

## Research Article

### Factors Influencing the Participation and Level of Avocado Export Market: A Double-hurdle Regression Approach from Northwest Ethiopia

Tigist Genanew <sup>1</sup>, and Mengistie Mossie <sup>2\*</sup>

<sup>1</sup>Melkassa Agricultural Research Center, Ethiopian Institute of Agricultural Research, Adama, Ethiopia

<sup>2</sup>Department of Rural Development and Agricultural Extension, College of Agriculture and Environmental Sciences, Bahir Dar University, PO. Box 79, Bahir Dar, Ethiopia

\*Corresponding author: [mengistiemoosie@gmail.com](mailto:mengistiemoosie@gmail.com)

Received: March 18, 2026; Accepted: June 6, 2026

**Abstract:** Market participation is essential for enhancing the livelihoods of smallholder farmers in developing nations including Ethiopia. While avocado exporting recently emerged in the North Mecha District, participation rates remain low, and factors influencing this engagement remain under-researched. This study examines factors influencing avocado producers' participation in the export market and the extent of their participation. Using a mixed-methods approach, data were collected from 305 households through purposive and systematic random sampling. Descriptive statistics and Double-hurdle model were applied for data analysis. The results from the inferential statistics reveal that export market participants were relatively younger (with average age of 44 years) and better educated (3.4 average years of schooling) than non-participants, while also producing nearly four times the quantity of avocados (2,061 kg vs. 562 kg). The double-hurdle model reveals that the decision to participate is significantly influenced by the household head's sex, distance to cooperatives, farm size, livestock holding size, cooperative membership, frequency of extension contact, market information, and total production volume. Furthermore, the intensity (level) of participation is determined by marital status, credit access, cooperative membership, market information, and quantity of production. Policy interventions focused on strengthening cooperative infrastructure, improving credit and extension services, and expanding land allocation for avocado production to strengthen export engagement are required.

**Keywords:** Avocado, production, double hurdle, export market, Northwest Ethiopia

**Citation:** Genanew T and Mossie M. (2026). Factors Influencing the Participation and Level of Avocado Export Market: A Double-hurdle Regression Approach from Northwest Ethiopia. *J. Agric. Environ. Sci.* 11(1): 16-32. <https://doi.org/10.63990/jaes.v11i1.13263>



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

## 1. Introduction

The integration of smallholder farmers into international agricultural markets remains a cornerstone of global development agendas. Organizations such as FAO and various international development agencies emphasize market-oriented agriculture as the primary vehicle for poverty reduction, hunger eradication, and rural food security

in sub-Saharan Africa (Etuk and Ayuk, 2021). In Ethiopia, developing market-oriented agriculture is key to transforming the rural economy. The Ethiopian Government has continually made this transformation a priority, aiming to change agriculture from being based on supporting the farms to being based on creating and selling products as a business (FAO, 2021). This strategic shift is organized in the Ten-Year

National Development Plan (2021–2030), which seeks to enhance the diversification and value addition of export commodities to improve Ethiopia's competitiveness within regional and global value chains (MoPD, 2021). By promoting high-value crops, the state aims to elevate rural incomes and bridge the gap between smallholder production and global consumer demand.

In Ethiopia, the agricultural sector remains fragmented, dominated by smallholders managing an average of 0.9 hectares (Otekunrin et al., 2019). This land constraint creates a poverty trap where subsistence farming yields insufficient income for reinvestment. Transitioning to market-oriented farming specifically export markets orientation is expected to break this cycle by generating significantly higher profit margins than domestic trade (Mariyono, 2019). In the context of this study, market participation is defined not just as the act of selling, but as the depth of engagement in the market chain. This study distinguishes between the decision to participate (the binary entry into the market) and the intensity of participation (the quantity of output commercialized). Understanding this distinction is critical, as the factors that encourage a farmer to enter a market are often distinct from those that allow them to scale their operations.

Among high-value crops, avocado (*Persea americana*) has emerged as a “green gold” for Ethiopia. Historically dominated by unprocessed commodities like coffee and oilseeds, Ethiopia's export portfolio is now diversifying into horticulture. Due to its favorable agro-climatic conditions and the rising global demand for nutrient-dense superfoods, the Ethiopian government has identified avocado as a strategic export fruit (Yohannes, 2022). The Amhara Region, specifically the North Mecha District, has become a focal point for this revolution. With its hot and humid tropical climate and robust irrigation infrastructure, the district began large-scale cultivation of export-demanded varieties primarily the Hass variety, which constitutes 90% of local production due to its international preference. Since 2017, collaborations between the Ethiopian Ministry of Agriculture, USAID, and MASHAV (Israel's Agency for International Development) have empowered local cooperatives, such as the Selam Vegetable and Fruit

Cooperative Society, to link smallholders directly to European markets.

Despite the high stakes and institutional support, smallholders' participation in avocado export markets remains underwhelming. While international markets offer premium prices, they also demand rigorous quality standards and consistent supply volumes that many smallholders struggle to meet (Đuric, 2020). Existing literature in Ethiopia has extensively covered domestic market participation for various crops across comparable regions, such as the central highlands and Rift Valley basins (Hagos et al., 2020; Gurmis and Melese, 2022; Menelek et al., 2022). However, there is a critical empirical study gap regarding the export market specifically within the North Mecha District. The study area presents a distinct socio-ecological context where irrigation (e.g., the Koga Irrigation Scheme) and targeted institutional interventions have increased avocado production, yet the factors behind transitioning from domestic surplus sales to export market chains remain unexamined.

Many researchers have traditionally employed Tobit or Heckman selection models to analyze market behavior. However, the Tobit model is overly restrictive, assuming that the same variables influence both the decision to participate and the intensity of participation (Luchia et al., 2018). Similarly, the Heckman model is only appropriate if sample selection bias is present. This study addresses these gaps by employing a Double Hurdle (DH) model, a more flexible econometric approach that treats the participation decision and the level of participation as two independent hurdles (Wooldridge, 2002). This allows for a more nuanced understanding of how variables like extension services, credit access, and cooperative membership act differently at different stages of the market journey. Therefore, the study was conducted to provide empirical evidence on the factors determining avocado export market participation and level of participation among smallholders in North Mecha District. Specifically, to quantify the current level of export market participation, to identify the socio-economic, institutional, and farm-specific factors that determine the binary decision as well as intensity (quantity) of avocado supplied to the export market.

