Analysing the Factors that Influence Market Participation among Avocado Producers in Kaffa Zone of South-Western Ethiopia

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ABSTRACT
Market participation by smallholder farmers is crucial for livelihood improvement in developing countries. Even though it is the source of currency, the fruit market has not been given attention. Therefore, this study intended to identify factors influencing avocado producers’ market participation decisions and volume of market participation in the Kaffa zone, Ethiopia. Gimbo and Chena districts were selected purposefully with a multi-stage sampling method on the bases of production potential. Data for this study were collected from 384 households from six representative Kebeles with the Cochran formula. Both primary and secondary data were employed. Primary data was collected using a semi-structured questionnaire. Both descriptive statistics and the double hurdle econometric model were employed for analysis. The descriptive statistics showed that out of 384 households (236 participants and 148 were non-participants), 89.19% were male avocado market participants and 76.69% were male avocado non-market participants. The econometric model results confirmed that market participation decisions (hurdle 1) of producers were significantly influenced by sex, market experience, education level, and family size. The intensity of avocado market participation (hurdle 2) is significantly affected by the market experience, access to credit services, extension contact, family size, and off-farm income. Understanding the factors of both avocado market participation decisions and level of participation helps policymakers to re-adjust their policies both at the regional and federal government levels. Then, this study recommends that governments need to exploit more effort into market-oriented production to enhance the productivity of avocados. Credit providers also must strengthen. Additionally, modern production technologies must be taken into consideration to increase the avocado quantity produced.

KEYWORDS
Avocado; market participation; producer farmers; kaffa zone

Introduction
Agriculture is an important engine of economic growth for developing countries. It contributes to 30% of GDP (FAO, 2013) and more than 40% of employment in active labor force globally (Benjamin et al., 2014). Smallholder farming accounts for 75% of agricultural production in Kenya, Ethiopia, Uganda, and Tanzania which supports 80% of livelihoods directly (Salami et al., 2010; MoFED, 2015).

Today, small-scale farming is the primary means of livelihood source for the Ethiopian population (majority) and the basis of the national economy. It contributes to 72.7% of employment, 35.8% of GDP, and 81% of foreign exports (CIA, 2017). Even though small-scale farming has persisted as a promising resource for both self-sufficiency and export it is constrained by production technologies and limited market access to both input and output (Hagos and Zemedu, 2015).
Even though a shift from subsistence agriculture to commercial agriculture is crucial, its transition is not fast (Pingali and Rosegrant, 1995). In a broader market economic system and financial expansion, the outcomes of market participation enhance the well-being of farmers via improved comparative earnings and productiveness growth (Johnston and Mellor, 1961). Most farmers engaged in agriculture in Sub-Saharan Africa like Ethiopia are still self-insufficient, with low inputs and productiveness. Increasing smallholder farmer’s market participation performs an essential function in poverty alleviation (Olwande et al., 2015). But to participate in agricultural markets and increase their farm incomes they often turn to typical cash crops, such as cotton and coffee or high-value crops especially fresh fruits like avocado and vegetables. Such crops have a high-income potential and are important for the livelihoods of farmers worldwide. However, transaction costs are particularly high in these markets. Specializing on cash crops often entails high risks due to high input costs, considerable price volatility, and a dependency on one or large buyers (Poulton et al., 2004). In general, the transition is the key driver of one’s country’s economic growth (Carletto et al., 2017).

According to Hazell et al. (2007), most farmers living in absolute poverty are smallholder farmers. “This is probably because of smallholder farmers missing advertising consciousness and competencies to promote their harvests and, consequently, the bulk of them regularly choose to decrease cost on the farm gate or with inside the nearby markets” (Gyau et al., 2016). Commercializing smallholder farmers is a way to take the welfare advantages of the market primarily based on entirely trade economies to smallholder agriculture and is relevant to an inclusive improvement process (Arias et al., 2013).

