively significant whereas distance from seed distribution areas influences negatively the probability to select the distribution system of bread wheat seeds. Generally, the limited certified seed suppliers as well as long chain seed distribution system were inefficient for the formal seed distribution system in the study areas.

*4.2. Recommendations.* Based on the findings, the possible recommendations were forwarded:

Extension contact is important for getting technical support and easily managing newly introduced

agricultural technologies to increase the production of bread wheat. Therefore, any concerned bodies should create a conducive environment to train the extension workers intensively and extensively. As a result, the extension workers support smallholder farmers by giving short-term training for using formal seed distribution systems widely.

Distance from seed distribution area was negatively and significantly related to the selection of formal seed distribution system. Therefore, the government increases the number of primary cooperatives which distribute bread wheat seeds directly to farmers in groups with the nearest areas to access reliable markets for bread wheat seed variety.

Household income influenced positively and significantly the selection of formal seed distribution systems. Therefore, farmers should engage in off-farm activities like petty trade, beef fattening, dairy farms, sheep fattening, and poultry farms to generate off-farm income and on-farm income.

Seed quality influenced positively and statistically the selection of formal seed distribution system with the expected result. Therefore, the government and non-government organizations should support and organize both private and public seed multiplier organizations so that smallholder farmers would prefer formal seed distribution channels and follow strong monitoring and evaluation seed distribution system.

Education influenced the selection of formal seed distribution systems positively and statistically. Therefore, any concerned bodies need to increase the awareness creation of farmers about the importance of using improved bread wheat seed varieties using informal seed distribution system in the study areas.

Access to credit had a statistical and positive influence on the selection of a formal seed distribution system. The provision of credit plays a significant role in solving farmers' cash problems. Therefore, the government should strengthen and promote access to credit service providers in the district for solving the farmers' cash problem.

The contribution of public bread wheat seed supplier was only 33% and producers' sources of bread wheat seed from the local market as well as from their own farm were saved. Hence, any concerned body should strengthen and support certified bread wheat seed suppliers so as to increase production and productivity which improves the smallholders' livelihoods as well.

#### Acronyms

ACSI:	Amhara Credit and Saving Institution
BOA:	Bureau of Agriculture
DA:	Development agent
DSM:	Direct seed market
ESE:	Ethiopia Seed Enterprise
FGD:	Focus group discussion



GDP: Gross domestic product  
 HHs: Households  
 MOA: Ministry of Agriculture  
 NGO: Nongovernmental organization  
 WBOA: Woreda Bureau of Agriculture  
 WAO: Woreda Agriculture Office.

## Data Availability

The data used to support the findings of this study will be available upon request from the corresponding author.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Authors' Contributions

The authors spent their time writing a proposal, collecting data, searching secondary data within the complicated condition of getting an Internet connection, self-sponsoring research budget, analyzing, and writing up the final manuscript.

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