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Research Article

Analyzing Potato Market Participation, Market Surplus, and Market Outlet Choice on Small Farm Household Level in Lemo District, Southern Ethiopia

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This study was aimed to analyze potato market participation, market surplus, and market outlet choice in Lemo District of southern Ethiopia. To achieve the objective, primary and secondary data sources were employed and 202 potato producers were selected following simple random sampling techniques. The collected data were analyzed by using Heckman second-stage and multivariate probit models to identify factors that determine potato market participation decision and potato farmer market outlet choice, respectively. The Heckman's first-stage (probit) result indicates that education level, sex, membership in the cooperative, distance to the nearest market, remittent from family members, own transportation facilities, seed types, frequency of extension contact, lagged market price, and amount of credit that farm household used for potato production significantly ($P <$) determined producers' participation in potato market. Heckman second-stage (OLS) result showed that education level, cooperative membership, family size, total cropland size, oxen owned, types of seed, and lagged market price were significantly ($P <$) determined potato marketed surplus. Multivariate probit results showed the probability to choose wholesalers ($P <$), retailers ($P <$), collectors ($P <$), and consumers ($P <$) market outlets who were significantly affected by age, educational levels, sex, farm experiences, distance to near market, family size, remittance, land size, product supplied to the market, own transport facility, and extension service. Therefore, we recommend that the government and concerned stakeholders should focus on promoting improved potato seed, encouraging education, promoting farmers' cooperatives, empowering females, strengthening rural-urban infrastructure, and protecting informal labor trading.

1. Introduction

Agriculture is the major driver of economic growth, and it contributes about 31.2% of GDP, 65.33% of employment, and 79.24% of the population lives in rural areas that rely on agriculture for their livelihoods. In the 2019/20 budget year, the Ethiopian government committed to 38.8 percent of expenditures to the whole economy from this, and 15.5 percent of the expenditure is for Agricultural and Rural Development activities [1]. According to [2] report, the agricultural sector also covers over 87 percent of export value. In addition, the sector is given an overriding focus in the government's plan for the growth of the economy as a whole.

Ethiopian government gives great emphases for small-scale commercial farmers by following the development of irrigation for vegetable production [3]. Recently, because of their high nutritional value, vegetables are in high demand in both local and foreign markets and are classified among those export commodities that generate considerable amount of foreign currency earnings to the country [2]. As a matter of this fact, farms in Ethiopia used to grow vegetables over a considerable land area for years. Vegetable production provides a source of income for the smallholder farmer

as well as an important source of food security for the people of Swaziland, thereby reinforcing the overall development of poverty reduction goals [1].

Potato (*Solanum tuberosum* L.) is one of the leading vegetable crops in Ethiopia [4], and it is nutritionally considered a well-balanced major plant food ranging from the macrocomponents to micronutrients. The basic reason for this is its high yielding ability in a short season; the presence of suitable agro-ecological zones; the availability of labor for its production on large areas of land; and the accessibility of a potential market with considerable benefit, and potato is an important food and cash crop as income sources in Ethiopia [5]. Potato and onion/shallot are the most commonly marketed vegetables accounting for about 60% and 20% of the marketed products. The other products such as cabbage, beetroots, carrot, garlic, green pepper, and tomato are marketed at relatively smaller quantities by few farmers [6]. According to [7], low-value activities for potato take place at the farmers, brokers or wholesalers, retailers, and even consumer levels. Moreover, potato tubers' crop has significant importance with the potential for domestic and export markets and industrial processing. However, the production, marketing, and consumption of potatoes are restricted due to improper postharvest handling. Similarly, Abraham [8] stated that limited access to the market, low price of the product, lack of storage, lack of transport, low quality of the product, and lack of policy framework to control the illegal trade route are the major marketing problems. Potato has been considered as a strategic crop by the Ethiopian government aiming at enhancing food security and economic benefits to the country through improving the production and productivities of potatoes [9]. Only focus on improvement in production and productivities of potatoes is not sustained food security issues, so creating demand-driven market outlet choice is a critical one to improve the livelihood of smallholder potato producers and is required to meet the growing food demand.

Many scholars [8–10] have conducted their research on potato market participation and market supply, but those did not assessed some very critical independent variables such as remittance, effect of improved seed, and the factors affecting market outlet choice of potato producers by using a multinomial logit model [10]. Accordingly, the researchers considered four channels, wholesaler only, cooperatives only, the collector only, retailers only, and any combinations of four. The gap was that producers may choose consumers' market outlet choices, and another gap is that producers also may choose different channel choices simultaneously to sell their products. The productivity of potato was reported as 17.58 tons/hectare [11] and 21 tons/hectare [12]. Still, potato is produced mostly for local consumption and the local market [5] in Ethiopia including study area. Therefore, this study identified and analyzed the gap that currently facing in a study area through analyzing potato market chain analysis and market outlet choice.

1.1. Conceptual Framework. Conceptual framework in this study was constructed from different kinds of literature reviewed. The conceptual framework of this study is presented in Figure 1. Description of the dependent variable includes market participation, marketed surplus, and market outlet choice; demographic factors include age, sex, education level, farm experience, and family size; economic factors include remittance, farm size, own transport facility, number of oxen, and institutional factors such as access to market credit source, extension service, and provision of improved seed; and social factors include cooperative and lagged market price.

2. Materials and Methods

2.1. Description of the Study Area. This study was carried out in the Lemo district, which is located at about 232 kilometers far from Addis Ababa to the south on the road running from Addis Ababa to Wolaita Sodo and 208 kilometer away from Hawassa, the capital city of Southern Nations, Nationalities, and Peoples Regional State. The district is bordered by the north with Silte Zone, by the south with Kembata Tembaro Zone, Gombora district of Hadiyya Zone in the northwest, Anlemo district of Hadiyya Zone in the northeast, and Shashogo district of Hadiyya Zone in the east. The district lies between 7°.14′ to 7°.45′ north and 37°.05′ to 37°.50′ east with an altitude range of 1990 to 2720 m.a.s.l. The mean annual rainfall was between 700 mm and 1226 mm, and the mean annual temperature was between 15°C and 20°C [12].

The major livelihood strategy in the study area is mixed farming system in terms of crops and livestock. Major root crop components of the area are covered by potatoes [13].

2.2. Data Type, Sources, and Methods of Data Collection. Both quantitative and qualitative data were collected using primary and secondary data sources. Primary data were collected from potato value chain actors by recruited enumerators who fulfilled minimum requirements like those were familiar with study area, they can translate the English language to local language, and those were trained about the objectives of the study with the supervision of the researcher. Secondary data were collected from books, journals, thesis (different research reports), and CSA based on their relevant to this study. Three focus group discussions were undertaken following checklists that were used during data collection to triangulate the accuracy of the collected data from the individual interview. The focus group discussion participants were selected from each sample kebele, and also deep interview (key interview) was conducted to cross-check the collected data.

2.3. Sample Size and Sampling Procedures. From 20,533 households, 202 potato producers' sample respondents were selected by using simple random sampling technique from existing lists in the district. The sample size of potato producers was determined by using [14] formula as follows:

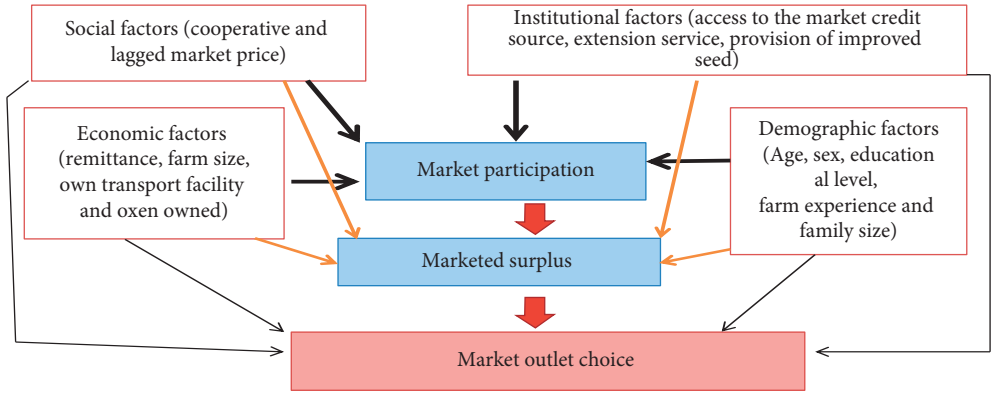

Figure 1: Conceptual framework of the study. Source: Adopted from review of different literatures (2021).

$$n = \frac{N}{1 + N(e2)}, \tag{1}$$

$$n = \frac{20533}{1 + 20533(0.07)^2} = 202, \tag{2}$$

where n is the sample size, N is the total potato producer households in selected kebeles, and e is the level of precision (0.07). Finally, proportion to population size was employed to select the sample households from each selected kebele .

2.4. Method of Data Analysis. In this study, both descriptive and econometric analyses were employed to data analysis. Descriptive statistics such as frequencies, percentages, means, t-test, $\chi 2$-test, and standard deviations were used to analyze the collected data.

2.4.1. Factors Affecting Market Participation and the Marketed Surplus of Potato. To identify factors affecting market participation and the marketed surplus of potato products in the study area, Heckman's sample selection model was used. In the first stage, the Heckman model attempts to capture participation decisions. This equation is used to construct a selectivity term known as the "inverse Mills ratio," which is added to the second-stage outcome equation that explains factors affecting the quantity of marketed surplus. The inverse Mills ratio is a variable, which is used to control bias due to sample selection [15]. The second stage involves including the Mills ratio to the quantity of marketed surplus equation and estimating the equation using ordinary least squares (OLS). If the Mills ratio is significant in the model, there are some unobserved variables in the participation equation, which is confirmed. After the inclusion of this extra term (lambda), the coefficient in the second-stage selectivity corrected equation is unbiased [16]. Specification of the Heckman two-stage model is written in terms of the probability of potato product producer's market participation (Y1i) and marketed surplus (Y2i). The participation/binary probit model is specified as follows:

$$Y_{1i} = X_{1i}\beta_{1i} + u_{1i}u \sim N(0,1), \tag{3}$$

$$PMP = 1ifY > 0, \tag{4}$$

$$PMP = 0ifY \leq 0, \tag{5}$$

where Y_{1i} is the latent dependent variable, which is not observed; X_{1i} are vectors that are assumed to affect or independent variable of the probability of sampled household potato market participation; β_{1i} is a vector of an unknown parameter in the participation equation; and u_{1i} are residuals that are independently and normally distributed with zero mean and constant variance.

2.5. The Observation Equation/the Marketed Surplus Equation

$$Y_{2i} = X_{2i}\beta_{2i} + \mu_i\lambda_i + \eta_i, \tag{6}$$

where Y_{2i} is the quantity of potato marketed in the second step; X_{2i} are the explanatory variables determining the quantity marketed; β_{2i} are unknown parameters that shows estimation in the quantity marketed; μ_i is a parameter that shows the impact of selectivity bias on the quantity marketed; and η_i is the error term.

$$\lambda i = \frac{(f(X_1\beta_1))}{(1 - f(X_1\beta_1))}, \tag{7}$$

where $f(X\beta)$ is a density function and 1-f ($Xi\ \beta i$) is a distribution function.

$$\begin{aligned}\text{Marketed surplus} = {} & \beta 0 + \beta 1\ \text{Age} + \beta 2\ \text{Education} \\ & + \beta 3\ \text{SEX} + \beta 4\ \text{COOPMR} \\ & + \beta 5\ \text{DNMARKET} + \beta 6\ A\,du\,ltequ \\ & + \beta 7\ E\ \text{Retance} + \beta 8\ \text{FSIZE} \\ & + \beta 9\ \text{transport} + \beta 10\ \text{oxen} + \beta 11\ \text{Seed} \\ & + \beta 12\ \text{EXTENSION} + \beta 13\ \text{LPRICE} \\ & + \beta 14\ \text{ACREDIT} + \mu i\lambda i + \eta.\end{aligned} \tag{8}$$

It means that marketed surplus is dependent variable, and other variables those found in right side from the equation are independent variables. Before fitting important variables into the Heckman two-stage selection model, it is necessary to test whether it was checked.

2.5.1. Econometric Model for Potato Market Outlet Choice Determinants. Producers' decisions to participate in a given market derived from the maximization of expected utility from these markets and help to reduce some risks than a single market channel [17]. Econometric models such as multivariate probit/logit and multinomial probit/logit are useful models for the analysis of categorical choice-dependent variables. Multinomial models are appropriate when individuals can choose only one outcome from the set of mutually exclusive and collectively exhaustive alternatives. However, in the study area, there are several market outlets (wholesalers, collectors, retailers, and consumers) and farmers who can select more than one outlet simultaneously to maximize the expected utility, and due to this, there are some overlapping and many farmers sell to more than one market outlet. So, the study adopted the multivariate probit (MVP) econometric technique to simultaneously model the influence of the set of explanatory variables on each of the different market channel choices, while allowing the unobserved and/or unmeasured factors (error terms) to be freely correlated, as well as the relationships between the choices of different market outlets [18].

The observed outcome of market channel choice can be modeled following random utility formulation. We consider the i^{th} farm household ($i = 1, 2, 3, \ldots, N$), facing a decision problem on whether or not to choose the available market. Let U_k represents the benefits of farmers to choose the *mth* market outlet where m denotes the choice of wholesaler (Y_1), retailer (Y_2), collector (Y_3), and consumer (Y_4). The producer decided to choose the m^{th} market outlet if $Y^* = Uk^* - U0 > 0$. The net benefit (Y_{im}^*) that the farmer derives from choosing a market outlet is a latent variable determined by observed explanatory variable (Xi) and the error term (ε)

$$\text{Yim} = \beta\text{im}X\text{im} + \varepsilon\text{im}Y\text{im} = \begin{cases} 1, & if\ y > 0 \\ 0, & \text{Otherwise} \end{cases}, \quad (9)$$

where Y_{im} ($m = 1, 2, \ldots 5$) denotes the market outlet choices, Y_1 for wholesaler, Y_2 for retailer, Y_3 for the collector, and Y_4 for the consumer (available for i^{th} potato producer ($i = 1 \ldots .n$)); Xim *is a* vector of explanatory variables, β_{im} denotes the vector of parameters to be estimated, and ε_{im} are random error terms distributed as a multivariate normal distribution with zero mean and variance-covariance matrix V.

3. Results and Discussion

3.1. Characteristics of the Sample Households. As presented in Table 1, of 202 sampled potato-producing households, 156 were both product producers and market participants and the rest 46 households were only potato producers.

The survey result indicates that except all continuous variables such as age of household head, educational level, distance to the nearest market, family labor force, total cropland size, oxen owned by a farmer, access to extension service, and amount of credit used was considered in this study. All variables except age of respondents were statically significant mean difference between participant and nonparticipant in the market. A positive relationship was only observed in the variable distance to market.

As shown in Table 2, the $\chi 2$ test revealed that there was a statistically significant proportion difference between market participants and nonparticipants in terms of sex, membership in cooperative, access to remittance, own transportation facilities, types of seed they used, and lagged market price.

3.2. Determinants of Market Participation Decision and Marketed Surplus. Potato products are produced for both market and household consumptions in the study area. Social, economic, institutional, and demographic variables are assumed to determine potato product market participation and marketed surplus by sampled potato producer households.

Heckman's selection model was employed to identify market participation and marketed surplus. Before running the Heckman two-stage model, the hypnotized predicted variables were checked for the existence of a multicollinearity problem. The computed values of VIF and CC were found to be very low compared with their respective critical values (<10 for VIF and <0.75 for CC), which revealed the absence of a severe multicollinearity problem among these potential explanatory variables.

The variables were also checked for the presence of heteroscedasticity in the data by using Breusch-Pagan/Cook-Weisberg (chi^2 (1) = 97.75; prob > chi^2 = 0.00), and the test result shows that there was a heteroscedasticity problem. This problem can be overcome by using robust Heckman two-stage results; for model result, interpretation robust results were employed.

3.2.1. Determinants of Potato Market Participation. In the first stage of Heckman, the household decides whether they would be a potato seller or not. The decision to participate in the potato market was estimated by a robust first-stage Heckman estimator. Fourteen potential predictor variables (six dummy and eight continuous) were selected and entered into Heckman's first-stage model. The results of the study indicate that the Wald test of the hypothesis that all regression coefficients are jointly equal to zero is rejected at the 1% significance level in potato. This test result shows that, jointly, the independent variables included in the probit regression model explain the variations in a household's probability to sell potato.

(1) The educational level of household head. Educational level of the household head had a positive and significant effect on market participation decisions at a 1% significance level. This might be due to educated households that may calculate the

Table 1: Two potato market participations and weighted mean comparison test of continuous variables.

Continuous variable	Mean			t-value
	Nonparticipants ($n = 46$)	Participants ($n = 156$)	Total ($n = 202$)	
Age of household head	48.61	47.33	47.62	0.699
Educational level	2.087	7.481	6.252	−10.440***
Distance to the nearest market	72.152	43.628	50.124	7.737***
Family labor force (adult equivalent)	4.489	5.455	5.235	−3.036***
Total cropland size	0.832	1.508	1.354	−5.666***
Oxen owned by a farmer	1	2.135	1.876	−7.331***
Access to extension service	0.565	2.365	1.955	−10.966***
Amount of credit used	0	1728.205	1334.653	−2.533**

Note. *** and ** show statistically significant level at 1% and 5%, respectively.

Table 2: Two-group mean comparison test of dummy variables.

Variable	Categories	Nonparticipant (46)	Participant (156)	$\chi 2$
Sex of household head	Male	34 (74%)	141 (90.38%)	8.32***
	Female	12 (26%)	15 (9.62%)	
Member of cooperative	Yes	2 (4.35%)	34 (21.8%)	7.38***
	No	44 (95.65%)	122 (78.2%)	
Effect of remittances	Yes	17 (37%)	108 (67.23%)	15.69***
	No	29 (63%)	48 (32.77%)	
Own transportation facilities	Yes	10 (21.74%)	120 (77%)	47.16***
	No	36 (78.26%)	36 (23%)	
Types of seed they used	Improved	4 (8.70%)	126 (80.77%)	80.45***
	Local	42 (91.30%)	30 (19.23%)	
Lagged market price	Good	5 (2.17%)	64 (41.03%)	14.3***
	Bad	41 (89.13%)	92 (58.97%)	

Note. ***shows statistically significant level at 1%.

cost and benefit based on the market price trend. In the study area, the price trends are increasing for potatoes from time to time; on that trend, more educated household heads are more participants in the market. This finding parallel with [19] educational level affects potato market participation positively and significantly.

(2) Sex of household head. The sex of the household head had a negative and significant effect on potato market participation decision at a 1% significant level. In the study area family, livelihood obligations might be common for both sex household heads, but male household heads have more capability to get additional income than female household heads to pay those expenses. For that reason, female household heads are more market participants than male household heads. This result is in line with the result of [20] being a male household head, which was found to exert a negative impact on Koch and bulla market participation.

(3) Membership in cooperative. As expected, this variable had a positive relationship with household head potato market participation decision, and it was found to be statistically significant at a 5%. Being a member of the cooperative motivates farmers to participate in the market through networking and the provision of up-to-date information to members. This finding in line with findings by [21] found that being a cooperative member can affect the women in market participation for soybean positively.

(4) Distance to the nearest market. As expected, market distance had been negatively and significantly associated with the household head participating in the potato market and statistically significant at 1%. The closer the market, the lesser would be the transportation charges, reduced walking time, and reduced other marketing costs, better to access market information and facilities. This result in line with the result of [22] revealed that distance to the market affects the supply of wheat by smallholders in Ethiopia revealed negatively.

(5) Effect of remittances. As expected, it had been positively and significantly associated with the household head to participate in the potato market and statistically significant at 5%. According to kebeles' key informant interview, household head remittent was more market participants than other remittent family members after he/she comes back. The reason for this was that they are more aware of technology transfer with additional income. This result in line with [23] nonfarm income from remittance exhibited positive effects on farmer market participation on Farm Households' Food Security.

(6) Own transport facility. It was similar to prior expectation that own transport facility for household heads had positive and significant effects on potato market participation decision at 1%. The finding corroborates that of [24] who found that in determinants of market participation and intensity of marketed surplus of teff producers in Bacho and

Dawo districts of Oromia State, Ethiopia, own transport facility affects teff market participation significantly and positively.

(7) Types of seed they used. Types of seed that farm household head used had positive and significant effects on household head potato market participation decision at a 1% significance level. Using improved seed varieties was associated with a high productivity level than that of local varieties. If there is a highly productive yield, this leads to more market participation. This result confirms with findings by Reference [25] that improved potato seed affects the probability of the potato market participation positively.

(8) The number of extension visits. It had been a significant and positive effect on the household head farmers' market participation decision at a 5% significance level. This could be attributed to the fact that an increase in the number of extension visits would avail up-to-date information regarding agricultural technologies that might improve productivity, and therefore, it increases the probability of market participation. This study similar to the study undertaken by [26] indicated that the number of extension visits from government workers had a positive and significant effect on the decision to participate in the market.

(9) Lagged market price. Lagged market price had a positive and significant effect on market participation decisions at a 5% significance level. Most of the time farm household heads expect that if the last year's price for potato products was good, the probability for potato market participation is the increase this year. This result similar to the result found by [27] indicated that the lagged market price has a positive and significantly affects teff market participation.

(10) Amount of credit used. As expected, the amount of credit used by farm household heads was positively and significantly influences the likelihood of farmers in market participation at less than a 1% significance level. The findings of [28] hinted that access to credit had a positive and significant impact on producers' likelihood to participate in the potato market because the availability of credit reduces transaction costs of both input and output markets (Table 3).

3.2.2. Determinants of Potato Marketed Surplus. Heckman's second-stage estimation identifies the significant factors that determine potato marketed surplus by using the selection model, which included the inverse Mills ratio calculated from a maximum-likelihood probit estimation of potato market participation decision. The coefficient of the inverse Mills ratio (Lambda) in the Heckman two-stage estimation is significant at the 1% probability level (Table 4). This indicates the existence of sample selection bias, which is the existence of some unobservable farmer characteristics determining farmer's likelihood to participate in the potato market, thereby affecting the extent of marketed surplus. The positive sign of the inverse Mills ratio shows that there are unobserved factors that are positively affecting both participation decision and marketed potato volume. Rho (p) is the correlation between the error terms of the substantive and selection models. Rho features a potential range between −1 and +1 and might give some indications of the likely range of selection bias. A correlation with a definite quantity of 1 would occur if the regression coefficients of the selection model and also the regression coefficients of the substantive model were estimated by identical processes (i.e., potential selection bias). The overall goodness of fit of the model parameter estimates is assessed based on the Wald chi-squared test. The null hypothesis for the Wald chi-squared test is that all coefficients are jointly zero. A total of thirteen potential predictor variables (six dummy and seven continuous) were selected and entered into the Heckman second-stage model. To examine what factors determine the sampled household's marketed surplus of potato in the study area, Heckman second-stage model after robust was used because there was a heteroscedasticity problem. From those explanatory variables, the education level of the household head is a membership on cooperative, family size, total cropland size, oxen owned by a farmer, types of seed they used, and lagged market are significantly determined potato marketed surplus.

(1) The education level of household head. As expected, education of household had been positively and statistically significant at less than 1% significance level. As the sample household head education status increases by a unit year, the quantity of potato supplied to the market increases by 1.71 Qt. This suggests that the educated household head is highly potato suppliers to the market because educated farmers have more knowledge and experience that allow them to interpret information about the market. This study in line with [9] who found the educational level of the household head affects the potato market supply positively.

(2) Being a membership in a cooperative. The survey result shows that being membership in a potato cooperative had been a positive and significant effect on household potato marketed surplus at a 1% significant level. Cooperative members get well-updated information, improved seed, and different direct and indirect supports from cooperatives. This makes farmers enable to produce more products and supply to the market. The Heckman second-stage model shows that if a farm household head is a member of any potato cooperative, the quantity of potato that is marketed in the market increased by 12.36 Qt, making other things constant. This finding in line with Reference [9] found that being cooperative membership affects potato market supply positively and significantly.

(3) Family size (adult equivalent). Family size affects the potato market surplus positively and significantly at less than a 10% significant level. It was opposite to prior expectations. The survey result indicates that as family size in adult equivalent increases by one unit the potato marketed surplus increase by 1.96 Qt, making other things constant. When farm household head has a high family size, they used their labor on income generation. By that generated income, they

Table 3: First-stage probit estimation after robust results of the determinants of potato market participation.

Variable	Coefficient	Robust Stand error	Z	Marginal effect
Age of household head	−0.0045	0.0191	−0.23	−0.0003
Education level of the household	0.2795	0.0671	3.08	0.0203***
Sex of household head	−1.736	0.8457	−2.65	−0.1262***
Member of cooperative	1.075	0.5814	2.43	0.0781**
Distance to the nearest market	−0.0251	0.0067	−8.88	−0.0018***
Adult equivalent	0.0182	0.0809	0.22	0.0013
Effect of remittances	0.6966	0.4864	2.01	0.0506**
Total cropland size	−0.3492	0.4125	−0.81	−0.0254
Own transportation facilities	1.932	0.6873	2.72	0.1405***
Oxen owned by a farmer (oxen)	−0.0363	−0.3396	−0.11	−0.0026
Types of seed they used	1.327	0.3852	3.91	0.0965***
Frequency of extension contact	0.6419	0.4012	2.26	0.0467**
Lagged market price	1.474	0.5466	2.37	0.1071**
Amount of credit used	0.0117	0.0002	3.92	0.0008***
Constant	−2.791***	0.7650	−3.65	
Number of observations			202	
Wald chi^2 (13)			158.10***	

Note. ***∗∗∗, **∗∗, and *∗ show statistically significant level at 1, 5, and 10%, respectively.

Table 4: Results of the robust Heckman second-stage selection model for potato market surplus.

Variable	Coefficient	Stand error	Z
Age of household head	−.0420	.179	−0.23
Education level of household head	1.714***	.534	3.21
Sex of household head	1.446	5.139	0.28
Member of cooperative	12.356***	4.628	2.67
Distance to the nearest market	−.082	.055	−1.49
Adult equivalent	1.957*	1.015	1.93
Effect of remittances	−3.890	3.565	−1.09
Total crop land size	13.667***	13.667	3.56
Own transportation facilities	1.199	3.093	0.39
Oxen owned by a farmer (oxen)	13.821***	3.735	3.70
Types of seed they used	8.514***	3.237	2.63
Frequency of extension contact	1.439	1.507	0.96
Lagged market price	13.110***	4.127	3.18
Constant	−61.998***	−14.447	−4.29
Mills lambda (λ)	27.967***	10.895	2.57
Rho	1		
Sigma	19.804	1.931	
Lambda	19.804	1.931	

Note. ***, **, and * show significance at 1, 5, and 10%, respectively.

might rent additional land and other inputs to produce a high amount of potato products, which leads to a high amount of potato supplied to the market. These findings relate to Reference [21] found family size positively affect the supply of soybean by women farmers.

(4) Total croplands that had for farm household head. As it was hypothesized, the size of landholding positively and significantly influences the volume of potato marketed surplus at less than 1% probability. As the area of landholding by farmers increased by one hectare, the quantity of potato-marketed surplus would increase by 13.67 Qt. By Reference [29], this indicated that a unit increase in land allocated for wheat would give rise to an increase in the amount of wheat supplied to the market. Also household farm size exhibited positive effects on farmers' participates in commercialization.

(5) Oxen owned by a farm household head. As expected, the number of oxen that have for the household head was positively and significantly affects the marketed surplus of potato at a 1% significant level in a study area. The result shows that all things make constant, as oxen owned for farm household head increased by one marketed surplus for potato products increased by 13.82 Qt. Reference [30] found that the number of oxen owned by households had a positive and significant effect on the potato marketed surplus.

(6) Types of seed that farm household head used. The use of improved seed varieties had positive and significant effects on potato marketed surplus at less than 1% significant level. The survey result reveals that if the seed of the potato is improved, the potato supplied to the market is increased by 8.51 Qt, making other things constant. Reference [28] found that access to improved seed influence the amount of potato marketed surplus positively and significantly.

(7) Lagged market price. As expected, lagged market price had positive and significant effects on potato marketed surplus at less than 1% significant level. Robust Heckman's second-stage result shows that if the lagged market price for potato products was good, the market surplus for potato products increased by 3.645 Qt, making other variables constant. This indicates that if last year's prices for potato products were changed from bad to good, most farmers facilitated to allocate large land for potato products and they supply a high amount of potatoes to the market. In the study area when compare potato supplied to the market in the lagged year with the survey year, there was a decrement in potato supplied to the market. Reference [27] found that lagged market price has positive and significantly affect teff market participation.

3.2.3. Market Outlet Choice for Potato Producers. In the model result, Wald chi-squared (48) test was significant at the 1%, which indicates that the subset of coefficients of the model is jointly significant and that the explanatory power of the factors included in the model is satisfactory; thus, the MVP model fits the data reasonably well. Likewise, the model is significant because the null hypothesis that the choice decision of the four potato market outlets is independent was rejected at a 1% significance level. The likelihood ratio test in the model indicate that the null hypothesis of market outlet independence is rejected at the 1% significance level, and there are significant joint correlations for two estimated coefficients across the equations in the models.

There are differences in market outlet selection behavior among producers, which are reflected in the likelihood ratio. Statistics of the estimated correlation matrix show that correlation between each pair of dependent variables $p21$ (correlation between the choice for retailer and wholesaler outlet), $p41$ (correlation between the choice for consumer and wholesaler outlet), $p31$ (correlation between the choice for collectors and wholesaler outlet choice), and $p32$ (correlation between the choice for collector and retailer outlet) is negative interdependent and significant at the 1, 1, 1, and 5% probability levels, respectively.

The simulated maximum-likelihood (SML) estimation of marginal success probability for each outlet's result shows that the probability of potato producers' market outlets chooses wholesale, retailer, collector, and consumer, which was 36.54%, 54.48%, 25%, and 37.18%, respectively.

The result in Table 5 shows that out of 12 explanatory variables included in the multivariate probit model that can affect the market channel choice of potato in the district, ten variables had a significant effect on market channel choice. They were the age of household head, educational level of household head, sex of household head, farm experiences, distance to near market, family size of household, remittance, land size allocated for potato, total product supplied to the market, own transport facility, and frequency of extension service, which were found to significantly affect the market outlet choice behavior of potato producers.

(1) Age of household head. The age of the farm household head affected choosing consumers' market outlets positively and significantly at a 10% significant level. The result shows that the aged households are more likely to choose consumers' market outlets. This is due to that the older farmers did not travel too long distances to get other choices in the district market in addition to having a better knowledge of cost and benefits associated with various potato market outlets.

(2) The educational level of the farm household. Household head had a positive and significant effect on market channel choice of a consumer at a 5% significant level but negative effects on market channel choice of collectors at a 5% significant level. The reason is that formal education enhances the information acquisition and adjustment abilities of the farmer, thereby improving the quality of decision making on profitable and productive. This result is consistent with the findings of [8, 31].

(3) Sex of household head. Sex of producer had negative and significant effects on collector channel choice at a 10% significant level, but it had a positive and significant effect on retailer channel choice at a 5% significant level. This is due to the farm household head is female; they might have many duties in their family because they may not select appropriate channels to sell their product. Therefore, female household head simply sold their surplus product to a collector in the local area. And they decrease to sell for the retailer market outlet, which was higher compared with the male household head. This finding is related to Reference [20] who found that male house farmers choose the best market outlets to sell their farm produce.

(4) Farm experience on potato production. Farm experience in potato production affects market channel choice negatively and significantly for collector channel choice and consumer channel choice at a 5% significant level, respectively. This implies that making other things constant if the farm experiences on potato production increase by one year, the probability of farm household head market channel choice for collector and consumer decreased by 1.41% and 1.94%, respectively, because when farm household is more experienced and well known in potato production, he/she produces a huge amount of product, and then, they might choose another channel choice like wholesaler channel choice or retailer channel choice to sell a huge amount of products rather collector or consumer. Finding in line with [24] revealed that the experience of the producer had a positive effect on choosing market outlet choice.

(5) Distance to the nearest market. It had a significant and negative effect on the decision of choosing the retailer market outlet at a 5% significant level. The marginal effect result shows that all other things constant, the probability of choosing to retailer market outlet choice decreased by 0.46 percent to sell if the distances increase by one minute. This is since most producers prefer to sell their products at the farm gate without incurring transaction costs. Delivering potato products to the retailer mostly found in the town area to meet retailers, farm producers should pay transportation cost but they might not interest to pay. Therefore, farm household heads select nearer markets, as well as farms, get channel choice for the potato product sell than retailers channel choice. This study is related to Reference [10] who found that distance to the market significantly affects market channel choice.

(6) Family size (adult equivalent). Household size has a negative and significant relationship with the likelihood of choosing collector outlets at less than a 5% significant level. This result indicates that having more household size has a negative relationship with likely choosing collector outlets. This finding is consistent with the finding of Reference [32] who found that having a large family size was better for delivering output to the final market outlet.

Table 5: Marginal effect after multivariate probit model estimation.

Variable	Wholesaler	Retailer	Collector	Consumer
	dF/dx	dF/dx	dF/dx	dF/dx
AGE	−.0011	−.0082	0.0045	.0101*
EDUC	0.0091	0.0033	−0.0338**	0.0350**
SEX	−.0306	0.3618**	−0.2670∗	−00644
COOP	−.0345	0.0631	−0.1149	−01298
FREXPR ~ E	0.0070	−.00076	−0.0141**	−00194**
DNMARKET	0.0014	−.0046**	−0.00028	0.0043
Adultequ	0.0069	0.0306	−0.0379∗	0.0388
REMITANCE	0.2337**	−.3983***	0.1575**	−0.1378
Farm size allocated	−.0403	0.6241	0.0046	0.0226
Output supplied	0.0140***	−.0086**	−0.00038	−0.0018
TRANOWN	−.2084	0.3328***	0.0544	0.2422**
FXCON	−.0492	0.02213	−0.0177	0.1387***
Wald chi^2 (48) = 120.95***	Likelihood ratio test of $p21 = p31 = p41 = p32 = p42 = p43 = 0$ Log likelihood = −285.080 chi^2 (6) = 48.592***			

Note. ***, **, and * show significance at 1, 5, and 10%, respectively.

(7) Remittance from farm household. It affects potato market outlets' choice. The model result shows that there is a positive effect of remittent on wholesaler and collector market outlet choice, but remittent has negative effects on retailers' market outlet choice. This is due to if there is/are family household members are remittent in other countries like South Africa and Dubai they send additional fund. By that fund, farm household head diversifies their income into different types because they are not willing to retail their product and they choice wholesaler and collector outlet choice to sell potato product.

(8) Quantity supplied to market. It influences market outlet choices significantly. For farm household head to select, wholesaler market outlet choice positively affected by the quantity of potato supplied to the market at a 1% level of significance. And the likelihood of choosing retailers negatively and significantly by the quantity of potato supplied to the market at a 5% level of significance. The result shows households that supply large output of potato accessed wholesaler market outlet compared with households who supply less because of wholesaler capacity to purchase large amounts of potato products. This is because if the quantity of potato offered to the market is high, producers might fear taking it back to their house if it is not sold because they choose wholesalers' outlets. On the contrary, if the amount of product that offered to the market is small, farm household might be interested to sell for retailers. This study is in line with Reference [33]. This finding shows that the household that chooses a wholesaler is positively and significantly affected by volume supply to the market.

(9) Owning transport facilities. It influenced the choice of retailers' and consumers' outlets positively and significantly at 1% and 10%, respectively. Transport facility ownership by farmers increased the likelihood of choosing retailers and consumer outlets. This might be due to the reason that farmers who have their transport facilities could supply their products to urban centers and sell to retailers and consumers directly to get better prices than prices get from collectors/wholesalers. This shows that the availability of transportation facilities helps reduce long market distance constraints, offering greater depth in marketing choices. This result is in line with that of Reference [34] who found that owning transport facilities influenced the choice of retailer's outlet positively and significantly. In addition, they point out that the more family size helps to supply vegetables to different retailer shops and restaurants in different units, which affect operating vegetable production.

(10) Frequency of extension contact. It affects market outlet choice for the potato market positively and significantly. The survey output indicates that the frequency of extension contact affects producers' consumer market outlet choice positively and significantly at less than 1% significant level. Farmers who have more access to extension improve household intellectual capital, which improves potato production, diverts production resources to markets rather than consumption, and choice market channels. The study conducted by Reference [31] on determinants of wheat market outlet choice of smallholder farmers: the case of Dembecha district, Amhara National Regional State, Ethiopia. They found that the frequency of extension contact affects consumers' market outlet choices positively.

4. Conclusion

On one hand, Heckman's first-stage selection model indicates that the probability of potato market participation significantly determined by same explanatory variables like the education level, the sex, being membership in cooperative, distance to the nearest market, income from remittent, own transportation facilities, seed type, frequency of extension contact, lagged market price, and amount of credit used. On the other hand, the Heckman second-stage result indicates that the education level of household head, being a membership on cooperative, family size, total cropland size, oxen owned by a farmer, types of seed they used, lagged

market price, and inverse Mills ratio (lambda) affected the second decision concerning farm households' extent of potato market participation. Potato producer in the study areas supplies their products through collectors, wholesalers, retailers, and consumers' market outlets. The multivariate probit model results indicated that the probability of choosing wholesalers, retailers, collectors, and consumers market outlet choice significantly affected by age, educational level, sex, farm experiences, distance to near market, family size, remittance, land size, product supplied to the market, own transport facility, and extension service. These problems can be addressed by providing improved seed, being membership in a cooperative, providing adult education, credit access, nearer market, and income from remittance.

4.1. Recommendation. Depending on the findings of this study to promote potato producers encouraging adult education for farmers, diversification of different cooperatives, credit-providing institutions should facilitate and give training on the use of credit for farmers, empowering women to exercise resource use rights and gains equal to males. Office of agriculture, research institute, university, and different nonprofit institutions should provide improved potato seeds for farmers and the concerning bodies should be trying to stop the informal labor trading system [24].

Abbreviation

CSA: Central Statistical Agency
FAO: Food and Agricultural Organization
FGD: Focus group discussion
GDP: Growth domestic product
LDARDO: Lemo District Agricultural and Rural Development Office
MVP: Multivariate probit
OLS: Ordinary least squares
VIF: Variance inflation factor
Qt: Quintal.

Data Availability

The data of this study is available up on reasonable request.

Conflicts of Interest

The author declared that they have no conflicts of interest.

Authors' Contributions

The first author leads the overall research process and thoroughly revised all parts of the manuscript including abstract, introduction, methods, and interpretation of results. The second author participated in primary data collection, analysis, and interpretation of preliminary results. All authors read and approved the final manuscript.

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