Tropical and sub-tropical fruit can make a significant direct contribution to the subsistence of small-scale farmers by providing locally generated nutritious food when other agricultural crops have not yet been harvested. Fruits are versatile products that depending on need, can be consumed within the household, or sold. Fresh tropical fruits are on winning ground in world markets as recent statistical figures show (Anonymous, 2001). Its production has risen by 7% annually since 1997, and the bulk of these fruits (98%) are grown in developing countries. According to Yeshila (2004), the latest figure shows that avocado and pineapple account for 44% of the total traded volume, followed by mangoes (27%), avocados (12%), and papayas (7%). The main reason for the increase in demand for tropical fruits is the growing familiarity of consumers with tropical fruits, their taste, nutritional value, and cooking qualities. Even though, the demand for fruit increases from year to year in developing countries, like Ethiopia, greater than 90% of fruits are produced and marketed through traditional domestically sourced production and marketing systems (Assessment et al., 2013). This might be due to different factors like demographic, socioeconomics, institutional, and market-related problems (ibid).

The fruit sector in Ethiopia has high-value products as compared to other crops and promises high returns on relatively small investments (Timoteos and Tistig, 2012). According to CSA (Central Statistical Agency) (2017), in the 2016/17 production season about 107,890.60 ha were cultivated for fruits, of this 16.53% were for avocados, 14.29% were for mangoes and the rest 30.82% for other fruits. In this area, 7,923,665.02 quintals were produced.

South Nation Nationalities and Peoples region of Ethiopia is the leading fruit producer in the country. As an indication, in this region in the 2016/17 production season, 68,580.42 ha were cultivated by the fruit as the result around 5,612,267.27 qt fruits were produced (CSA (Central Statistical Agency), 2017). In the Kaffa zone, 4,271.48 ha were cultivated by the fruit. Using this area 182,600.32qt was produced (CSA (Central Statistical Agency), 2017).

Most studies on market participation and even market supplies are on food crops and lack a systematic focus on fruits. This leads to wrong policy recommendations. Moreover, previous research globally in general and specifically in Ethiopia like Ao et al. (2019), Ngenoh et al. (2019), Jaji et al. (2018), Tarekegn et al. (2020), Temesgen and Hiwot (2017), Osmani and Hossain (2015), Tadesse and Temesgen (2019), and Tesfaye (2020) in one way or another face model selection problem or variable specification problem. For instance, Tarekegn et al. (2020) conducted research on the value chain analysis of bananas in Bench Maji and Sheka Zones of southern Ethiopia. He tried to see the value chain of bananas using 180 banana producers with Heckman two stage econometric models. As
a result, the distance to the market is positive. This happened due to a model selection problem. Osmani and Hossain (2015) conducted research on market participation in Bangladesh. They used a variable family size from the perspective of the labor force and got a positive effect on smallholder market participation in Bangladesh. But it must be seen from the perspective of consumption. This happened due to variable specifications. Our study depends on the double hurdle model proposed by Cragg (1971) and model selection criteria as we stated below in the methodology part. This is because in this model, non-participants are considered a corner solution utility model whereas in the Heckman two-stage model, non-participants will never participate under any circumstances (Kahenge et al., 2020; Mossie et al., 2020; Musah, 2013).

Our research fills the above literature gaps through corrected model selection and sampling procedures and adds knowledge to the literature. In conclusion, this study envisages figuring out elements that have an impact on small-scale avocado producers’ choices to take part in the market and the extent of market participation (amount supplied) within the Gimbo and Chena districts of the Kaffa region for the 2019 production year (season). By doing so, witness the providers of the growing literature on farm households’ participation in horticultural crops (Avocado).

Description of the Study Area
Kaffa Zone is formerly one of among SNNPR (Southern Nations, Nationalities, and People’s Region) zones in Ethiopia. But now it is under the southern region of Ethiopia. It is located approximately 460 km southwest of the capital city of Ethiopia. Debub Omo bounded it in the south, Bench Maji in the Southwest, Sheka in the West, Oromia Region in the North, and Konta in the East. This Zone has a total population of 874,716, of whom 431,778 are men and 442,938 are women (CSA (Central Statistical Agency), 2017).

Attitudinally, the expected topography elevation above sea level is 1795 m (MASL) or (5889 feet). The major financial sector in the region is ruled by agriculture. Agriculture contributes about 41% of the GDP, 80% of exports, and 80% of the active labor force. Other sectors encompass offerings and tourism, manufacturing, and others. Agriculture is the spine of the economic scheme with a maximum of the alternative sectors (i.e., tourism) dependent on its robust side-to-side linkages. The following Figure 1 indicates where Gimbo and Chena districts are located in the Ethiopia Kaffa zone.

