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INTENSITY AND PROSPECT OF SMALLHOLDERS' POTATO COMMERCIALIZATION IN SOUTHERN ETHIOPIA: EVIDENCE FROM GAMO ZONE

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ABSTRACT

Ethiopia has set agricultural commercialization as one of the policy priorities to transit from subsistence-oriented agriculture to commercialized one, which could ensure stable livelihoods for both producers and consumers. Despite this, much of the country's crop production, particularly tuber crops, is still subsistence-based. Potato is the leading tuber crop in Ethiopia in terms of its production capacity, productivity, and market demand, and its commercialization could significantly impact the policy. Thus, this study aimed to analyze the determinants and prospects of the intensity of potato commercialization. Data for the study was gathered from 255 smallholder potato producers using multistage sampling techniques. The inferential statistics with Tobit regression and thematic content analysis were used to analyze quantitative and qualitative data. The findings depict that formal education, the number of oxen, the proportion of land dedicated to potatoes, potato output, contact with extension services, cooperative membership and accessibility to irrigation water significantly increase the intensity of potato commercialization while distance to market and paved road have a negative impact. The potential for future improvements in potato commercialization depends on the exploitation of existing opportunities, including farmers' production skills, agroecology, the government focuses on agriculture, water availability and NGO intervention from the production side, increased market outlets, higher market demand and local knowledge of post-harvest management from the consumption side. The government and other initiatives must focus on extension services, cooperative farming, market and road accessibility, and utilizing the identified opportunities.

KEYWORDS

potato output commercialization, prospect, mixed research method, tobit model, Ethiopia

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INTRODUCTION

In many developing nations, including Ethiopia, smallholder agriculture is vital in fulfilling food needs and stimulating economic growth (Zhou et al., 2013, Ferris et al., 2014). Nevertheless, one of the strong arguments in smallholder agriculture is the necessity of increasing the involvement of smallholder farmers in the market and food supply chain, which primarily depends on the commercialization of their agricultural production (Madhin, 2009, Mudhara, 2010, Radović-Marković, 2010, Okezie et al., 2012). The possible drivers of this necessity comprise the size of the population, urbanization, growth of the non-farm sector, increasing domestic and foreign trade demands and related circumstances (Berhanu, Moti, 2010). Moreover, commercializing crops is integral to changing agriculture via heightened productivity, facilitating economic diversification and accelerated economic expansion (Barrett, 2008, Yaseen, 2018, Raj, Hall, 2020, Shajahan, Radović-Marković, Manohar, 2024).

In Ethiopia, though smallholder agriculture has a considerable influence on Ethiopian food production and economic growth (Zerssa et al., 2021), most smallholder farmers in the country are unconnected from the market, and a majority of them market less than 50% of their crops (Abafita et al., 2016). Several problems obstruct commercializing smallholder agriculture in Ethiopia, such as inadequate infrastructure, inefficient marketplaces, land deterioration, and a rapidly expanding population. Consequently, smallholder farmers' integration into the market has become a primary goal of Ethiopia's policy agenda to transform its subsistence agriculture system, make progress out of poverty, and sustainable agricultural development (Gebre-Selassie, Bekele, 2012b, ATA, 2016). For instance, Ethiopia's Growth and Transformation Programs (GTP-I and GTP-II) have recently sought to construct Integrated Agro-industrial Parks (IAIPs) to bridge the gap between the agricultural sector and increase the value of basic agrarian goods.

Of the tuber crops, Potato (*Solanum tuberosum* L.) is the key source of food and income in Ethiopia's highlands (Gebru et al., 2017). This crop can be cultivated on about 70% of Ethiopia's arable land (Hirpa et al. 2010, Tadesse et al. 2018). The data from the Central Statistical Agency (CSA) from 2014-2019 show that potato covers about 41.14% of the total area of root and tuber crops and 29.9% of the total production. This is likely attributed to the high yield in a short season, ideal agroecology, accessible labour in the country's highlands, and market demand.

The commercialization of potatoes (in this paper, the share of the value of potato output that is marketed is usually the standard form of agricultural commercialization that can also reveal production decisions in response to market signals, therefore integrating the input dimension of commercialization (Pingali, 1997). The excellent benchmark for the commercialization of potatoes in the country is an increasing demand for fresh potatoes in the domestic market and food processing industry and the current international market conditions characterized by high prices for cereals (Gildemacher et al., 2009; AgroBIG, 2016)., the potato produced in the country is being exported to regional markets like Djibouti, Somalia, and Middle East countries (Fekadu, Dandena, 2006, EHDA, 2011). For instance, out % of the total volume of potatoes marketed to Somalia, 75% is supplied from East Hararge and 25% from the central part of Ethiopia (Aman et al., 2014).

Despite the evidence mentioned above, the commercialization of potatoes by smallholders to fulfil both local and regional markets is neither satisfactory nor stable, indicating the necessity for more efforts to reduce the difference between the accessible supply and the demand in local and regional markets (Mahlet et al., 2015). Potatoes have been overlooked in agricultural marketing strategies, particularly in the study area, as it is commonly deemed a bulky, perishable commodity with expensive transportation costs and limited export potential, typically restricted to cross-border transactions (Daniel, 2020).



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Previous studies in varying parts of Ethiopia (Mesfin et al., 2014, Gebru et al., 2017, Seifu, Eshetu, 2017, Biniam et al., 2019, Daniel, 2020) was conducted regarding the adoption of new potato varieties and production. Nevertheless, despite emphasizing the acceptance and generation of potatoes, none of these studies has focused on the status, degree, and likelihood of commercializing it.

Additionally, while evaluating other studies concerning the commercialization of potatoes (Sebatta et al., 2014, Kumilachew, 2016, Hagos, Geta, 2016, Asfaw, 2020), a considerable number of gaps were noticed, which the present research endeavoured to fill. Examples include the minimal sample size and missing important socioeconomic variables which affect smallholders' potato commercialization, such as credit amount, access to irrigation, mobile phone ownership, and product volume. Furthermore, this study provides insights to local decision-makers, planners, and practitioners in setting priorities for agricultural investment, resource allocation, market stability, and poverty reduction.

CONCEPTUAL FRAMEWORK AND MEASUREMENT OF COMMERCIALIZATION INTENSITY

Commercialization of agriculture takes many forms and is defined in different ways. Its meaning goes beyond supplying surplus products to markets; it has to consider both the input and output sides of production and the decision-making behaviour of farm households in production and marketing simultaneously (Pingali, 1997, Von Braun et al., 1994). Moreover, commercialization is not restricted only to cash crops as traditional food crops are also frequently marketed to a considerable extent (Berhanu et al., 2006).

However, the core of most definitions of agricultural commercialization is the degree of participation in the output market, focusing on earning cash incomes (Strasberg et al., 1999; Von Braun, 1994). According to these authors, commercialization supplies a higher amount or percentage of surplus products to the market. Because as illustrated by Pingali (1997), one component of agricultural commercialization (use of purchased inputs) is likely to proceed in tandem with the degree of participation in output markets. Based on this adopted definition, a more comprehensive Household Commercialization Index (HCI) was used to compute potato commercialization's intensity. Mathematically, HCI is expressed as:

$$HCI = \frac{\text{Gross value of potato sold by } i^{\text{th}} \text{ household in year } j}{\text{Gross value of potato produced by } i^{\text{th}} \text{ household in year } j} * 100 \quad (1)$$

where:

HCI = commercialization index of i^{th} household in potato sales expressed as a percentage.

The commercialization process is, undoubtedly, a long, drawn-out process that occurs along a commercial pathway from 0-1. A value closer to 0 indicates subsistence farmers, and a value closer to 1 implies fully commercialized farmers (Govereh et al., 1999).

The Conceptual Framework of this study is meant to describe key causal relationships between the intensity of potato commercialization measured by HCI and the different socio-demographic, economic, institutional, and physical factors.

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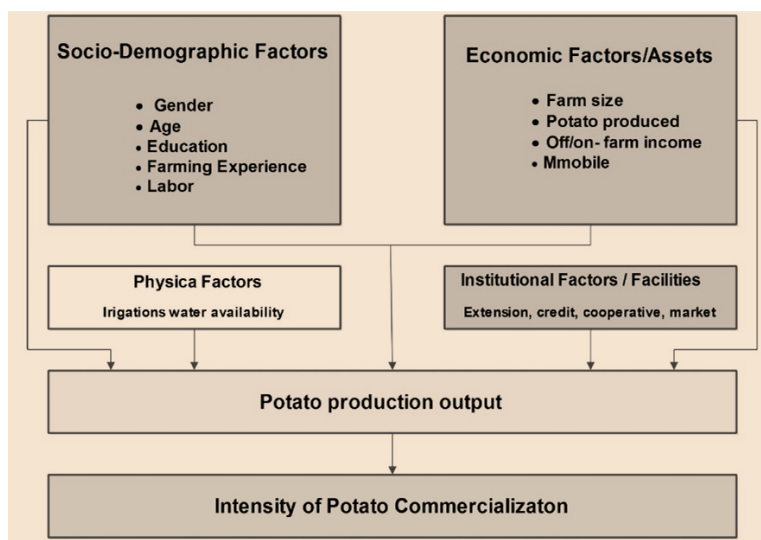


Figure 1. Conceptual work of the study

RESEARCH METHODOLOGY

Study area

The study was conducted in the Gamo Zone, one Zone in Southern nations, nationalities, and peoples' region, Ethiopia, located at 6°15'N latitude and 37°E longitude. The Zone has a total area of 6460.11 km² and consists of 14 districts, and the elevation of the Zone ranges from 600 to 3300 msl. The land's topography characterizes an undulating feature that favours the existence of different climatic zones in the area. The current total population of the Zone is estimated to be 1,597,767, with a population density of 80 inhabitants per square kilometer (Figure 2). The Zone has tremendous potential for Irish potato production and is crucial in ensuring market food supply. Different potato varieties include Gudenie, Degemegn, Belete, Jalene, and Tolicha, and a local variety named Asmera is produced and marketed in the area (CSA, 2016).

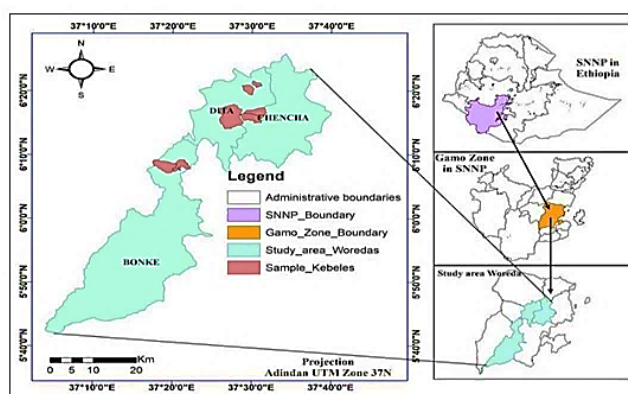


Figure 2. Location map of the study area.

Source: Authors sketch using Ethio GIS data



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Research design and sampling technique

The research followed a cross-sectional survey design of quantitative and qualitative data for 2022. Four-stage sampling techniques with a combination of probability and non-probability sampling techniques were utilized to reach the final sample respondents. First, the Gamo zone was selected purposely based on potato production experience and the authors' previous exposure and understanding of the problem when working in the area. Second, the target districts (Bonke, Dita, and Chencha) were selected purposely based on their high potential for potato market supply. In the third stage, two sample potato-growing kebeles from each district (Yela and Chosha from Bonke, GanaKare and Kodo from Dita, and Yoyra and Dambo from Chencha) were selected randomly).

Then, the sample size from the sampling unit, $N=4599$, was determined using the Kothari formula in equation 2 below.

$$n = \frac{z^2 pq N}{e^2 (N-1) + z^2 pq} = \frac{(1.96)^2 (0.5)(0.5)(4599)}{(0.05)^2 (4599-1) + (1.96)^2 (0.5)(0.5)} \approx 355 \quad (2)$$

where:

n – is the sample size,

Z – is the standard cumulative distribution that corresponds to the level of confidence with the value of 1.96,

e – is desired level of precision,

p – is the estimated proportion of an attribute present in the population with the value of 0.5 as suggested by Kothari (2004) to get the desired minimum sample size of households at 95% confidence level and $\pm 5\%$ precision; $q = 1-p$, and

N – is the size of the total population (sampling unit) from which the sample is drawn.

Then, n is redistributed to each Kebele via probability proportion to size.

Finally, a systematic random sampling technique was applied (equation 3), which has specific plus points and can be taken as an improvement over a simple random sample as it spreads more evenly over the entire population (Kothari, 2004).

$$K = \frac{N}{n} \quad (3)$$

Where:

K – is the interval among which the first sample is to be drawn using the lottery method,

N – is the total number of households in each sample Kebele, and

n – is the total sample size allocated for each sample Kebele.

Thus, the 1st subject was selected randomly, and every k th subject from the sampling frame was included until the determined sample size was reached.

The study also applied the same sampling procedure of selecting the study zone, sample districts, and kebeles to select the final focus group, discussants, and key informants. Finally, Focus Group Discussants (FGDs) and Key Informants were considered the non-sampled respondents to whom



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the qualitative data was conducted in the sampled Kebeles using the Checklists. In total, 3 FGDs, each consisting of 8 discussants (2 kebele leaders, 2 development agents, 2 male-headed and 2 female-headed potato producers). The key informant interview (KII) was conducted with experts from districts' agricultural offices, Trade and Industry Development offices, cooperative offices, and selected potato producers).

Data sources, types, and collection methods

To achieve the stated objectives, both qualitative and quantitative data were collected from primary sources (respondents) and secondary sources (reports of Districts and Zonal governments, statistical information, published theses and dissertations, and journal articles). The collected data from these sources include detailed socioeconomic and demographic characteristics of the respondents, data on potato output market participation, indicators for prospects of potato commercialization, gross volume and value of potatoes produced and sold per household per year, and others.

The quantitative data were collected using a semi-structured questionnaire administered by well-trained enumerators (2 from each Kebele) and the researchers. And the qualitative data were collected using Focus Group Discussions (FGDs) and Key Informant Interviews (KII). Here, open-ended questions were explicitly prepared for an in-depth understanding of the qualitative responses and opinions that supplement and triangulate quantitative data.

Analysis Methods

The descriptive statistics, frequency, percentage, mean, and standard deviation were used to describe and summarize the demographic and socioeconomic characteristics of the respondents. And the inferential statistics, T-test, and χ^2 -test were applied to compare the mean and proportion difference of continuous and discrete explanatory variables, respectively.

To examine determinants of intensity of potato commercialization, models like Tobit and Heckman's two-stage and double hurdle models are the competing models. However, the econometric model specification relies on the variable's nature, the study's purpose, and the type of data available (Komarek, 2010). Thus, our dependent variable, the intensity of potato commercialization measured by HCI, is censored. Because some of its values cluster at the limit, i.e., 0 for subsistence potato producers and 100 for fully potato commercialized farmers. Hence, the censored regression model, Tobit, is an option for handling this limited dependent variable. The general formula for defining Tobit is as follows:

$$Y_i^* = \beta_i x_i + \varepsilon_i \quad (4)$$

where:

y_i^* – a latent variable, which is unobserved for values less than 0 and greater than 100 that represent subsistence or fully commercial index,

x_i – is a vector of independent variables, which includes factors affecting the intensity of potato of commercialization,

B – a vector of unknown parameters to be estimated,

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ε_i – a disturbance term assumed to be normally distributed with zero mean and constant variance σ^2 , and

$i = 1, 2, 3 \dots n$ (n = the number of observations).

Given the observed dependent variable commercialization index (y_i), The Tobit model is specified as follows:

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^* & \text{if } y_i^* > 0 \end{cases} \quad (5)$$

The Tobit model is estimated using maximum likelihood estimations. However, the i th coefficients can't be interpreted directly as estimates of the magnitude of marginal effects of changes in the explanatory variables on the expected value of the dependent variable because there are three main conditional expectations of interest in the Tobit model. These are the conditional expectation of the underlying latent variable (y^*); the conditional expectation of the observed dependent variable (y); and the conditional expectations of the uncensored observed dependent variable ($y_j, y > 0$).

Following (McDonald, Moffitt, 1980, Greene, 1997), the marginal effects of these conditional expectations, respectively, are given as:

$$\frac{\partial E(y^*/x)}{\partial x} = \beta \quad (6)$$

$$\frac{\partial E(y^*/x)}{\partial x} = \beta \Phi \left(\frac{x\beta}{\sigma} \right) \quad (7)$$

$$\frac{\partial \Pr(y > 0/x)}{\partial x} = \Phi \left(\frac{x\beta}{\sigma} \right) \frac{\partial}{\partial \beta} \quad (8)$$

The interpretations of these marginal effects depend on the point of interest based on the focus of the study (Greene, 2003). The researcher is interested in the average population of the study and how those values vary with covariates; hence, equation 6 was used.

The study's qualitative data was recorded and transcribed and afterwards analyzed through thematic content analysis, emphasizing identifying, analyzing, and interpreting patterns of meaning or themes argued by FGDs and KIIs (Alhojailan, 2012).

DESCRIPTION OF VARIABLES

The following explanatory variables (Table 1) were included in the study to explain the dependent variable based on their theoretical and empirical backgrounds and the context of the study area.

Table 1. Description of the Variables and Hypothesis

No	Variables	Variable type	Measurement	Expected sign
Dependent variable				
1	Intensity of potato commercialization	Censored	HCI in percent	



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Explanatory variables				
2	Gender	Dummy	1. Male, 0 Otherwise	-
3	Age	Continuous	Year	-
4	Education level	Continuous	Year of schooling	+
5	Household labor size	Continuous	AE	+
6	Potato farming experience	Continuous	Year	+
7	Oxen	Continuous	Number	+
8	Land cultivated for potato	Continuous	Hectare	+
9	Potato production volume /year	Continuous	Kg	+
10	Off/Non-farm income	Continuous	Birr	-
11	Extension contact	Continuous	Frequency	+
12	Distance to the nearest market	Continuous	Hour	-
13	Distance to the main paved road	Continuous	Hour	-
14	Cooperative membership	Dummy	1 member, 0 not member	+
15	Credit amount	Continuous	Birr	+
16	Mobile ownership	Dummy	1 owned, 0 otherwise	+
17	Irrigation water accessibility	Dummy	1 accessible, 0 otherwise	+

RESULTS AND DISCUSSION

Statistical summary of explanatory variables concerning potato output market participation

Of the total surveyed households, the proportion of potato output market participants was 238 (67%), and non-participants were 117(33%), meaning that in the study area, the current status of potato market participation is increasing and it needs to investigation on the intensity of potato commercialization.

The summary of continuous variables in Table 2 below depicts that the mean year of formal education for potato output market participants was higher (3.98 years) than that of non-participants (1.06 years). The mean difference was statistically significant at a 5% level. The mean farming experience in years for market participants was longer (2.08 years) compared to the non-participants' (1.28 years), with a statistically significant difference at a 1% level. Also, the mean proportion of land for potato farming and the mean potato product in a kilogram of market participants were higher (1.38 ha and 2480 Kg/year) than the non-participants' (0.86 ha and (1230 Kg/year, respectively). These variables had a significant mean difference between the two categories at 1% and 5%, respectively. Owning more oxen enabled potato producers to participate in the market (1.34) than owning fewer oxen (0.9), and the mean difference was statistically significant at a 1% level. Potato producers in the area receive credit from private and governmental sources, and the mean credit in Birr received by potato market participants was more significant (3185.00) than non-participants (1887.6).



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Moreover, the market participants had more frequent visits to the extension agents (1.41 times/month) than the non-participants (0.85/month), with a significant difference of 1%. In contrast to the variables mentioned above, the mean distance of the closest market and main paved road for potato market participants takes less time to travel (1.82 and 1.06) than the non-participants (2.57 and 2.91). The mean difference of these variables for the two groups was statistically significant at 1% and 5% levels, respectively.

Table 2. Respondents' characteristics (Continuous Variables)

Categories of Variables	Participants (238)		Non-participants (117)		t-value
	Mean	SD	Mean	SD	
Age	40.02	7.7	42.61	8.40	-2.332
Education years	3.98	2.32	1.06	0.99	2.198**
Household labor size	3.16	1.19	2.07	1.01	-2.756
Potato farming experience	2.08	1.98	1.28	1.29	3.177***
Off/non-farm income	4437.72	3404.91	3419.28	2124.66	-0.099
Proportion of land for potato	1.38	0.99	0.86	0.62	4.009***
Number of oxen	1.34	0.74	0.9	0.55	2.748***
Credit amount	3185.0	534.4	1887.6	472.2	1.799*
Potato product volume	2480	1949	1230	819	2.594**
Distance from the closest market	1.82	0.99	2.57	1.0	-5.406***
Distance from the paved main road	1.06	0.71	2.91	0.81	-2.297**
Frequency of extension contact	1.41	0.91	0.85	0.71	4.399***

Source: Field Survey, 2022.

The summary of discrete variables in Table 3 below indicates that the proportion of cooperative members in the potato market participant category was higher (44.3%) than the proportion of cooperatives in the non-participants (31.4%). And the more significant proportion of potato market participants (68.6 %) was accessible to the irrigation water source compared to non-participants (31.0%). The χ^2 -test result shows a significant proportion difference between these two variables at 1 and 5 % significance levels, respectively, between the participants and non-participants.

Table 3. Respondents' characteristics (Discrete Variables)

Variables	Categories	Participants (238)	Non-participants (117)	χ^2 -value
		%	%	
Household head gender	Female	23.5	27.1	0.296
	Male	76.5	72.9	
Mobile ownership	No	40	55.7	5.082
	Yes	60	44.3	
Cooperative membership	No	55.7	67.7	2.757**
	Yes	44.3	32.3	
Irrigation water accessibility	Not accessible	31.4	49.0	2.801**
	Accessible	68.6	31.0	

Source: Field Survey, 2022.



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As a result, presented in Table 4 below, the mean HCI of potato farmers was found to be 34%. Most potato farmers (43%) in the area are situated at the transition line (semi-commercialized); thus, on average, they supply 42.4% of their total annual potato output. The two extremes, subsistence, and fully commercialized potato farmers, supplied 6.12 % and 71.7% of their total annual potato output. Generally, the figures from the result indicated that, in the study area, the commercialization pathway of potato producers stretched from subsistence to full commercialization.

Table 4. Intensity of Potato Commercialization (Descriptive result)

Intensity of Commercialization	Observation	%	Mean HCI
Subsistence (0-0.25)	138	39	0.06
Transition (0.26- 0.50)	150	42	0.43
Fully commercialized (0.51-1)	67	19	0.72
Total	355	100	0.34

Source: Field survey, 2022.

Determinants of the Intensity of Potato Commercialization

Out of the 355 sample households, 117 (33%) did not sell their potato product even if produced in the 2022 production year, and the data was censored. The model result presented in Table 5 below indicates that the goodness of fit of the Tobit model was statistically significant at a 1 % significance level (i.e., $\chi^2 = 175.05^{***}$). Thus, out of 16 explanatory variables used in the model, 9 were found to be statistically significant and discussed as follows:

Formal Education is positively and significantly associated with the intensity of potato commercialization. The marginal effect analysis indicates that a 1-year increase in households' education would increase their likelihood of being commercialized by 2.76%, *ceteris paribus*. The focus group discussants argued that educated farmers in the study area are more eager to use agricultural inputs like improved potato seeds and fertilizers. They also easily understand the costs and benefits of their farming activity and shift from cereal production to potato and other vegetable production. In contrast to this finding, Lighton and Emmanuel (2016) found that the education status achieved by the farmers increases the probability of shunning rural agricultural life and instead opting for higher, faster-paying professions.

Land Allocated for potato production has a positive and significant influence on the intensity of potato commercialization. A 1 additional hectare of potato production land would increase commercialization intensity by 2.3%, *ceteris paribus*. **The FGDs' result also justified that** farmers who cultivate large land sizes for potatoes in the area had a sound output, and their likelihood to be transitioned and commercial farmers increased.

Moreover, the key informants informed that as farmers produce a particular crop on a large land, their probability of losing product by different risks decreases, and they gain more benefits and can participate in the market more easily than their counterfactual producers. This finding is consistent with Assefa et al. (2019) and Meleaku et al. (2020).

Oxen number is also one of the significant factors that influence the intensity of potato commercialization. Thus, a 1 unit increase in the number of oxen would increase the intensity of commercialization by 4.1 %, *ceteris paribus*. One member of the FGD reported that "Oxen are the major source of traction power in the study area, and farmers with two (pair) and more *oxen could cultivate their own land and other farmers' land for share production that resulted in increased output*." The result is consistent with the finding of Birara et al. (2020).



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Also, the quantity of potato output is positively and significantly associated with the intensity of potato commercialization. For each kilogram increase of potato product, *ceteris paribus*, the households would be 0.5% more likely to be commercialized. This result is also consistent with the finding of Birara et al. (2020).

Extension Contact: Frequency of extension contact is positively and significantly associated with the intensity of potato commercialization. Each additional contact per month of potato producers to the extension agents, *ceteris paribus*, would increase the likelihood of their potato commercialization by 3.37%. The FGDs also argued that farmers who frequently visit the extension agents had improved their know-how on the benefits of producing potatoes for more than home consumption purposes. Compared to their counterparts, they use improved potato seed, chemical fertilizer, and animal dung.

Cooperative Membership also positively and significantly affects the intensity of potato commercialization. The marginal effect results depict that being a member of a cooperative, *ceteris paribus*, would increase the probability of farmers' potato commercialization by 1.85%. The evidence from key informants shows that farmer's involvement in cooperatives, particularly potato cooperatives established by the VITA organization, savings and credit cooperatives established by the government, and women's self-help groups established by the HOPE organization in the area enabled their information sharing among the co-members and as a source of initial capital to produce and commercialize potato.

Table 5. Tobit result on determinants of intensity of potato commercialization

Variables	Coefficient	Std. Err.	T	P> t	dy/dx
Gender of household head	.0895981	.0324578	1.53	0.128	.0339791
Age of household head	-.0001808	.0019582	-0.09	0.927	-.0001239
Education level	.0403306***	.0119185	3.38	0.001	.02763
Potato farming experience	.00186977	.0091063	2.05	0.41	.0128096
Household labor size	.0340724	.0132957	2.56	0.12	.0233426
Off/non-farm income	-.0000142	.000011	-1.30	0.196	-9.76e-06
Proportion of potato farmland	.0339975*	.0190551	1.78	0.076	.0232913
Oxen number	.0601494***	.0205356	2.93	0.004	.0412077
Credit amount	.0000385	.0000311	1.24	0.217	.0000263
Potato product volume	.07021***	.0017936	3.91	0.000	.00481
Distance from main paved road	-.0286955**	.0198734	-1.44	0.015	-.00921
Distance from the closest market	-.0492482**	.0180469	-2.73	0.0201	-.019658
Frequency of extension contact	.0571792***	.0196359	2.91	0.004	.0337393
Mobile ownership	.00346442	.0315869	1.10	0.274	.0237343
Cooperative membership	.0271026**	.0318422	0.85	0.039	.0185677
Access to irrigation water	.0269346**	.0322231	0.84	0.040	.0184526
_cons	.0876208	.1189722	0.74	0.462	
/sigma	.2217455	.0123407			
Number of observations = 355, LR Prob> chi2 = 0.000, chi2 (16) = 175.05, Log-likelihood = -43.174248, Pseudo R ² = 0.6697, 117 left-censored observations at IC <= 0, 238 uncensored observations and 0 right-censored observations.					

Note: ***, **, and * represents statistical significance at 10, 5, and 1%, respectively.

Source: Field survey, 2022.



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Access to irrigation water has a positive and significant influence on the intensity of potato commercialization. Being accessible to irrigation water sources, *ceteris paribus*, would increase the likelihood of farmers commercializing potatoes by 1.84%, indicating that some farmers have used small-scale irrigation by diverting water in traditional mechanisms from rivers. Some other farmers use motorized water pumps and rope pump irrigation technologies that enable them to intensify potato production. Similarly, Abineh (2021) found the positive effect of irrigation on agricultural commercialization.

In contrast to these factors, distance from the **main paved road** and distance from the **closest market** is positively and significantly associated with the intensity of potato commercialization. For an hour's additional journey to the main road and closest market, *ceteris paribus*, the probability of intensifying potato commercialization would decrease by 0.9% and 1.9 %, respectively. The FGDs argument supports this result: when farmers reside far from the main road and market, they cannot access both input and output market information; they fear the transportation cost since the potato output is bulky; consequently, they produce potatoes for only home consumption. Conversely, farmers closer to the main road are highly initiated in potato commercialization as they hope to transport their output from the farm.

Prospect of Potato Commercialization

The prospects of crop commercialization vary across the country and from place to place, and it can be viewed mainly from production and consumption perspectives (Hailu et al., 2015, Yigezu, 2021). Hence, this paper was devoted to assessing and identifying potato commercialization prospects from these perspectives.

The household survey, FGDs, and field observation on prospects of potato commercialization indicate that in the study area, the production and marketing of potato crops are increasing over time. One evidence was that most of the farmers, 238 (67%) of the surveyed households, produced potatoes beyond their home consumption in the year 2022. The majority of the FGDs argued that the prospects of potato commercialization would be good and depend on the utilization of current existing opportunities in the area. Thus, as indicated in Table 6 below, out of the total respondents, 30.2%, 23.9%, 23.9%, 7.8% and 49.4%, 19.6%, 17.2%, and 13.7% reported that agro-ecological suitability, farmers' knowledge and skill on potato production, government focus on agriculture, irrigation water availability, and VITA intervention as opportunities from production sides for the future expansion of potato commercialization, respectively. And 49.4%, 19.6%, 17.2%, and 13.7% of the total respondents reported that increased market outlets and demands, increased market information and communication, farmer's knowledge and skill on post-harvest management and transportation accessibility from the consumption side as opportunities for the future expansion of potato commercialization, respectively.

Table 6. Opportunities for the Prospect of Potato Commercialization

Contexts	Opportunities	Freq.	%	Rank
	Good farmers' knowledge and skill in potato production	85	23.9	2
Production side	Agro-ecological suitability	107	30.2	1
	Irrigation water availability	50	14.1	3
	Government focus on agriculture	85	23.9	2
	VITA intervention	28	7.9	4



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		355	100	
Consumption side	Good framers' Knowledge and skill in post-harvest management	61	17.2	3
	Increased market outlets/demands	175	49.3	1
	Transportation accessibility	49	13.8	4
	Increased market information and communication	70	19.7	2
		355	100	

Source: Field survey, 2022.

CONCLUSION AND POLICY IMPLICATIONS

The departure of smallholder farmers from subsistence to commercialization-based production has been the policy agenda of the government in Ethiopia. However, commercializing vegetables and root crops like potatoes has not gotten enough attention compared to their production potential in Ethiopia and the study area.

So, the study focused on analyzing the determining factors and prospects of smallholders' potato commercialization. The analysis result indicates that the intensity of potato commercialization is the function of the area's demographic, socioeconomic, institutional, and physical factors., farmers' educational status, proportion of land allocated for potatoes, oxen number, quantity of potato output, extension contact, cooperative membership and access to irrigation water significantly increases the intensity of potato commercialization whereas, distance from the main road and closest market substantially decreases the intensity of potato commercialization.

Furthermore, the investigation result on prospects of potato commercialization shows that there are opportunities to progress out subsistence potato farming. The agroecology, the good trend in farmers' knowledge and skill of potato production, government support, irrigation water and VITA intervention from the production side, increased market outlets and demand, increased market information and communication, and farmers' knowledge on post-harvest management from consumption side was found to be better opportunities for the prospects of potato commercialization.

Though potato has been produced in the area and is profitable, it needs further attention to achieve the required commercial stage. Hence, to promote the realization of commercialization of the sector, the Ethiopian agricultural marketing policy and development actors at different levels in the country should create more awareness of the importance of potato commercialization/ need to strengthen the program of adult education, cooperative farming, delivery of appropriate farm inputs/ improved seeds and construction of irrigation facilities to increase the volume of potato marketed., market and road access to farmers should be given more emphasis. Finally, the prospects of potato commercialization tell us that focusing on utilizing the existing opportunities should be strengthened.

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