## 2. Materials and Methods

### 2.1. Description of the study area

The study was conducted in the North Mecha District, situated within the North Gojjam Administrative Zone of the Amhara National Regional State, Ethiopia (Figure 1). The district comprises 38 kebeles (the smallest administrative units), with its capital, Merawi, positioned approximately 35 km from the regional city of Bahir Dar and 530 km northwest of Addis Ababa. Geographically, the district is bordered by Bahir Dar Zuria to the north, Yilmana Densa to the east, South Achefer to the west, and South Mecha to the south. The district has a total area of 1,481.64 km<sup>2</sup> and is characterized by a predominantly plateau landscape. The topography is classified into two agro-ecological zones: highlands (2.9%) and semi-highlands (97.1%), with elevations ranging from 1,800 to 2,850 meters above sea level. The climatic conditions are highly conducive to horticultural production, specifically avocado with the mean annual temperatures fluctuate between 17.5°C and 20°C. The area receives a mean annual rainfall of 1,200–1,800 mm, with the heaviest precipitation occurring during the main rainy season (summer) season from mid-June to early September (Mazengiya et al., 2023). The pedological profile is dominated by Nitisols, which cover 93% of the district. These deep, well-drained soils are ideal for fruit trees. The remaining area consists of Vertisols (4%) and Andosols (3%).

North Mecha is a densely populated district with a total population of approximately 374,196. The population density stands at 252.6 persons per km<sup>2</sup>, significantly exceeding the zonal average of 158.25. The primary livelihood is based on a mixed crop-livestock farming system, where avocado production has recently emerged as a critical high-value component alongside traditional staples. A sophisticated year-round system focused on high-value vegetables (onion, potato, garlic, cabbage, tomato, and pepper) and various fruit trees (Berhan, 2023). Additionally, the Eucalyptus tree serves as a vital non-food cash crop for many households (Alemayehu et al., 2023). The livestock subsector complements crop production, with a high density of cattle, poultry, sheep, and goats per household. These assets provide not only nutritional security but also the organic manure and animal traction (oxen) essential for intensive avocado cultivation (Tafere et al., 2015). The district's comparative advantage in the export market is largely driven by the Koga Irrigation Project. This large-scale dam provides a 7,000-hectare irrigation capacity, positioning North Mecha as a horticultural hub within the Amhara region. As of 2021, avocado cultivation expanded to cover 365 hectares. The district successfully produced and channeled approximately 1,600 quintals of avocado into the international market (WoA., 2021).

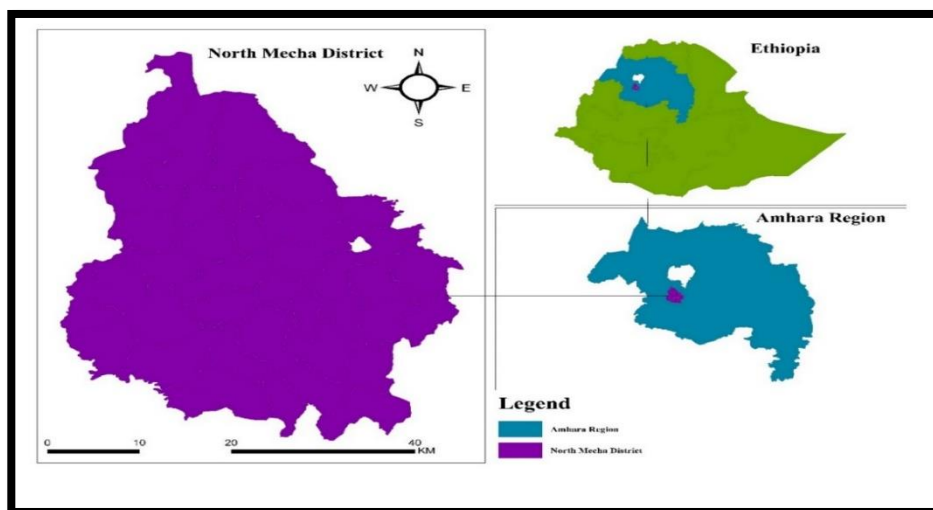


Figure 1: Map of the study area  
(Source: Own GIS manipulation, 2024)

## 2.2. Research design and sampling

This study adopted a cross-sectional research design, which is effective for capturing the prevailing socio-economic status and market dynamics of smallholder farmers at a specific point in time. To ensure a robust understanding of the research problem, a mixed-methods research approach was employed. By integrating both quantitative and qualitative data, the study leverages the statistical power of household surveys alongside the contextual depth provided by qualitative insights, thereby increasing the validity and triangulation of the findings (Mengistie and Kidane, 2016).

A combination of primary and secondary data sources was utilized. Primary data were collected directly from smallholder avocado producers through structured questionnaires, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs). Whereas, secondary data were sourced from published empirical research, unpublished district-level reports, Central Statistical Agency (CSA) bulletins, and Agricultural Bureau records to provide historical context and validate household-level data.

The target study population for this research is defined as the smallholder avocado producers residing within North Mecha District. A two-stage sampling design was implemented to select representative study units from this population: Stage I (Kebele selection): From the 38 administrative kebeles in the district, 10 were purposively selected based on their high potential of avocado production and active engagement in both domestic and export market chains. Stage II (Household stratification): The sampling frame was stratified into two distinct groups: export market participants (N = 499) and non-participants (N = 794). This stratification ensures that the characteristics of both groups are adequately captured for the DH analysis. Finally, respondents were selected from each stratum using simple random sampling proportional to the population size of each Kebele.

Given the relatively homogeneous socio-economic characteristics of the smallholder farmers in the study area and the finite nature of the population, the sample size was determined using the formula developed by Yamane (1967). Following this calculation and

accounting for the proportional distribution across the two strata, a total of 305 households (118 participants and 187 non-participants) were surveyed.

## 2.3. Data analysis

Descriptive statistics (mean, frequency, percentage, and standard deviation) were employed to analyze demographic, socio-economic, and institutional characteristics at household level. Inferential statistics t-test for continuous variables and chi test for dummy variables were used to test the existence of any statically verifiable differences among farmers who participated and their counterfactuals. Under econometric analysis, DH regression was used to estimate avocado export market participation decisions and level of participation by smallholder farmers. In this study, avocado export market participants were defined as those who were used to sell a part of avocado produce in the export market during the 2022/2023 production year. Smallholder farmers that did not sell any portion of their avocado produce on the export market were classified as non-participants.

### 2.3.1. DH model specification

When examining the dichotomous issue of whether or not to participated in avocado export market models with binary dependent variables like the logit and probit types are typically used. The common methods cited by many scholars were heckman selection model, Cragg's DH model, and Tobit model (Cragg, 1971; Tobin, 1985; Awotide et al., 2016). However, the model specification mainly depends on the purpose of the study and the type of data available. Tobit model is very restrictive. For instance, this model has been revealed to be inadequate to the determinants in export market participation: the decision to participate (or not) in export markets and the level of export market participation. Any variable, which determines the probability of participation also must determine the intensity of participation in the export market, which is not always true (Luchia et al., 2018). Even though the explanatory variables, which determine the decision of export market participation and level of export market participation may be in the same direction, but the magnitudes and statistical significance level for these two processes could be relatively different. The DH model proposed by (Cragg, 1971) is more flexible than the Tobit model because it accounts for possibility that factors

determining the decision to market participation and intensity of market participation may be different in variable, magnitude, and significance level. The Heckman two-stage model is specifically designed to correct for sample selection bias. In the absence of empirical evidence confirming such bias, employing this model is unnecessary, and standard regression techniques should be used instead.

In this case, the DH model is appropriate (Wooldridge, 2002). That is why recent studies used the DH approach to study market participation (Gurmis and Melese, 2022). Consequently, this study was applied the DH model developed by (Cragg, 1971) to study the export market participation decision and extent of the participation. The DH model is a parametric generation of the Tobit model and Heckman model, whereby two separate stochastic processes determine the decision to participate and the level of participation. The DH model encompasses two step estimation procedure. In the first-stage, probit regression was used to identify factors affecting export market participation decision. The first decision variable ( $y$ ) takes the value 1 for farmers who participated in avocado export market and 0 otherwise. However, the expected utility of market participation  $[Y^*]_i$  is a latent variable. Hence, the first decision (export market participation hurdle) of the smallholder farmers is formulated as:

$$\begin{aligned}
 D_i &= \alpha Z_i + K + \varepsilon_i \\
 D_i &= 1, \text{ if } D^*_i > 0, \\
 D_i &= 0 \quad \text{if } D^*_i \leq 0 \dots \dots \dots (1)
 \end{aligned}$$

where  $D_i$  is a dummy variable that takes the value 1 if the producer participated in export market and 0 otherwise,  $Z_i$  is a vector of independent variables hypothesized to influence export market participation decision,  $K$  is the regressors,  $\alpha$  is a vector of parameter to be estimated and  $\varepsilon_i$  error term. Not all avocado producers participate in the export market on the same level of intensity. As stated previously, the intensity of export market participation is measured in terms of the quantity of avocado sold for export. In the second-stage, truncated regression that eliminates part of sampled observation based on the value of the dependent variable was used. The regression considers the observations that take 1 for participation decision.

Therefore, the second hurdle represents the actual level of avocado export market participation, stated by the quantity of avocado supplied to expert market; the truncated regression model with the lower left truncation equal to 0 was used to determine factors affecting the intensity of avocado export market participation. The truncated regression model for level of participation was described in Eq. (2) as:

$$\begin{aligned}
 y_i &= \beta_i x_i + \mu \lambda_i + \varepsilon_i \\
 y^*_i &= \beta_i x_i + v_i \\
 y_i &= \{y^*_i \text{ if } y^*_i > 0 \text{ and } D_i > 1; 0 \text{ otherwise}\} \\
 \dots & \dots \dots (2)
 \end{aligned}$$

Where,  $y^*_i$  and  $y_i$  are latent and the observed intensity of avocado export market participation, respectively,  $x_i$  is a vector of variables influencing intensity of avocado export market participation and  $\beta$  is a vector of parameters to be estimated. The error terms are expected to be independently and normally distributed as both decisions made by the individual producer independently which are as:  $\mu_i \sim N(0,1)$  and  $v_i (0,\delta^2)$ .

The log likelihood function for the DH model that nests probit model and a truncated regression model is given following as:

$$\begin{aligned}
 \log L &= \sum \ln \left[ [1 - \Phi] \left( Z_i \alpha \right) \left( \frac{X_i \beta}{\sigma} \right) \right] + \\
 & \sum \ln \left[ \Phi \left( Z_i \alpha \right) \frac{1}{\sigma} \varphi \left( \frac{Y_i - X_i \beta}{\sigma} \right) \right] \\
 \dots \dots \dots (3)
 \end{aligned}$$

Where,  $\Phi$  and  $\varphi$  refer to the standard normal probability and density functions, respectively,  $Z_i$  and  $X_i$  represent independent variables for the Probit model and the Truncated model, respectively,  $\alpha$ ,  $\sigma$ , and  $\beta$  are parameters to be estimated for each model.

**Dependent variables**

*Export market participation decision (EMP):* It is a dummy variable that characterizes the participation of households in the export market regressed in the first step of the two-step estimation procedure of the respondents who participated (sold) in the export market taking the value of one. Whereas it takes the value of zero for the respondent who did not participate (not sell) in the export market during the 2022/23 production season.

*Quantity of avocado export (QAE):* It is a continuous variable in the second step of the selected model. It was measured in kilograms converted to quintal and represents the actual quantity of avocado exported to export market by smallholder farmers during the same production season, selected for regression analysis and is non-negative values.

### ***Explanatory variables and hypothesis***

*Age of household head:* It is a continuous variable, measured in years. The elderly farmers may be reluctant to adopt new methods of avocado farming hence reducing the output marketed in the export market (Karing'u et al., 2020). The ability of old-aged farmers to access information on inputs and marketing was less this decreased market participation (Andaregie et al., 2021). Contrary to this Amare et al. (2019) that older farmers have more social connections, have better access to information so they have more opportunities to participate in the avocado export market. In this study, it was expected to have both a positive and negative impact on the decision and level of export market participation.

*Sex of household head:* Female-headed households and male-headed households do not equally participate in different market participation and manage their households. This means that men-headed households are highly involved in export market participation. Female-headed households are not market-oriented like that of male-headed households (Gurmis and Melese, 2022). In rural area, males are considered as the main players of the majority of economic activities in their household (Andaregie et al., 2021). Therefore, in this study, expected to be male-headed households are expected to be more likely to participate in avocado export as compared to their counterpart, female headed households.

*Education level:* It is a continuous variable measured in years of schooling and refers to the formal schooling of a respondent up to the survey period. Contrary to this Abate et al. (2022) education can enable the farmers to improve the farming practice to maximize their production that consequently increased the amount of produce sold in the market. Additionally, Menelek et al. (2022) education enhances skills and knowledge to improve competence in production and marketing processes. The educational level of farmers

increases their ability to get information on how to produce and increases sells of tef produce (Nebere et al., 2021). Therefore, education level was expected to have positive or negative relationship with household decision and level of avocado export market participation.

*Family size:* The number of family members live in the house. Increased family size means high demand for food that make households sell some fruits in the local markets, which could have been sold in the export market, hence, reducing the extent of participation in export marketing (Karing'u et al., 2020). Family members are more consumers than workers, or their contribution as labor in avocado production is less than being consumers like that of pineapple producers (Gurmis and Melese, 2022). It is expected to have a negative relationship with household export market participation.

*Marital status:* This is a dummy variable and takes a value of 1 if the household head is married and 0 otherwise. Married farmers have a broad chance for decision-making, thus marital status is suggested to have a positive effect on sales decisions (Tabitha and Clem, 2016). It was hypothesized that married respondents have a better social status in the community and being respected by the community members could have better access to formal organizations. Additionally, they could have better resources. Therefore, being married was expected to have a positive relationship with avocado export market participation.

*Distance from cooperative office:* It is the distance of the avocado fruit producer households from the cooperative office and it is measured in hours of walking on feet time. The closer the cooperative office, the lesser would be the transportation charges, reduced walking time, and reduced other marketing costs, better access to market information and facilities. Therefore, it was expected to have a negative relationship with avocado export market participation.

*Extension contacts (frequency):* It is a continuous variable and measured in the number of days of contact with an extension worker per month. It can be the visit of a farmer by an extension worker, or vice versa. The study by Gurmis and Melese, (2022) shows that an extra day of extended visits raised the level of

producer participation in the market. The frequency of extension contact raises both the degree of the marketed surplus and the likelihood of market participation. Extension agents assist farmers with everything from land preparation and production by offering training on cultivation techniques and information about the practice of improved varieties. (Menelek et al., 2022). Therefore, it was expected to influence avocado export market participation.

*Access to credit:* It is a dummy variable measured as one if a sample household has access to credit, zero otherwise. Credit access increases the capacity of avocado producers to purchase necessary inputs and boost production (Gurmis and Melese, 2022). Access to credit improves the financial capacity of farmers to buy improved inputs, thereby increasing production which is reflected in the marketed surplus (Kifle et al., 2022). Therefore, it hypothesized that access to credit would have a positive influence on both market participation and the volume of avocado sales.

*Membership of cooperative:* - It is a dummy variable measure done if sampled household is a member of cooperative, zero otherwise. Farmers organizations promote the networking of farmers in agricultural marketing, therefore promoting ease of access to marketing services (Karing'u et al., 2020). Farmers' club membership had a positive and highly significant effect on the quantity of mangoes sold. It creates linkage and synergy with value-chain actors and the market could enhance market participation, thereby improving the bargaining power of producers (Hagos et al., 2020). Therefore, membership in cooperatives of avocado producers is expected to have a positive effect on participation and level of participation in export market.

*Size of land allocated for avocado production:* This refers to the total land allocated for avocado production. It is measured in hectares. Relatively large size of land under avocados indicates more trees in production and therefore higher quantity of avocados produced (Kwizerimana, 2017; Hagos et al., 2020). Similarly, according to Kassa et al. (2017) more land allotted to banana growing, more quantity supplied to the market. Therefore, this variable was hypothesized to have a positive effect on both export market

participation decision and level of avocado export market participants.

*Non/off-farm income:* This indicates the income of households generated from different sources. It is dummy variable measured as one if a sample household participated in off /non-farm activity, zero otherwise. If households participate in non/off-farm activity it helps to meet their different types of basic needs within the household. Non/off-farm income can mitigate financial constraints for producers, and therefore reduce their willingness to participate in the date market according to Menelek et al., (2022). Contrary to this Motuma et al. (2024) off-farm engagement provides farmers with access to information and knowledge that helps them increase their agricultural production and marketing of products. Therefore, in the study, it is expected to have a positive or negative relationship with the dependent variable.

*Cultivated farmland size:* This refers to the total cultivated land size of a household measured in hectares. According to Karing'u et al. (2020). Farmland increased the proportion of avocados sold in the export market increase due to the fact that land is the main production asset that has a direct bearing on the production of marketable output. This study expects a positive effect on the avocado export market participation.

*Livestock-owned (TLU):* It is a continuous variable measured in tropical livestock units (TLU). The households with a relatively large number of livestock are expected to be more productive, produce a relatively more amount of production, and supply more proportion of the output than those with relatively smaller proportion. As stated by market Andaregie et al., (2021), since smallholder farmers plough their land by using oxen, large livestock holding increases production and productivity, and hence supply to the. In contrast, household-owning livestock require time dedicated to feeding, keeping, and grazing animals. Livestock can also be used to mitigate financial constraints, this in turn means that date producers are less likely to participate in date production and marketing (Menelek et al., 2022). Farmers owned more livestock were expected to have

negative or positive effect in the decision and level of export market participation.

*Market information:* It is dummy variable measured as one if a sample household has market information, zero otherwise. According to Menelek et al. (2022) positive association between this variable and marketable surplus were found. Market information is a vital instrument during marketing because it informs the farmers about marketing conditions. Farmers who have price information prior to marketing tend to sell more of their products than those without (Jebesa, 2019). Mango producers who have the behavior of searching price and production information from different sources such as neighbors, friends, or media benefitted from mango marketing (Dessie et al., 2019). This variable was expected to have a positive effect on decisions and the level of export market participation.

*Distance from agricultural extension office:* It is the distance of the avocado fruit producer households from the agricultural office and it is measured in hours of walking on foot time and it is a continuous variable. It is expected to have a negative impact on decisions and the level of export market participation.

*Quantity of avocado produced (QAP):* It is a continuous variable in the second step of the selected model. It was measured quintal and represents the actual quantity of avocado produced by smallholder farmers during the 2022/23 production season, selected for regression analysis takes non-negative values. More volume of tef also supplied more tef produce to the market when the production of tef in a given year was better, the higher the market supply and the amount of tef that can be sold in the market (Kifle et al., 2022).

### 3. Results and Discussion

#### 3.1. Socio-demographic characteristics

The descriptive and inferential results of continuous socio-demographic characteristics reveal significant differences between the two groups. The mean ages of the participants and non-participants were 44 and 54 years with standard deviations of 9.02 and 10.47 respectively. The maximum and minimum ages observed were 76 and 25 years for non-participants and 68 and 28 for participants respectively. The independent t-test result was ( $t=8.2969$ ;  $P=0.000$ ) these indicates there is mean age difference between participants and non-participants (less than 1% type I error). In the study area, the largest family size was 10 and the smallest was 2 persons per household. The mean family size of participants was 4.6 and it was 5.4 for non-participants. Standard deviations for the two groups were also 2 and 1.9 respectively. There was a significant variation in the family size between avocado export market participation and non-participant households ( $t= 3.1859$ ;  $P\text{-value}=0.0008$ ) at a 1% significant level.

The education level of the respondents is measured in years of schooling. The mean education of the household heads for participants and non-participants is 3.4 and 0.79 years, with standard deviations of 0.41 and 0.18, respectively. The maximum and minimum education levels observed were 10 and 0 years for non-participants and 15 and 0 for participants respectively. The independent t-test result was ( $t= -6.4409$ ;  $P=0.000$ ) which indicates there is a 1% significant mean education difference between participants and non-participants (Table 1).

**Table 1: Household characteristics for continuous variables**

Variables	Participants (118)		Non-participants (187)		Total sample (305)				T-test value
	Mean	SD	Mean	SD	Min	Max	Mean	SD	
Age	44.2	9.02	53.89	10.47	25	76	50.1	10.9	8.2969***
Family size	4.63	2.01	5.36	1.91	2	10	5.07	1.98	3.1859***
Education level	3.4	4.55	0.79	2.52	0	15	2	3.67	-6.4409***

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

The result shows that 98.31% of male and 1.69% of female headed respondents were participants and 97.33% of male and 2.67% of female headed respondents were non-participants. The findings also show that 91.80 % of respondents were married (Table 2). From these, 98.31% of the participants and 87.70% of non-participants are married while 1.69% of participants and 12.3% of non-participants are

unmarried. The chi-square test was used to determine whether there were any differences between sample households' marital status and based on their participation in the avocado export market. The result showed a statistically significant difference between marital status and export market participation ( $\chi^2=10.8121^{***}$ ,  $P<0.5$  p-value=0.001).

**Table 2: Household characteristics for dummy variables**

Variables	Category	Participants (118)		Non-participants (187)		Total sample (305)		Ch2-test
		N	%	N	%	N	%	
Sex	Male	116	98.31	182	97.33	298	97.7	0.3092***
	Female	2	1.69	5	2.67	7	2.30	
Marital status	Married	116	98.31	164	87.70	280	91.8	10.8121***
	Unmarried	2	1.69	23	12.30	25	8.2	

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

### 3.2. Economic and production characteristics

In the study area, own land, rented land and shared cropping lands were considered as total cultivated land. The mean cultivated farmland, for participants was 2.22 hectares, while for non-participants was 1.57 hectares with standard deviation of 0.62 and 0.59 respectively. There were statistically significant differences between export market participants and non-participants based on size of land owned, at a 1% significance level (t-value= -9.1656 P-value=0.001). The mean total livestock holding size for participants

was 5.48 and 6.38 for non-with standard deviation 2.9 for participants and 2.18 for non-participants. The differences between export market participant and non-participant was statistically significant, at 1% significance level (t-value= 3.0853 P-value=0.001) of significance. The average size of farmland allocated for avocado production of export market participant was 1.4 and 0.7 hectare for non-participant with standard deviation of 0.6 and 0.4 respectively and statistically significant, at 1% significance level (Table 3).

**Table 3: Endowment factor of production of smallholder farmers**

Variable	Participant (n=118)		Non-Participant (n=187)		Difference	t-value/chi2
	Mean	SD	Mean	SD		
Cultivated farm land	2.22	0.623	1.57	0.59	-0.6484388	-9.1656***
Livestock holding	5.48	2.90	6.38	2.18	0.9019307	3.0853***
Land allocated for avocado production	1.38	0.45	0.65	0.31	-.7276399	-13.3989***

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

Quantity of avocado production shows significant at a 1% significance level (Table 5) difference between the two groups. The average quantity of avocado production by participants is 2061.25 kg and 562.53

kg for non-participants the mean difference is 1498.72 kg with standard deviation of 3310.81 for participants and 963.69 for non-participants (Table 4)..

**Table 4: Quantity of avocado production: mean comparison results**

Variable	Participant (118)		Non-Participant (187)		Difference	
	Mean	SD	Mean	SD	Mean	t-Value/chi2
Quantity of Avocado production	2061.25	3310.8	562.533	963.69	-1404.7	-5.7271***

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

### 3.3. Institutional Characteristics

In the study area smallholder farmers are selling avocado to export market through cooperative. The cooperative establishes to create linkage between smallholder farmers and export agency. The Agricultural cooperative office provides training and input (seedling). In the study area most of export market participant farmers are member of this cooperative. From the participant group 75.42% and 4.28% from the non-participant were a member of cooperative. The chi-square test shows that there is statistically significant difference between the two groups in terms of membership in farmers' cooperative at 1% significant level (chi2= 168.8438 p-value= 0.000).

The Chi2 test showed that the difference between participant and non-participant in terms of involve in on/off farm activity was significant at a 10% level with 47.59% of non-participant and 57.63 % of participant participate in. From the total sample 51.48% involved in on/off farm activities in the study area. Market Information is the main variable that possibly affect avocado export market participation. It is vital for, form sample households 46.61 % of the participant and 34.76 % of the non-participant had market information. The chi-square test shows that there is statistically significant difference between the two groups in terms of get market information access from any source at 5% significant level (Table 5).

**Table 5: Access to institutional support services for dummy variables**

Variable	Response	Participant (118)		Non-Participant (187)		Chi2
		N	%	N	%	
Access Credit	Yes	56	47.46	71	37.97	2.6811
	No	62	52.54	116	62.03	
non/off-farm income	Yes	68	57.63	89	47.59	2.9159*
	No	50	42.37	98	52.41	
Cooperative membership	Yes	89	75.42	8	4.28	168.84***
	No	29	24.58	179	95.72	
Market Information	Yes	55	46.61	65	34.76	4.2576**
	No	63	53.39	122	65.24	

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

Distance to the cooperative is an important variable since the cooperative is used as a collection center for avocado export market participants and a source of information to sell products. In line with this, the average distance of the non-participant and participant groups to the cooperative was approximately 64.89 minutes and 49.19 minutes respectively. The standard deviation of participants and non-participants were

13.2 and 23.9. with statistically significant difference between the two at 1% significance level.

On the other hand, contact with an extension agent helps farmers to be aware of participation in export

market. The extension agents provide technical information and advice as well as training on avocado production and export market. From the result of this study extension experts had more contact with

participants than non-participants. The average number of extension contact of participant farmers was 2.6 and 1.3 for non-participants, respectively with standard deviation of 1.2 and 0.56 respectively. There

is a statistically significance difference between the two groups (participants and non-participants) at a 1% significance level in terms of extension contact (Table 6).

**Table 6: Access to institutional support services for continuous variables**

Variable	Participant (118)		Non-Participant (187)		Difference	
	Mean	SD	Mean	SD	Mean	t-Value
Distance from cooperative	49.19	13.2	64.89	23.9	-15.7	6.54***
Extension frequency	2.6	1.2	1.3	0.56	-1.30	-12.72***
Distance from agriculture office	47.72	22.68	48.05	22.04	0.33	0.12

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Source: Owen survey, 2022/23

### 3.4. Factors affecting avocado export market participation

Factors affecting avocado export market participation and level of participation were analyzed using the DH model. However, before running the model, all preliminary tests were conducted. The results for the determinant of avocado export market participation have a binary nature and the first stage is estimated using the Probit model, whereas the second stage uses the truncated model as presented in Table 7. The likelihood ratio test indicates that the overall goodness of fit of the DH model is statistically significant at  $P < 0.01$  significance level. This indicates that explanatory variables jointly explained the probability of participation in the avocado export market.