**Sampling Technique and Sample Size Determination**
Smallholder avocado producers in the two districts of the Kaffa zone are the target population for this study. To draw proper data, both purposive and random sampling techniques were applied to select sample avocado producers. The sample frame of the study is the list of households obtained from selected six kebeles of the two districts from the district’s Agriculture office. The major avocado growing districts are Gimbo and Chena. Multistage sampling techniques were employed. First, the Kaffa zone was selected purposely based on its potential for avocado production. Second, Gimbo and

![Figure 1. Study area map Source: Adapted from GIS, 2019.](image-url)
Chena districts were selected purposely based on their highest potential for fruit (Avocado) production and accessibility to the market. Third, three kebeles (small population) from each district were selected by stratified random sampling techniques with district agricultural offices. Accordingly, Shomba-Sheka, Hibret, and Kicho kebeles from Gimbo districts; Dosha-toga, Boba-bela, and Bobaguta kebeles from Chena district were selected. Finally, respondents were proportionally selected by employing a simple random sampling technique. As a sampling frame, a list of farming households was obtained from the respective kebele agriculture offices and categorized into participants and non-participants in the fruit market with the assistance of local informants. The sample size was determined using Mugenda and Mugenda (2003) table since the total population size (N) is more than 10,000. The sample size is determined using probability proportional to the sample size-sampling technique of Cochran (1977):

$$n_0 = \frac{Z^2 \cdot (p)\cdot (q)}{d^2}$$

$$n_0 = \frac{1.96^2 \cdot (0.5)\cdot (0.5)}{0.05^2} = 384$$

where $n_0$ = desired sample size when the population; $Z$ = standard normal deviation (1.96% to 95% confidence level); $P = .5$ (proportion of the population included in the sample, that is, 50%); $q = 1-P$, that is, 0.5; $d =$ chosen degree of precision (0.05). With this formula, 384 households were included in the sample.

Therefore, a sample (n) of 384 fruit-growing households was set. Then avocado producers were proportionally allocated among the selected kebeles.

**Data Types, Sources, and Methods of Data Collection**

This study used cross-sectional data as a study design. Both non-quantitative (qualitative) and number-based data (quantitative) were collected from primary and secondary sources. For the reliability of the data semi-structured questionnaire survey was used. This means that triangulation procedures were used. Primary data turned into prepared, revised, and pre-tested in advance. Six data collectors who have a BSc degree were proposed and employed for data collection for each study kebeles which were from April 2019 to July 2019. The collected data tell us about family characteristics, possession of assets, production systems, socio-economics problems, institutional factors, and activities of the market. Secondary data were collected from published and unpublished files of each qualitative and quantitative sort of data.

**Conceptual Framework**

Our study is based on the utility maximization framework concept that farmers’ decisions about whether to participate in the avocado market or not. According to Norris and Batie (1987), the key assumption of this model is that the decision of farm households is based on the principle of utility maximization. Specifically, in this study for a farmer to participate in the avocado market is that the farmer sells a part of their avocado output in the market. According to (McFadden, 1974), a household’s utility function from using alternative $j$ is then expressed as follows:

$$Y_i* = U_{ij} - U_{ik} > 0$$

$Y_i*$ is the farm household’s net benefit, $U_{ij}$ and $U_{ik}$ were utilized from participation and nonparticipation, respectively, of its small-scale avocado producer. Since these utilities are unobservable. they can be expressed in Equation (2) as a function of observable elements:
\[ Y_i^* = X_i \beta + \mu_i, \text{with} \ Y_i = \begin{cases} 1, & \text{if } Y_i^* > 0 \\ 0, & \text{if } Y_i^* \leq 0 \end{cases} \quad (3) \]

where \( Y_i \) is the observed dependent variable,

\( X_i \) is a vector of explanatory variables,

\( \beta \) is a vector of parameters estimated, and

\( U_i \) is an independent normally distributed error term with zero mean and constant variance. In general, this conceptual understanding leads us to select an appropriate model for analysis.

**Econometric Model Specification**

Limited dependent models (Heckman two-step models, Tobit, Double hurdle) were used in the study of crop market participation. If the mills’ lambda of Heckman’s two-step models is insignificant which indicates there is minimal selectivity bias in the model, in this case, Heckman is less appropriate as compared to other limited dependent models. Hence, the Tobit model and double hurdle model were compared using the model specified test (Komarek, 2010). Based on the model specification test result indicated in the result and discussion’s part among limited dependent models (Heckman two-step models, Tobit, Double hurdle), the last model is appropriate for this research dataset and the mills’ lambda (0.235) of Heckman two-step models is insignificant (appendix Table 1).

According to Wooldridge (2002), the Tobit model assumes that the household’s decision to the seller and on how much to sell if the sale occurs is determined by the same mechanism. With the model specification test discussed later below and shown as well in the model result, Tobit does not fit this research data set following the specified test. The model proposed by Cragg in 1971 was an alternative to the selectivity model, which is by far the fittest model for this data set. Its name comes from the fact that there are two hurdles to overcome before observing a non-censored observation and to nest the general Tobit model. According to Newman et al. (2001), the first hurdle involves the choice of to sell or not to sell avocado (participation decision), whereas the second hurdle concerns the level of avocado sales the producer chooses (quantity of sales decision). It indicates that a producer makes two decisions with respect to the sale of an item. Even the model considers non-market participants as a cornerstone, which is not considered in the Heckman two-step model.

In addition, Burke (2009) indicates that estimating the determinants of the continuous dependent variable in the second stage double hurdle model is useful because it allows a subset of the data to crash at some value without causing bias, hence we can obtain all the data in the remaining sample for the participants. Therefore, in the double hurdle model, there are no restrictions regarding the elements of explanatory variables in each decision stage. According to Wooldridge (2002), the participation and quantity of teff sales equation are written as:

\[ d_i^* = X_i \alpha + \mu_i \quad (4) \]

| District | Selected fruit-producing kebeles | Total no. of kebeles in the district | Total no. of district households | Total no. of district fruit producers | No. of producers in each kebele | No. of samples taken from each kebele |
|----------|---------------------------------|-------------------------------------|----------------------------------|-------------------------------------|-------------------------------|----------------------------------|
| Gimbo    | Shomba-Sheka                    | 35                                  | 12,311                           | 6880                                | 675                           | 62                               |
|          | Hibret                          |                                     |                                  |                                     | 683                           | 64                               |
|          | Kicho                           |                                     |                                  |                                     | 681                           | 64                               |
|          | Dosha-toga                      | 39 (3 town kebeles)                 | 21,685                           | 9753                                | 694                           | 65                               |
|          | Boba-bela                       |                                     |                                  |                                     | 654                           | 61                               |
|          | Boba-guta                       |                                     |                                  |                                     | 733                           | 68                               |
| Total    |                                 | 74                                  | 33,996                           | 16,633                              | 4,120                         | 384                              |

Source: Own computation from each kebele administration data (2019).
\(d_i = 1\) if \(d_i > 0\), \(d_i = 0\) otherwise

where \(i\) represent the \(i^{th}\) household head

- \(x_{1i}\) are factors influencing the avocado market participation decision,
- \(\alpha\) represent a random error term that is supposed to be N (0, 1) or normally distributed,
- \(d_i\) representing a latent (level) participation variable in the second hurdle two of the double hurdle model and we can see a dichotomous value of

\[d_i = 1\] if \(d_i > 0\), \(d_i = 0\) if \(d_i \leq 0\)

\[y_{i}^{*} = x_{2i}^{\beta} + \nu_i\]  (5)

\(y_i\) Observed if:

\[y_i = y_i^{*}\] if \(y_i^{*} > 0\) Or \(d_i = 1\)

\[= 0\] else

where \(y_i^{*}\) represent a latent level of decision variable,

\(x_{2i}\) are variables that affect the volume of avocado going to sell,

\(\beta\) and \(\nu_i\) error terms and they are not dependent on each other. If the individuals independently make the two decisions these terms are assumed to be N (0, 1).

According to Moffatt (2005), 'the log-likelihood function for the double hurdle model with independent error terms can be given as:

\[LL = \sum_{i} \ln \left( 1 - \theta(x_{1i}\alpha) \theta \left( \frac{x_{2i}\beta}{\alpha} \right) \right) + \sum_{i} \ln \left( \theta(x_{1i}\beta) \frac{1}{\alpha} \phi \left( \frac{x_{2i}\beta}{\alpha} \right) \right)\]  (6)

The sum of the log-likelihood of the probit model and the truncated regression model under the assumption of independent error terms is the log-likelihood of the double hurdle model. In this case, the left part of the double hurdle is the log-likelihood function of the probit model, whereas the right one is the log-likelihood function of the truncated regression model.

Model Specification Tests

To check which model is best from double hurdle and most restrictive Tobit model both a standard log-likelihood ratio test and Akaike’s Information Criteria (AIC) were used as the Tobit model nested to the double hurdle model (Humphreys, 2013).

The Tobit model can be tested against the double hurdle model by restricting the parameters of the participation (probit model) equal to the parameters of the truncated regression model as well as the Tobit model. Let \(\text{llprobit}\) be the log-likelihood of probit model, \(\text{lltruncreg}\) be the log likelihood of truncated regressions and \(\text{lltobit}\) be the log-likelihood value of Tobit model. Now the likelihood ratio test (LR) can be carried out as follows:

\[\text{Tobit test (LR)} = 2 * (\text{llprobit} + \text{lltruncreg} - \text{lltobit})\]  (7)

The test statistic has a \(\chi^2\) distribution with degrees of freedom equal to the number of a parameter that included in the regression (probit = truncated = Tobit) plus the intercept.

Definition of working Variables and hypothesis

Dependent variable

Market Participation Decision (MPD)

Is a dummy variable that characterizes the participation of the household in the market that is regressing in the first step of two-step estimation procedure. Of the respondents who participate (sell) in the market take the value of one. Whereas it takes the value of zero for the respondent who did not participate (not sell) in the market during the 2019 Avocado production season.
**Quantity of Avocado Marketed (VAM)**

It is a continuous variable in the second step of the selected model. It is measured in quintals and represents the actual quantity of avocado marketed by farm households during the 2019 production season, selected for regression analysis takes non-negative values.

**Independent Variables**

The explanatory variables expected to influence the dependent variables were the following.

**Quantity of Avocado Produced per Land (Yield)**

It is a continuous variable and measured in quintals per acre. The variable is hypothesized to have a positive contribution to both participation decisions and the total extent of avocado that was supplied to the market. Farmers who produce more output per tree are expected to supply more fruit (Pineapple) to the market than those who produce less. Abbey (2007) and Adugna (2009) found that the quantity of tomato and papaya produced by producer farmer households has improved the marketable supply of the thus crops significantly. Ayelech (2011) indicated that a unit alteration in the quantity of both avocado and mango in Gomma woreda, Jimma zone, Oromia National Regional state marketed supply of these crops under consideration increased by 0.939 qt and 0.816qt, respectively. Nega and Samuel (2017) also indicated that the quantity of mango and avocado produced in the Gedeo zone positively affected the market supply of the commodities.

**Avocado Market Experience (AME)**

It is a continuous variable and is measured in the number of years one has stayed in avocado marketing. A household with a better experience in avocado production and marketing is expected to produce more amounts of the product than those with less experience and as a result is expected to supply more amounts to market. Therefore, experience in avocado markets is expected to affect both market participation decisions and intensity positively.

**Proximity to the Nearest Market (PTNM)**

It is a continuous variable measured by how far farmers go to sell their products to the market. If the farmer is in a village or distant from the market, he is poorly accessible to the market. Therefore, we hypothesized that this variable is negatively related to market participation and marketable surplus. A similar study was done by Holloway et al (2000) on milk-market development in the Ethiopian highlands. Their result shows that distance to the nearest market causes decline in market supply. A similar issue was studied by Wolday (1994) on the food grain market in the case of Alaba Siraro, he identified that poor market access has a significant and negative effect on the quantity of food grain supplied. Nega and Samuel (2017) indicated that households who have access to market information can supply 0.054qt more than those who do not have access to market information, other things remaining constant. Mohammed (2011) showed that access to market information is related to the marketable supply of products and proximity of producers located near to the market.

**Sex of the Household Head (SEX)**

This is a dummy variable that takes a value of one if the household head is male and zeroes otherwise. Both men and women participate in fruit production. A male household was observed to have a better tendency than a female household in fruit production and supply of fruit. The sex of sample household heads has a positive impact on both avocado and pineapple market participation and level of participation in the study area. Tshiunza et al. (2001) discussed the determinants of market production of cooking bananas in Nigeria. In their study, male farmers tended to produce more cooking bananas than females. County (2014), indicated that being a male-headed household increased the proportion of Avocado and Pineapple sales by 0.0387qt.
**Family Size (FAMSZ)**
It is a continuous variable measured in adult equivalent, i.e., hence, consuming the commodity in the household affects the producer’s decisions to participate in the market. However, the family size is expected to hurt avocado market participation and volume of sales. A larger family size requires larger amounts for consumption, reducing market participation and marketable surplus. A study by Singh and Rai (1998) indicated that buffalo milk marketed surplus was negatively affected by family size. Wolday (1994) also tried to indicate the quantity of maize marketed is negatively affected by household size.

**Frequency of Extension Contact (FEXTC)**
It is a continuous variable measured in number. It is expected that the extension service widens the household’s knowledge regarding the use of improved avocado and pineapple production technologies and has a positive impact on avocado market participation decisions and level of participation. Ababo (2016) found the frequency of extension contact positively influenced the participation decision of framers in the maize market. This suggests that improved production technologies were availed through extended contact that will affect the market participation decision of households. Therefore, the frequency of extension contact is hypnotized to affect both market participation and level of participation positively and significantly.

**Irrigation Access (IRA)**
This variable is a dummy represented by one if the sample producer has access, and is zero otherwise. It is expected that if households accessed irrigation they will produce more and decide to sell these commodities and will also sell more than the previous. Therefore, this variable hypothesized that it would have a positive effect on both market participation and the level of avocado and pineapple market participants.

**Non/Off-farm Income (NFI)**
It is a continuous variable measured in Birr. Off-farm income represents the amount of income the farmers earn in the year out of on-farm activity on the farm. Non-farm income is the amount of income generated from activities other than crop and livestock production like labor in non-agricultural activities (small-scale industrial activities, cottage industries, commercial, and others). This additional income improves the households’ financial position, which in turn enables them to invest in purchasing the needed amount of farm inputs especially fertilizer and improved seed. At the highest level of off/non-farm income, households tend to participate in cooperatives more intensively (Kidane, 2001). On the other hand, Beza (2014) showed that non-farm income negatively affected the supply of maize to the market. The reason might be representatives who generate more income from non-farm activities, tends to sell less and increase family food consumption. Moreover, Azeb and Tadele (2017) results showed that income from non-farm activities is positively related to the quantity of teff supplied to the market. This could be because farmers who have additional income would have the chance to buy food for consumption at any time and increase their marketable crops. Therefore, non/off-farm income will affect avocado and pineapple market participation and level of participation positively or negatively and significantly.

**Level of Education (Grade)**
It is a continuous variable measured in years of schooling and refers to the formal schooling of a respondent up to the survey period. Those household heads that had formal schooling, increased the acceptance of new idea and technology that will boost the volume of avocado sales. Therefore, we hypothesized formal schooling to positively influence market participation and marketable surplus. Astewel (2010) also confirmed this in paddy supply.
Credit Access (Credit)

It is a dummy variable measured 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. Therefore, it hypothesized that access to credit would have a positive influence on both market participation and volume of Avocado and Pineapple sales.

Results and Discussion

This section has two parts, descriptive and econometric analysis. First, the descriptive analysis with mean, χ² and t-test demographic, socio-economic, and institutional factors are discussed. Finally, with econometric model (double hurdle) factors affecting market participation decision and level (volume) of market participation are discussed.

The total sample households 81.51% were male-headed (Table 2). Among market participant sample households, 89.19 were male-headed and 76.69 are again male-headed out of non-participant sample households. The average family size is 5 and 9 persons per household for participants and non-participants respectively. But the average family size of the whole sample respondents is around seven persons per household. The mean farming experience of sample households is 26.09 years. Except land allocated to avocado there is a significant difference between avocado market participants and non-participants in the study area. For instance, training makes a significant difference between whether sample respondents were to participate or not participate in the avocado market.

Factors Influence Avocado Market Participation and Intensity of Participation

In this section, we discussed factors affecting avocado producers market participation decisions and level of participation. As we tried to mention in the research method part of model specification double hurdle models were selected based on the model specification test. Accordingly, the Heckman selection model was not appropriate for this data set since IMR is insignificant (0.235) as indicated in the appendix. Then, the double-hurdle model is evaluated against the Tobit model specification. The test statistic for the log-likelihood of avocado product is (LR = 230.3) which by far exceeds the critical χ² value of 23.209 at 10 degrees of freedom and at the 1% level of statistical significance in favor of the double-hurdle model. Finally, the double hurdle model is appropriate for avocado data set of this research (Table 3).

Table 2. Description of variables by market participation status of avocado producers.

| Variables                                | Total (N = 384) | Participants (N = 236) | Non-participants (N = 148) | t/χ²-value |
|------------------------------------------|-----------------|------------------------|----------------------------|------------|
| Farming experience                       | mean 26.09      | 26.90                  | 16.82                      | −15.41***  |
| Family size                              | mean 6.75       | 5.35                   | 8.99                       | 21.86***   |
| Sex of the household head                | Male (%)        | 81.51                  | 76.69                      | 9.42***    |
| The land allocated for avocado           | 0.78            | 3.77                   | 1.79                       | 0.38       |
| Income from an off-farm activity         | Yes (%)         | 53.65                  | 86.02                      | 258.03***  |
| Literacy status                          | mean 3.85       | 6.06                   | 0.32                       | −28.35***  |
| Access to credit                         | Yes (%)         | 59.38                  | 63.56                      | 4.45*      |
| Avocado marketed supply                  | mean 4.98       | 8.11                   | 0                          | −36.77***  |
| Training                                 | Yes (%)         | 38.28                  | 46.61                      | 17.98***   |

Source: Generated from survey data (2019).

Note: ***, ** and * are statistically significant at 1%, 5%, and 10% probability level, respectively.
The probit model performed well with a pseudo $R^2$ of 0.96. Out of 10 variables (4 dummy and 6 continuous) included in the probit model, 4 variables were significant. The output of the double hurdle model (hurdle 1) showed that avocado producers’ decision to participate in the avocado market was positively and significantly affected by the sex of the household head, avocado market experience, and the education (grade) of the sample producers. On the other hand, family size negatively and significantly affected the probability of avocado producers’ decision to participate in the market. Each of the significant variables is discussed here below.

**Sex of Household Head**
As expected sex of the household head positively and significantly influences the likelihood of avocado producers in market participation at a 5% significance level. Male-headed households increased the likelihood of market participation by 41%. This suggests that female-headed households are not market-oriented like that of their counterparts. This result is in line with other findings (Sigei *et al.*, 2014; Handschuch and Wollni, 2016) Abitew *et al.* (2015) on potato market supply in Ethiopia confirmed that the sex of household head has a positive and significant effect (Hegena *et al.*, 2022).

**Family Size (Adult Equivalent)**
Family size is negatively associated with the probability of market participants at the 1% level of significance and a level of participation at a 5% level of significance. The marginal effects of this variable indicate that an increase in adult equivalent in the family decreased the probability of avocado producers’ market participation by 26% and the level of participation by 1.28. This implies that the family members are consumers than workers, or their contribution as labor in avocado production is less than being consumers like that of pineapple producers. Genie and Adeoti (2011) confirmed that the level of market participation has decreased by 3% because of increased household size. These are in contrast to the findings of Osmani and Hossain (2015) who found that family size has a positive effect on smallholder market participation in Bangladesh, and (Hegena *et al.*, 2022) on vegetable market supply in Yayo and Hurumu districts of Ethiopia. The contradiction is due to them except (Hegena *et al.*, 2022) they used the variable wrongly from the perspective of labor, but it must be seen from the perspective of consumption. Musah (2013) also confirmed that our findings are similar to those by Musah (2013).

### Table 3. Regression result for double hurdle model of avocado market participation.

| Variables                      | 1st hurdle | 2nd hurdle | Marginal Effect | