Ethiop. J. Agric. Sci. 32(3) 37-53 (2022)

Commercialization of Coffee Production in Coffee-Based Farming Systems in Ethiopia

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Abstract

Commercialization of agriculture is an important part of the agrarian transformation of low-income economies and a means of ensuring food security, enhanced nutrition, and incomes. This study was designed to examine coffee commercialization in the coffee-based farming system of Ethiopia. It was conducted in two regional states, namely, Oromia and Southern Nation, Nationalities and Peoples (SNNP) which constitute 95% of coffee production in the country. Data were collected using a structured questionnaire from a total of randomly selected 953 households. The Tobit model is used to identify factors affecting farmers' coffee commercialization in major coffee-producing areas. The results of the study showed that 89% of coffee-producing households supply coffee to the market. Coffee is more commercialized (76%) compared to other staple foods (such as maize) in the area. The econometric result also showed positive effects of access to key public services (education and extension services) and the adoption of improved coffee varieties on the commercialization level of coffee. The positive effect of radio ownership on coffee market participation also suggests the need for more farm-based tailored radio programs that can provide market information for the farmers. Diversification through intercropping is a method to promote the marketing of cash crops, which necessitates wider diffusion of enhanced climate-smart practices. Moreover, research, extension, and other development partners must pay due attention to any barriers/drivers that encourages the access and use of the improved varieties.

Keywords: Adoption, Coffee, Commercialization, Farming system, Tobit

Introduction

In Ethiopia, agriculture contributes 34% to the GDP, employs 79% of the population, and accounts for 79% of foreign earnings (MOA, 2019). It is also the major source of raw materials and capital for investment and the market for the country. Despite volatility due to its dependence on rain and the seasonal shocks, the sector has shown considerable growth over the past decade as the result of an estimated doubling in the use of modern farm inputs, the rapid expansion of arable land, increased labor productivity, government investments in the extension system and an improved road network (Pauw, 2017). The agricultural sector of Ethiopia, however, is dominated by smallholder farming which produces 95% of main crops such as cereals, pulses, oilseeds, vegetables, root crops, fruits, and cash crops (Aweke and Gelaw, 2017). Coffee is also the major crop produced in

Ethiopia in four production systems: forest coffee (accounting for 10%), semi-forest (35%), garden coffee (50%), and plantation coffee (5%).

More than 15 million people in Ethiopia rely on the coffee sector for their livelihoods (Petit, 2007). The country is also the center of origin and genetic diversity of Arabica coffee (ECFF, 2015) which constitutes 70% of the total coffee traded in the world (Kew and ECFF, 2017). In terms of coffee export, Ethiopia is the world's fifth-largest exporter of Arabica coffee (Moat *et al.,* 2017). Apart from this, coffee is an export commodity that accounts for 34% of the nation's total export earnings (USDA, 2019).

It is estimated that smallholder farmers produce above 90% of organically produced Ethiopian coffee (EtBuna, 2021). This production is mainly rain-fed and characterized by having low levels of input use (including fertilizers, pesticides, and herbicides) resulting low yields averaging 0.64 tons per hectare (Tadesse *et al.* 2020) (cf. the world average of 0.8 t/ha and that of Brazil, 1.65 t/ha) (FAOSTAT, 2019).

The contribution of smallholder agriculture to reducing poverty and hunger in developing countries depends on sustainable access to markets, market participation, or commercialization (Wiggins and Keats, 2013). Agricultural commercialization refers to the process of increasing the proportion of agricultural produce that is sold by farmers (Pradhan *et al.,* 2010). It can broadly be looked at from two perspectives; a rise in the share of marketed output or purchased inputs per unit of output (Jaleta *et al.,* 2009). The transition from subsistence to commercial agriculture is also referred to as the commercialization of agriculture which is considered an important part of the agrarian transformation of low-income economies and a means of ensuring food security, enhanced nutrition, and enhanced incomes (Kurosaki, 2003). Consequently, smallholder commercialization is regarded by the Ethiopian government as the focal point for the agricultural development of the country (Gebremedhin and Jaleta, 2010).

This study tries to examine the commercial behavior of smallholder coffee producers and their extent of commercialization. Although there is a rich body of literature on coffee, there is no adequate information on the extent and determinants of coffee commercialization in the country. Previous studies by Gebreselassie and Ludi (2008) on coffee farmers' market participation were limited to a few coffee-producing areas of the country with only a few zones and *woredas (*districts) were included in the studies. In addition, the studies did not make any effort to explain the role of using improved technology and practices on coffee commercialization. This study fills this gap and provides national-level information from which wider policy issues could be drawn. The specific objective of the study was to estimate the level of coffee commercialization and

identify the factors that affected the commercialization rate of coffee in the coffee-based farming systems of Ethiopia.

Materials and methods

The study areas

The study focused on Oromia and the SNNP regional states which represent more than 95% of coffee production in the country (Figure 1). From each one of these two regional states, four zones were selected to represent major coffee production areas in the country. Hence, Gedeo, Sidama, Kafa, and Sheka zones were drawn from the SNNP regional state while Ilubabor, Jimma, West Wollega, and Kellem Wollega zones were selected from the Oromia regional state. The zones selected represent both garden coffee (coffee-*enset* farming system) and forest coffee (coffee-maize farming system). In the same way, two *woreda*s were also selected from each of the study zones making a total of 16 sample *woredas*.

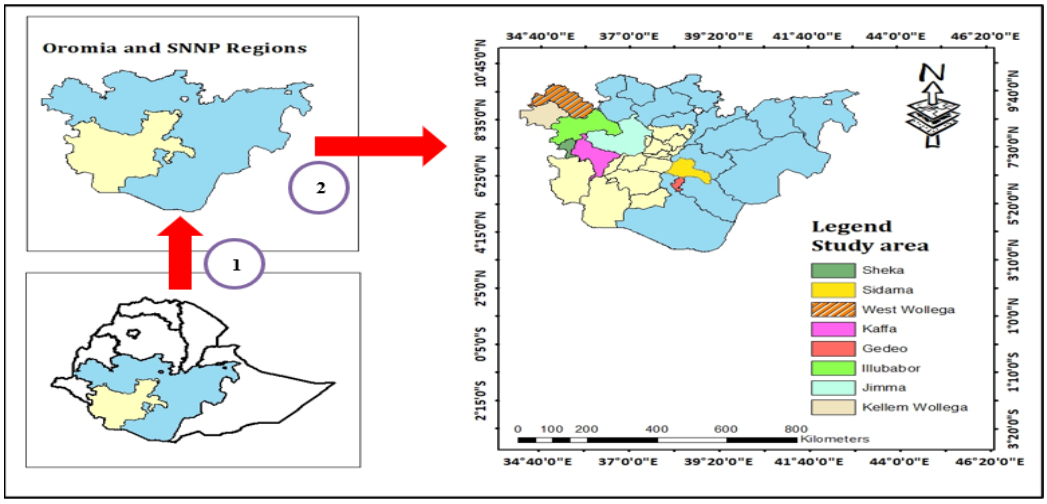


Figure 1: Map of the study area

Sampling techniques

A multistage sampling technique was employed involving both purposive and random sampling techniques to select the sample from target population. First, regions and zones were purposively selected based on the number of coffee growers, the area allocated to coffee, and the quantity of coffee produced. Accordingly, Oromia and SNNP regional states were chosen for the study because these regional states alone accounted for 89% of coffee growers, 97% of the coffee area, and 95% of coffee production in the country (CSA, 2018). Secondly, districts and Kebele Administrations in the study regions were selected using a

random sampling technique. Finally, households were randomly chosen from the sampling frame of coffee grower populations at the *Kebele* Administrations levels.

Sample size determination and data collection

Kothari's (2004) formula was used to determine a representative sample size for the study which is given by:

$$N = \frac{Z^2 pq}{e^2} = \frac{(1.96)^2\ (0.5)(0.5)}{(0.03175)^2} = 953 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where N is the sample size needed; Z is the inverse of the standard cumulative distribution that corresponds to the level of confidence, e is the desired level of precision, p is the estimated proportion of an attribute (socio-economic, institutional, and technological) that is present in the population, and q = 1-p. The value of Z is found in the statistical table which contains the area under the normal curve of a 95% confidence level. In the determination of sample size, setting the value of p=0.5 and hence q=0.5 yields the maximum optimum sample size while any other combination of the values of p and q yields less sample size using the Kothari formula. Therefore, using 0.5 for the values of p and q, and e=0.03 the Kothari formula gives a total of 953 samples to sufficiently represent the population in the selected study areas assuming a 95% confidence level and ≈3% precision. The sample was proportionally distributed for the regions (584 from SNNP and 369 from Oromia Regional states) based on production [Table 1]. Data was collected from the sampled households through a structured questionnaire administered by enumerators. The sampled zones cover about 48% of coffee-producing households in the country.

Table 1: Total sample size and sample distribution along study zones and regions

Region	Zone	Total sample size	% from the total	Total number of coffee farmers (CSA, 2018)
SNNP	Gedeo	199	21	255,661
	Sidama	200	21	1,103,585
	Sheka	81	8	69,961
	Kafa	104	11	252,858
	Sub-total	584	61	1,682,065
Oromia	Ilubabor	121	13	286,078
	Jimma	107	11	641,063
	West Wollega	105	11	282,357
	Kellem Wollega	36	4	187,093
	Sub-total	369	39	1,396,591
Grand total		953	100	3,078,656
Ethiopia coffee producing households				6,455,194
The proportion of coffee producers in sampled areas over the total coffee-growing households in Ethiopia				48%

Data analysis and model specification

Both descriptive statistics and econometric models were used to analyze the data. The Household Commercialization Index (HCI) was useful in the analysis of the level of coffee marketed by smallholder farmers. This is a tool that is used to determine the specific level of commercialization that each household contributes to the market. The most frequently used method of measuring agricultural commercialization in the literature is the proportion of the value of crop sold concerning the value of crop harvested (Chukwukere *et al.*, 2012; Ochieng *et al.*, 2016; Nwafor and van der Westhuizen, 2020).

$$Household's\ commercialization\ index\ (HCI) in\ \% = \frac{Coffee\ sold\ in\ kg}{Coffee\ produced\ in\ kg} x\ 100 \ldots\ldots\ldots (2)$$

The value of the index ranges from 0 to 100%. The closer the index is to 100 the higher the degree of commercialization. A value of zero is an indication that the farmer is operating under subsistence production (Onyebinama, 2012). The Tobit model was used to analyze factors affecting the commercialization of coffee in coffee-based farming systems. It was developed by Tobin (1958) to capture situations in which the dependent variable under study is observed for values greater than 0, i.e., for participation in crop sales, but is not observed, i.e., censored or non-participation for values of 0 or less. The standard Tobit model is defined by:

$$y_i = \{y_{i^*}\ if\ y_{i^*} > 0;\ 0\ if\ y_{i^*} \leq 0 \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where y_i is the observed variable and, y_i^* is a latent variable. The observable variable is defined to be equal to the latent variable whenever the latent variable is above zero and zero otherwise. The latent variable (the dependent variable) is defined in terms of the following relationships:

$$y_{i^*} = \beta x_i + \mu_i \sim N(0, \sigma^2) \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where x_i is the hypothesized independent variable, β is a vector of parameters to be estimated by the model, which determines the relationship between the independent variable (vector) and the latent variable, u_i is a normally distributed error term to capture random influences on this relationship. McDonald's and Moffit's (1980) approaches were also followed to decompose marginal effects to assess the effect of a change in the explanatory variables on the explained variable. Therefore, the three types considered in the analysis of the Tobit model are shown below. These are:

a) The marginal effect on the latent variable (unconditional expected value)

$$\frac{\partial E(y|X)}{\partial X_k} = \beta_k \emptyset(\frac{X\beta}{\sigma}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

b) The marginal effect on the expected value of observations conditional on being uncensored

$$\frac{\partial E(y|X,y>0)}{\partial X_k} = \beta_k + \beta_k \frac{\partial \lambda(c)}{\partial c} = \beta_k\{1 - \lambda(c)[c + \lambda(c)]\} < \beta_k \ldots\ldots\ldots\ldots (6)$$

where λ(c) is called the inverse mill's ratio. It captures the change in the dependent variable (conditioned on y>0) when changing x.

c) The marginal effect on the probability that the observations are uncensored

$$\frac{\partial Pr(y>0|X)}{\partial X_k} = \emptyset(\frac{X\beta}{\sigma})\frac{\beta_k}{\sigma} \quad \text{..... (7)}$$

Variables and their hypothesized signs

Dependent variable: Coffee commercialization index or the proportion of coffee supplied to the market.

Explanatory variables: Based on economic theories, past findings, and field observation, the following explanatory variables were included in the Tobit model. The definition of variables, measurements, and their signs of influence have been presented in Table 2. Unlike other aforementioned studies, some important explanatory variables such as the adoption of improved coffee varieties and the use of intercropping were added to this study as they tend to affect the commercialization level of the farmers.

Table 2: Explanatory variables and their hypothesized signs on coffee commercialization

Independent variable	Variable type	Definition and measurement	Hypothesized sign
Sex of the household head	Dummy	Sex (1=Men; 0=Women)	+/-
Mean family education	Continuous	Mean family education in completed years	+
Family size	Continuous	Number of family members	+
Radio ownership	Dummy	Household head own functional radio (1=Yes; 0=Otherwise)	+
Mobile phone ownership	Dummy	The household head owns a mobile phone (1=Yes; 0=Otherwise)	+
TV ownership	Dummy	Household head owns functional TV (1=Yes; 0=Otherwise)	+
Access to extension service	Dummy	The household head has access to extension services (1=Yes; 0=Otherwise)	+
Participation in coffee field days	Dummy	Household head participates on coffee field days (1=Yes; 0=Otherwise)	+
Distance of villages to the main market	Continuous	Distance of villages to *woreda* markets in kilometers	-
Coffee improved variety adoption	Dummy	Household head adopted improved coffee varieties (1=Yes; 0=Otherwise)	+
Use intercropping in coffee	Dummy	Practice intercropping in coffee (1=Yes; 0=Otherwise)	+/-
Total land size	Continuous	Total land size of the household in hectares	+
Coffee land size	Continuous	Total coffee land size of the household in hectares	+/-

Results and Discussions

Farmers' Demographic Characteristics

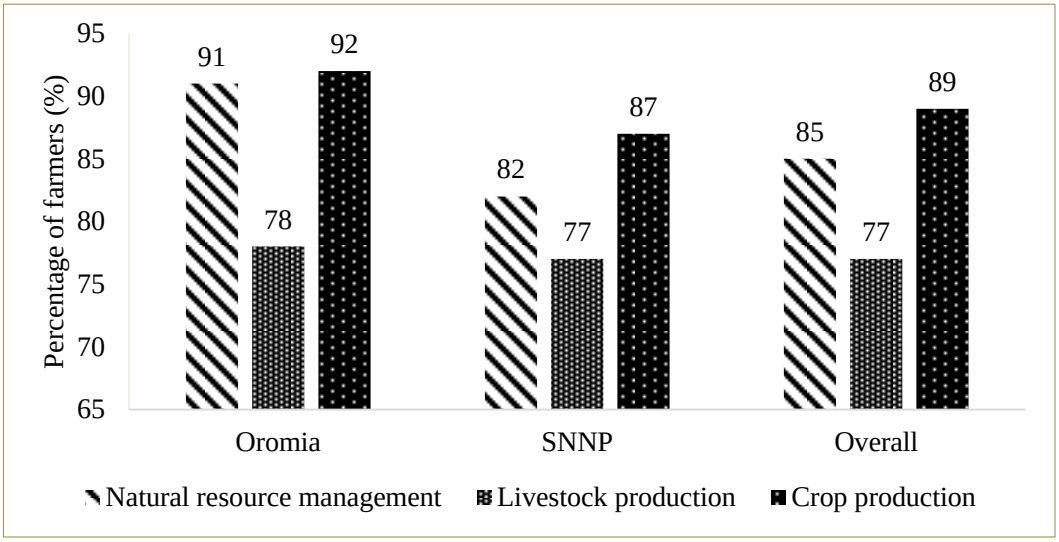
The study considered different explanatory variables that could affect the level of commercialization of coffee. We have tried to elaborate on every variable considered in the model. Based on the survey about 90% of survey respondents were from men-headed households and the rest 10% are women-headed households. The study included improved coffee variety adoption as an explanatory variable since the adoption of improved coffee could affect the level of commercialization. The study revealed that 57% of the farmers have adopted improved coffee varieties. Farmers at Oromia have a better adoption rate of improved coffee varieties (62%) than their SNNP counterparts (54%). There was a statistical difference between the adoption level of improved coffee varieties between the two regions at a 5% significance level. As the findings indicate, about 20% of the overall respondents have participated in demonstrations or field days in both regions. New technologies are introduced into the farming systems through on-farm demonstration activities which are conducted by research institutes and offices of agriculture. Field days are also organized to create opportunities for neighboring farmers to observe the performances of the new technologies. The study showed that the majority of farmers owned mobile phones (64%) and functional radios (54%) in both study regions. Mobile phones can help farmers get information on new agricultural technologies, prices of products, and inputs. Only 11% of the farmers had access to an electric power TV set [Table 3].

Table 3: Description is dummy explanatory variables by regions (%)

Variable	Oromia	SNNP	Pooled	Chi²	P value
Household sex [Men]	95	87	90	18.14	0.000***
Improved coffee variety adoption	62	54	57	5.99	0.014**
Participation in field days and training	19	21	20	0.68	0.410
Radio ownership	63	48	54	18.92	0.000***
Mobile phone ownership	69	61	64	5.92	0.015**
TV ownership	8	12	11	3.87	0.049**
Practice intercropping in coffee	20	61	45	148.31	0.000***

***, ** indicate significance levels at 1% and 5%, respectively

The results also revealed that 86% of the farmers had access to extension services for improved crop production practices [Figure 2]. The proportion of households who had access to extension services on improved livestock production practices was reported to be 78% and on improved natural resources management, 85%. This is a witness that development agents, *woreda* agriculture offices, and other public and NGOs are reaching out to the farmers to provide advice, training, and exposure visits to the farmers of the study regions. However, the result revealed that farmers in both regions have better access to crop-related extension services than livestock and natural resource extension services.



Natural resource Management: Chi^2 = 16.36; P-value =0.000***; Livestock production: Chi^2 = 0.04; P-value =0.843; Crop production: Chi^2 = 4.83; P-value =0.028**
Figure 2: Farmers' access to various extension services

The average age of sample household heads in the study regions was 42.6 years with a relatively older household head at Oromia (43.2) than at SNNP (42.3). The average family size of the respondents was 6.3. There was a significant difference between the two regions in family size at a 5% significance level. The study revealed that 90% of the sample household heads had exposure to education while only 10% were illiterate. The educational status of sample household heads was 4.8 years of schooling, on average. The mean family education was 3.9 years. The average family education level is a little higher at SNNP (3.93) than at Oromia (3.83). The mean distance of the farmers' residence from the main market was 8.7 km. There was a statistically significant difference between the regions in proximity to the main market at a 1% significance level, with farmers in Oromia being farther away.

The mean land size of households in the study area was 1.8 hectares, out of which 54% was allocated for coffee production implying the importance of coffee. Sample farmers from Oromia had larger land sizes (2.2ha) than those in SNNP (1.47ha), on average terms. In absolute terms, farmers in the Oromia region allocate more land to coffee (1.09 ha) than the SNNP counterparts (0.86 ha), yet proportionally farmers at SNNP allocate a higher share (59%) of their land to coffee compared to that of Oromia (50%) [Table 4].

Table 4: Summary statistics of continuous explanatory variables

Variable	Oromia		SNNP		Pooled		t	P value
	Mean	SD	Mean	SD	Mean	SD		
Household head age	43.16	12.18	42.29	12.35	42.63	12.29	1.07	0.284
Family size	6.09	2.45	6.46	2.28	6.32	2.34	-2.38	0.018**
Mean family education in years	3.83	2.44	3.93	2.22	3.89	2.31	-0.68	0.494
Household head education level (years)	4.92	3.51	4.72	3.48	4.81	3.49	0.83	0.405
Distance to the main market in km	11.99	6.52	6.55	6.06	8.66	6.78	13.09	0.000***
Total land size in hectares	2.20	1.93	1.47	1.62	1.76	1.78	6.29	0.000***
Total coffee land in hectares	1.09	1.52	0.86	0.99	0.95	1.23	2.89	0.004***

***, ** indicate significance levels at 1% and 5%, respectively

Commercialization levels of major crops

Farmers utilize their products for various purposes including sale, home consumption, and other uses (seed, gift, etc.). The results of the study showed that 89% of coffee-producing households supply coffee to the market. The proportion sold indicates the level of commercialization of the crop. As illustrated in Table 5, the mean commercialization level of coffee was 76%. This is an indication that coffee is a cash crop in the study regions where only about 24% was utilized for home consumption and other uses. Another important crop most commercialized in the areas was maize with a commercialization level of 48%. In this case, nearly half of the maize produced was sold while the other half was utilized for consumption, seed, and other purposes. The mean commercialization level of *enset* was also 47%. In this case, the quantity of *enset* sold was significantly higher in Oromia (75%) than in SNNP (37%) though SNNP is the dominant coffee belt and producer region in the country. The reason could be that *enset* is a staple food for the farmers in SNNP where about 47% of the quantity is devoted to consumption (cf. 17% in Oromia). Wheat is also the second most commercialized crop in the study area where 55% of the quantity was sold. The least commercialized crop was barley where only 27% was sold while 57% was spent for home consumption. Barley is perceived as a food crop mainly produced for home consumption.

Table 5: Commercialization level of major crops in the study regions (% of quantity sold)

Crops	Utilization	Oromia	SNNP	Overall	t	P
Coffee	Sold	79	73	76	1.59	0.019**
	Consumed	10	13	12	1.92	0.051*
	Other uses	11	14	12	4.25	0.042**
Wheat	Sold	46	60	55	-1.19	0.241
	Consumed	44	35	38	0.45	0.666
	Other uses	10	5	7	0.90	0.374
Faba bean	Sold	50	66	54	-0.44	0.700
	Consumed	38	22	34	1.72	0.096*
	Other uses	12	12	12	0.22	0.839
Maize	Sold	47	48	48	1.44	0.125
	Consumed	44	41	43	1.99	0.07*
	Other uses	9	11	9	0.76	0.451

Haricot bean	Sold	49	46	48	-0.126	0.900
	Consumed	39	40	40	-0.552	0.582
	Other uses	12	14	12	-0.211	0.355
Teff	Sold	47	48	47	1.08	0.293
	Consumed	42	42	43	-1.60	0.122
	Other uses	11	10	10	1.17	0.332
Enset	Sold	75	37	47	2.25	0.023**
	Consumed	17	47	39	-6.42	0.000***
	Other uses	8	16	14	-9.17	0.000***
Sorghum	Sold	44	39	45	0.55	0.585
	Consumed	41	43	41	-0.01	0.990
	Other uses	15	18	14	-1.57	0.123
Barley	Sold	30	17	27	0.87	0.392
	Consumed	52	75	57	-0.66	0.515
	Other uses	18	8	16	2.27	0.029**
***, **, * indicate significance level at 1%, 5% and 10%, respectively*						

Determinants of coffee commercialization

The Tobit model was used to investigate factors affecting the level of commercialization of coffee among households. It was run for the two regions separately as well as collectively for the whole sample [Table 6]. The result of the model showed that location, gender, education, adoption of improved coffee variety, extension access, and ownership of sources of information such as radio and land owned significantly affected the commercialization of coffee. The endogeneity problem between commercialization and adoption of improved coffee variety was tested using Durbin and Wu-Hausman test and resulted in no sign of endogeneity between the variables (p-value = 0.699 and 0.700, respectively).

Oromia region

The outcome of the econometric model showed that the Oromia region has a substantially higher level of commercialization of coffee than the SNNP region. Despite being a region known for producing and providing markets with highly sought-after coffee at global markets, such as Yirgachefe, Gedeo, and Sidama coffee, SNNP has less commercialization than Oromia. The reason is that, in contrast to SNNP, which is known for its garden coffee production, a huge amount of coffee is produced by farmers in the Oromia region from the forest. On the other hand, compared to the SNNP region, the average coffee and total land size are higher in Oromia.

As a result, coffee farmers in Oromia tend to sell more of their coffee.

Sex of the household head

The result of the model showed that male coffee farmers are less likely to sell their coffee products in the whole sample; however, it is not significant at a regional level. The result implies that women-headed households tend to supply more coffee to the market than men-headed households which is negative and significant for the whole sample. Men-headed households have a diverse option of

agricultural goods supplied to the market and women mostly depend on cash crops such as coffee which need less effort and resources to manage. Thus, women-headed households are more likely to supply their coffee product to the market than men-headed households. The result contradicts with Kusse *et al.,* 2022 and Dagmawe *et al.,* 2022 as the nature of coffee (a cash perennial crop) is different from food crops. Coffee does not need many resources once planted and women-headed households are inclined to produce coffee more than other annual crops which need resources for input purchase and other annual expenses. Future studies should supplement qualitative studies to explore the case as the proportion of women-headed households in the whole sample is only 10% (5% in Oromia and 13% in SNNP regions).

Mean family education

The result of the study showed that the mean family education had a positive and significant impact on coffee supplied to the market for the SNNP region and the whole sample. Even though not significant, education level has also a positive effect on coffee commercialization level. The result is consistent with Oliver and Georgina, (2013). The result revealed a positive impact of educational level on market participation. Education is theorized to have a positive impact on the farmers' understanding of production and market dynamics and hence, influences farmers' level of commercialization. Educational attainment enhances the farmers' ability to appreciate the essence of credit, new techniques, and information disseminated from extension agents which impact positively commercialization (Tolno *et al.,* 2015; Gachuhi *et al.,* 2021; Dubale *et al.,* 2021; Dagmawe *et al.,* 2022). It also increases the readiness of producers to accept new ideas and innovations and to obtain supply, demand, and price information. These together enhance farmers' willingness to participate in markets and increase the value of sales (Bekele, 2017).

Adoption of improved coffee variety

According to Andualem (2017) the supply of output to the market is highly correlated with the output produced which is directly related to using of improved crop varieties. An increase in output is the product of the adoption of improved technologies (Wordofa *et al.,* 2021). Thus, the adoption of improved coffee variety has significantly increased the coffee supplied to the market in both regions and for the whole sample. Tigist (2017) and Alphonse *et al.* (2021) also revealed the positive impact of agricultural technology (improved variety) adoption on market participation and intensity of participation.

Access to extension

Farmers' access to extension services has a positive and significant effect on the commercialization of coffee in the SNNP region and the whole sample. Extension

services enhance the productivity of agricultural goods as well as farmers' participation in the market. The access also boosts market information and then, market participation of smallholder farmers. The result corroborates with Dagmawe *et al.* (2022) and Yonannes and Berhanu (2022).

Training on crop management

Training on crop management affected the commercialization of coffee positively and significantly, especially at SNNP and for the whole sample. Training on agricultural technology drives technology adoption, and the adoption of technologies also affects productivity (output) positively. An increase in output also enhances commercialization which is consistent with Andualem (2017) and Amare *et al.* (2019). The effect of training on coffee commercialization in Oromia is positive but not significant which suggests the effect of other variables over training on market participation.

Practicing intercropping in coffee

The result revealed the positive and significant effect of practicing intercropping in coffee and commercialization in Oromia. Only a few farmers practice intercropping other crops in coffee in the Oromia region which has positive impact on market participation. Intercropping enhances the diversification of food and cash sources as well as enhances productivity. Leguminous crops and coffee shade crops such as *enset* are usually used for intercropping in coffee. Thus, farmers who intercrop other crops in coffee are more likely to produce and supply more coffee to the market. The positive impact of intercropping on crop yield and technical efficiency was also reported by Yu Hong *et al.* (2019), Alicia *et al.* (2020), and Kenta *et al.* (2020).

Radio ownership

Radio ownership affected coffee commercialization positively and significantly for both the Oromia region and the whole sample. Farmers in the Oromia region have better access to radio than the SNNP region as described on the descriptive result. The ownership of radio is related to information access which enhances market participation and commercialization. Farmers often get price information through the radio which helps them make informed decisions on the quality and quantity sold. The result corroborates with Chanyalew *et al.*, (2011) and Mtega (2018) who found a positive effect of market information for commercialization. Access to market information is an important factor in commercialization because it presents the farmers with all the options which are available for them to choose from to get higher returns.

Land allocated to the crop

Land allocated to coffee has a positive and significant effect on coffee market participation in both regions and the whole sample. Those farmers who have large coffee land sizes are expected to produce more coffee which in turn boosts market participation. The result is consistent with Gachuhi *et al.,* 2021, Dubale *et al.,* 2021, Kusse *et al.,* 2022 and Dagmawe *et al.,* 2022.

Table 6: Factors affecting the commercialization of coffee using the Tobit model

Variables	Oromia	SNNP	Pooled			
	Coefficient	Coefficient	Coefficient	Unconditional expected value	Conditional on being uncensored	Probability uncensored
Region [Oromia] Reference: SNNP]			5.444** [2.639]	4.533** [2.198]	4.492** [2.176]	2.770** [1.346]
Sex of the household head [MALE]	-9.658 [8.087]	-5.814 [4.842]	-7.409* [4.052]	-6.215* [3.400]	-6.113* [3.341]	-3.797* [2.079]
Mean family education in completed years	0.537 [0.710]	1.585** [0.764]	0.968* [0.519]	0.812* [0.435]	0.799* [0.428]	0.496* [0.266]
Family size in numbers	0.628 [0.682]	0.441 [0.707]	0.518 0.502	0.434 [0.421]	0.427 [0.414]	0.265 [0.257]
Adoption of coffee improved variety [YES]	6.795** [3.454]	8.195** [3.269]	2.15** [2.412]	1.804** [2.0231	1.774** [1.989]	1.102** [1.236]
Intercrop in coffee [YES]	6.809* [4.118]	-3.789 [3.426]	-0.914 [2.589]	-0.767 [2.171]	-0.754 [2.136]	-0.469 [1.326]
Crop extension service [YES]	2.001 [5.715]	9.086** [4.271]	4.545* [3.371]	3.812* [2.829]	3.750* [2.780]	2.329* [1.729]
Training on crop management [YES]	1.920 [4.307]	9.959*** [3.690]	5.77** [2.733]	4.840** [2.295]	4.761** [2.253]	2.957** [1.404]
Household head owns mobile phone [YES]	-0.865 [3.698]	-2.789 [3.542]	-1.615 [2.606]	-1.355 [2.186]	-1.332 [2.149]	-0.828 [1.336]
Household own functional radio [YES]	7.746** [3.528]	2.794 [3.236]	4.729* [2.413]	3.967** [2.024]	3.902** [1.990]	2.423** [1.238]
Household own functional TV [YES]	-0.408 [6.472]	-2.555 [5.152]	-2.502 [4.002]	-2.098 [3.356]	-2.064 [3.302]	-1.282 [2.051]
Distance to the main market in km	-0.294 [1.018]	0.092 [0.959]	-0.167 [0.706]	-0.140 [0.592]	-0.138 [0.582]	-0.086 [0.362]
Total owned land in hectares	0.582 [1.461]	-1.522 [1.417]	-0.968 [1.032]	-0.812 [0.866]	-0.799 [0.851]	-0.496 [0.529]
Total coffee land in hectares	0.357* [1.889]	1.531** [2.229]	0.844* [1.455]	0.708* [1.220]	0.697* [1.200]	0.433* [0.746]

Note: The number in the parenthesis is a standard error. ***, **, * indicate significance level at 1%, 5% and 10%, respectively

Conclusions and Recommendations

The study revealed that 57% of the sample farmers have adopted improved coffee varieties and about 89% of coffee producers supply their coffee to the market. Apart from this, the commercialization level of coffee was 76%, on average, which demonstrated the extent to which coffee is produced for sale. Farm households' access to communication media, such as radio, has contributed to the increased commercialization level of coffee. This indicates that efforts to improve

ease of access to local language-based radio programs in places where there is limited coverage as well as preparing tailor-made agriculture-related FM radio programs can pay in the form of marketable surplus, citrus paribus. The importance of using improved coffee varieties in enhancing the commercialization of coffee production underlines the need to support aggressive technology promotion efforts and provide all the necessary inputs required for the farmers to adopt the varieties. This involves strengthening the development of new varieties (along with their production packages) and the supply and dissemination of the technologies. Thus, research, extension, and other development partners need to closely pay due attention to the generation and dissemination of improved coffee technologies and practices. On the other hand, any barriers (socioeconomic, technical, or institutional) limiting the access and use of the improved varieties and practices should also be addressed. The positive effect of intercropping on commercialization calls for the diversification of different farming practices by smallholder coffee producers. The wider spacing between coffee plants enhances the use of intercropping and other improved farming technologies and practices.

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