The double-hurdle model was fitted with 16 explanatory variables as presented in Table 7. The first-stage model results showed that nine variables in which are sex of the household head, distance from the cooperative, total landholding size, total land allocated for avocado production, tropical livestock unit, membership in cooperative, frequency of extension contact, market information, and quantity of avocado production significantly determine the avocado export market participation of avocado producers.

Sex of household head had a positive and significant effect on the smallholder farmers export market participation decision at 10% significant level. This implies that male household heads more likely participated in the export market than female household heads. Holding other explanatory variables constant, being a male-headed household increased the

probability of avocado export market participation by 31%. This may be due to the fact that male-headed households are more likely interact with district experts and members of cooperatives. Additionally, male-headed households have better information than female-headed households because females have more burden in household care so they may not have time to interact with agricultural experts. This study result is in line with Gurmis and Melese (2022), who found being a male household head increases the likelihood of participation in the avocado market in the Kaffa Zone of Ethiopia.

Distance from a cooperative in walking time had negatively influenced the avocado export market participation decision at 1% significant level. This is due to the fact that farmers that live near to the cooperative have better access to information, less transaction cost, and waking time since the cooperative is the market place for avocado export market participant smallholder farmers. The marginal effect shows that all other factors remaining equal, when distance to cooperative increases by one minute, the probability of smallholder farmers participation in the avocado export market increases by 0.9%. This is in line with Keba and Yilma (2022), who found negative influence of distance to the main market on the probability of smallholder farmers participating in the banana market.

During the focused group discussion, the participants of FGD stated that the households near to the cooperative have an interest in participation in the avocado export market because it reduces the

transaction cost, they access information and training better than the smallholder farmers far from the cooperative. Cultivated farmland size was found to have a positive and significant effect at a 1% significant level on the export market participation decision of avocado producers. Farmers with large farmland are encourage to prioritize avocado production which leads to produce marketable surpluses. The marginal effect shows that *ceteris paribus*, when total land holding increases by one hectare, the probability of smallholder farmers participation in the avocado export market increases by 25%. The study is in line with Amare et al. (2019) who confirmed a larger farm size have positive effect on avocado export market participation.

As expected, land allocated to avocado production determines avocado export market participation positively and significantly at a 1% significant level. The more land allocated to avocado, the larger outputs from that land and expected to participate in the avocado export market. The marginal effect shows that holding all other explanatory variables constant, when land allocated to avocado production increases by one hectare, the probability of smallholder farmers participation in the avocado export market increases by 27%. This study is line with Tarekegn et al. (2020) who found the area allocated to fruit production has a positive effect on fruit market participation.

Total Livestock holding size is negatively associated with the probability of avocado export market participants at 10% significance level. Those farmers who participate in the avocado export market have less tendency to be involved in livestock production due to the fact that the avocado export market requires more time and area. The marginal effect results revealed that *ceteris paribus*, total livestock holding size decreased the probability of participation in the avocado export market by 3.3% per Tropical Livestock Unit. This study is in line with Kassa et al. (2017) and Mossie et al. (2020) who found livestock ownership negatively affected smallholder market participation.

Cooperative membership had a positive effect at 1% significant level. Farmers who are members of cooperatives access information easily, have input access such as seedlings, can access different services like training, and have access to the export market. The

marginal effect results revealed that holding other variables constant, membership in cooperatives increased the probability of participation in the export market by 55%. This study is in line with Karing'u et al. (2020) who found that membership in farmer organizations increased participation in the avocado export market by 1.10%. This implies that farmer organizations promote the networking of farmers in agricultural marketing and promote ease of access to marketing services. According to FGD participants smallholder farmers that are members of a cooperative have better chance to participate in the avocado export market since they have a linkage with the export market.

Frequent extension contact had a positive and significant influence on the export market participation decision at a 1% significant level. When extension agents visit farmers frequently, farmers are more likely to access information, training, and market awareness. The marginal effect shows that *ceteris paribus*, when extension contact increases by one day, the probability of smallholder farmers participating in the export market increases by 13%. This study is similar to Mengesha et al. (2019) and Mossie et al. (2020), who shows that the frequent of extension service contacts helps producers obtain up-to-date production and market information.

Market information had positive and significant influence on the avocado export market participation decision at a 1% significant level. Farmers involved in the export market had greater access to information than non-participants. Access to market information had a positive and significant influence

on the avocado export market participation decision at a 1% significance level. The marginal effect indicates that holding all other explanatory variables constant, having access to reliable market information increases the probability of smallholder farmers participating in the avocado export market by 19% compared to households that lack access to such information, *ceteris paribus*. This study is in line with Karing'u et al. (2020) who found that access to market information positively affected farmers' participation in the avocado export market by 3.63% (Table 7).

The quantity of avocado produced had positively and significantly influenced the export market participation decision at a 1% significant level. Due to the fact that producing relatively large quantity of avocados enables households to have a marketable surplus to participate in the export market. The marginal effect shows that *ceteris paribus*, when the quantity of avocado production increases by one kilogram, the probability of smallholder farmers' participation in the export market increases by 0.008%. This finding is consistent with Haile et al. (2022) who found a positive and significant relationship between amount of maize output produced and probability of market participation.

### 3.5. Determinant level of export market participation of avocado producers

To identify determinants of level of avocado export market participation second stage of the DH (truncated) model was employed. In this stage, the result confirmed that five variables such as marital status, access to agricultural credit, membership in cooperative, market information, and quantity of avocado production significantly affect quantity supplied to market by avocado producers.

Marital status determines the level of the avocado export market positively and significantly at 10% level of significance. This implies that smallholder farmers who get married supply 1.11 times more quintals of avocado to the export market (Table 7).

Access to credit was negatively and significantly associated with the level of avocado export market participation at a 1% significance level. Farmers with

access to credit provided 1.242 quintals less avocados to the export market than their counterparts. The smallholder farmers that have access to credit do not invest in avocado production rather they use it for other cereal crops, house building, education, and consumption. This finding is contrary to Menelek et al. (2022) who found that access to credit positively affects the supply of date to the market.

Cooperative membership of the household head was associated positively and significantly with level of avocado export market participation at 5% significant level. Avocado export market participant became a member of a cooperative avocados supplied to the export market increased by 2.95 quintals keeping the other variable constant. This result is consistent with the research conducted by Hagos et al. (2020) which shows that mango grower farmers' club membership had a positive and vastly significant effect on the quantity of mango sold. Additionally, membership in cooperatives could have better access to market information, inputs, extension services, technical advice, and credit facilities important to production and marketing decisions as stated in (Aliyi et al., 2021).

Access to market information positively and significantly affected the level of avocado export market participation at 10% significant level. Avocado producers who had access to market information increased export market supply by 1.21 quintals compared to their counterparts. Smallholder farmers that have more market information about the market specifically the price  $e$  supply more avocado to the export market (Table 7). These findings are similar to Aliyi et al. (2021) and Menelek et al. (2022) who found a positive relationship between market information and the marketable supply. The quantity of avocado produced was positively and significantly affected the level of avocado export market participation at a 1% significant level. One quintal increase in avocado production by avocado producers results in 0.011 quintal increase in avocado export.

**Table 7: Determinant of decision and level of avocado export market participation**

Variables	First-stage (Tier 1)	Second-stage (Tier 2)
-----------	----------------------	-----------------------

	Coefficient	Marginal effect	Coefficient
Sex of the household head	1.017* (0.541)	0.31	3.026 (3.132)
Age of household head	-0.006 (0.011)	-0.0025	-0.046 (0.054)
Marital status of household head	0.295 (0.65)	0.11	1.115* (0.618)
Family member in the household head	0.045 (0.061)	0.017	0.134 (0.146)
Education level	0.025 (0.029)	0.0098	0.001 (0.057)
Distance from the agricultural office	0.003 (0.005)	0.001	-0.001 (0.011)
Distance from cooperative	-0.023*** (0.005)	-0.009	-0.006 (0.019)
Cultivated farmland	0.651*** (0.2)	0.25	1.072 (0.901)
Land allocated for avocado production	0.704** (0.306)	0.27	1.024 (1.131)
Tropical Livestock Unit	-0.087* (0.046)	-0.033	0.034 (0.091)
Access to agricultural credit	-0.28 (0.231)	-0.109	-1.242*** (0.457)
Membership of cooperatives	1.516*** (0.268)	0.55	2.953** (1.452)
Frequency of extension contact	0.337** (0.154)	0.13	0.273 (0.21)
On/off-farm income	0.314 (0.244)**	0.12	-0.51 (0.754)
Market information	0.491 (0.236)	0.19	1.21* (0.678)
Quantity of avocado production	0.0002* (0.0001)	0.00008	0.01*** (0.0001)
_cons	-2.946**		-10.251 (5.614)
sigma_cons	(1.246)		2.883 (0.822)
<i>Number of observations</i>	305		
<i>Wald Chi2 (16)</i>	142.72		
<i>Prob&gt; Chi2</i>	0.0000		
<i>Log pseudo likelihood</i>	-336.84581		

Note: \*, \*\*, and \* indicate significance at 1%, 5%, and 10% levels, respectively. Robust standard errors in parentheses. Source: Owen survey, 2022/23

#### 4. Conclusion and recommendations

Utilizing cross-sectional data from 305 households and employing the DH model analysis explained the distinct barriers to market participation decision and intensity. The model result shows that the probability of smallholder farmers participating in the avocado export market increases with membership in cooperative, cultivated farmland size, size of land allocated for avocado production, extension contact

frequency, access to market information, sex of household head, quantity of avocado produced and decreases with an increase in distance from cooperative and livestock holding size. Furthermore, smallholder farmer's level of participation in the avocado export market increases with being married, access to agricultural credit, membership in cooperatives, access to market information, and increase in quantity of avocado production.

Cooperative membership improves avocado export market participation decisions. Hence, strengthening farmers cooperatives is required. The district agricultural office, and NGOs strengthen the cooperatives with required facilities (cold storage) in each avocado-producing *Kebeles* that could increase smallholder farmers participation in the export market. Furthermore, encouraging farmers to allocate more proportion of their land than the current for avocado production with good agronomic practices may be required. Therefore, the district Agricultural office need to encourage farmers to allocate more land and produce more avocados. Finally, the leveraging digital platforms to provide real-time market information is also required.

### Acknowledgements

The authors highly acknowledge respondents and experts who participated in the data collection process.

### Data availability statement

Data will be made available on request.

### Conflict of interest

The authors declared that there is no conflict of interest.

### Reference

- Abate, D., Mitiku, F., and Negash, R. (2022). Commercialization level and determinants of market participation of smallholder wheat farmers in northern Ethiopia. *African Journal of Science, Technology, Innovation and Development*. 14(2): 428-439.  
<https://doi.org/10.1080/20421338.2020.1844854>
- Alemayehu, A., Melka, Y., and Eshete, A. (2023). Eucalyptus woodlot adoption and its determinants in the Mecha District, Northern Ethiopia. *Frontiers in Forests and Global Change*. 6: 1–9.  
<https://doi.org/10.3389/ffgc.2023.1111301>
- Aliyi, I., Faris, A., Ayele, A., Oljirra, A., and Bayessa, M. (2021). Determinants of market participation among smallholder vegetable producers in Southwest Ethiopia. *Ethiop. J. Appl. Sci. Technol.* 12(2): 24–37.
- Amare, M., Mariara, J., Oostendorp, R., and Pradhan, M. (2019). The impact of smallholder farmers' participation in avocado export markets on the labor market, farm yields, salesprices, and

incomes in Kenya. *Land Use Policy*. 88: 104168.  
<https://doi.org/10.1016/j.landusepol.2019.104168>

- Andaregie, A., Astatkie, T., and Teshome, F. (2021). Determinants of market participation decision by smallholder haricot bean (*Phaseolus vulgaris* L.) farmers in Northwest Ethiopia. *Cogent Food & Agriculture*. 7(1).  
<https://doi.org/10.1080/23311932.2021.1879715>
- Awotide, B. A., Karimov, A. A., and Diagne, A. (2016). Agricultural technology adoption, commercialization and smallholder rice farmers' welfare in rural Nigeria. *Agricultural and Food Economics*.4(1).  
<https://doi.org/10.1186/s40100-016-0047-8>
- Berhan Tegegne, H. (2023). Analysis of institutional arrangements for water governance, crop production efficiency, commercialization, and impact on household welfare in irrigation schemes of the Amhara region, Ethiopia (Vol. 4, Issue 1).
- Cragg, J. G. (1971). Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*. 39(5): 829.  
<https://doi.org/10.2307/1909582>
- Dessie, A., Abate, D., and Wayu, S. (2019). Determinants of market participation among smallholder mango producers in Assosa Zone of Benishangul Gumuz Region in Ethiopia. *International Journal of Fruit Science*. 19(4): 292–309.
- Đuric, I. (2020). Digital technology and agricultural markets - Background paper for The State of Agricultural Commodity Markets (SOCO) 2020. Rome: FAO.  
<http://www.fao.org/documents/card/en/c/cb066en>
- Etuk, E. A., and Ayuk, J. O. (2021). Agricultural commercialisation, poverty reduction and pro poor growth: evidence from commercial agricultural development project in Nigeria. *Heliyon*. 7(5): e06818.  
<https://doi.org/10.1016/j.heliyon.2021.e06818>
- FAO. (2021). Major Tropical Fruits: Market Review 2020. Statistical Compendium Rome: FAO.
- Gurmis, N., and Melese, T. (2022). Analyzing the Factors that Influence Market Participation among Avocado Producers in Kaffa Zone of

- South-Western Ethiopia. *International Journal of Fruit Science*. 22(1): 794–808.  
<https://doi.org/10.1080/15538362.2022.2129549>
- Hagos, A., Dibaba, R., Bekele, A., and Alemu, D. (2020). Determinants of Market Participation among Smallholder Mango Producers in Assosa Zone of Benishangul Gumuz Region in Ethiopia. *International Journal of Fruit Science*. 20(3): 323–349.  
<https://doi.org/10.1080/15538362.2019.1640167>
- Haile, K., Gebre, E., and Workye, A. (2022). Determinants of market participation among smallholder farmers in Southwest Ethiopia: a double-hurdle model approach. *Agriculture and Food Security*. 11(1): 1–13.  
<https://doi.org/10.1186/s40066-022-00358-5>
- Jebesa, S. R. (2019). Determinants of Smallholder Farmers Market Participation and Outlet Choice Decision of Agricultural Output in Ethiopia: A Review. 7(4): 139–145.  
<https://doi.org/10.11648/j.ajaf.20190704.13>
- Karing'u, K. N., Isaboke, H. N., and Ndirangu, S. N. (2020). Transaction costs and participation in avocado export marketing in Murang'a County, Kenya. *Journal of Agribusiness in Developing and Emerging Economies*. 11(3): 221–240.  
<https://doi.org/10.1108/JADEE-12-2019-0206>
- Kassa, G., Yigezu, E., and Alemayehu, D. (2017). Determinants of smallholder market participation among banana growers in bench Maji Zone, Southwest Ethiopia. *International Journal of Agricultural Policy and Research*. 5(11): 169–177.
- Keba, A., and Yilma, B. (2022). Analysis of factors affecting banana market participation in the case of Assosa zone of Benishangul gumuz regional state, Ethiopia. 1–4.
- Kifle, D., Galmesa, A., and Getachew, B. (2022). Determinants of market participation decision and intensity of market participation in western Ethiopia: Evidence from smallholder tef producers. *International Journal of Agricultural Science and Food Technology*. 8(2): 125–133. <https://doi.org/10.17352/2455-815x.000153>
- Kwizerimana, S. (2017). Impact of collective marketing participation on smallholder avocado farmers' income in Murang'a County, Kenya (M.Sc. thesis).
- Luchia, T., Hadush, H., and Hadas, B. (2018). Evaluation of frontline demonstration of herbicide (Pyroxsulam) for weed control in bread wheat in Tigray, Northern Ethiopia. *Journal of Agricultural Extension and Rural Development*. 10(1): 20–27. <https://doi.org/10.5897/jaerd2017.0910>
- Mariyono, J. (2019). Stepping up to market participation of smallholder agriculture in rural areas of Indonesia. *Agricultural Finance Review*. 79(2): 255–270.  
<https://doi.org/10.1108/AFR-04-2018-0031>
- Mazengiya, M. N., Berhanu, A. A., and Misganaw, G. S. (2023). Driving Forces of Farmers' Decision towards Monoculture of Eucalyptus. *International Journal of All Subject Research*. 2(6): 14–21.
- Menelek, D., Mohammed, S., and Assefa, A. (2022). Determinants of Market Participation Decision and Intensity among Date Producers in Afar Region, Ethiopia: A Double Hurdle Approach. *International Journal of Fruit Science*. 22(1): 741–758.  
<https://doi.org/10.1080/15538362.2022.211919>
- Mengesha, S., Abate, D., Adamu, C., Zewde, A., And Addis, Y. (2019). Value chain analysis of fruits: The case of mango and avocado producing smallholder farmers. *J. Dev. Agric. Econ*. 11: 102–109.  
<https://doi.org/10.5897/JDAE2018.1038>
- Mengistie, D., and Kidane, D. (2016). Assessment of the impact of small-scale irrigation on household livelihood improvement at Gubalafto district, North Wollo, Ethiopia. *Agriculture (Switzerland)*. 6(3).  
<https://doi.org/10.3390/agriculture6030027>
- Ministry of Planning and Development (MoPD). (2021). Ten years development plan: Apathway to prosperity. Addis Ababa, Ethiopia.
- Mossie, M., Gereziher, A., Ayalew, Z., and Nigussie, Z. (2020). Determinants of small-scale farmers' participation in Ethiopian fruit sector's value chain. *Cogent Food & Agriculture*. 6(1).  
<https://doi.org/10.1080/23311932.2020.1842132>
- Motuma, G., Beriso, G., and Yacoob, E. (2024). Dairy product market participation and its impacts on household food security of smallholder farmers in Jimma zone Ethiopia: A PSM

- approach. *Cogent Food & Agriculture*. 10(1). <https://doi.org/10.1080/23311932.2023.2300875>
- Nebere, H., Tolossa, D., and Bantider, A. (2021). Analyzing Factors Affecting the Sustainability of Land Management Practices in Mecha Woreda, Northwestern Ethiopia. 1–16.
- Otekunrin, O. A., Momoh, S., and Ayinde, I. A. (2019). Smallholder Farmers' Market Participation: Concepts and Methodological Approach from Sub-Saharan Africa. *Current Agriculture Research Journal*. 7(2): 139–157. <https://doi.org/10.12944/carj.7.2.02>
- Tabitha, K., and Clem, T. (2016). Social economics, policy and development. *AgEcon Search*. 18.
- Tafere, M., Hassen, A., Kassa, B., Berihun, B., Tolla, M., Deneke, Y., Selassie, Y. G., and Tegegne, F. (2015). Participatory Rural Appraisal Report: Mecha District BDU Cascape Working Paper 5.
- Tarekegn, K., Asado, A., Gafaro, T., and Shitaye, Y. (2020). Value chain analysis of banana in Bench Maji and Sheka Zones of Southern Ethiopia. *Cogent Food & Agriculture*. 6(1). <https://doi.org/10.1080/23311932.2020.1785103>
- Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica*. 26(1): 24–36.
- Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. MIT Press.
- Woreda office of Agriculture (WoA). (2021). North Mecha District Office of Agriculture Annual Progress and Crop Production Report. Amhara regional state, Ethiopia.
- Yemane, T. (1967). *Statistics: An Introductory Analysis* (2nd Edition).
- Yohannes, N. (2022). Assessment of the challenges of coffee and oil seed exporters in Ethiopia (M.Sc. thesis). Bahir Dar University, Ethiopia.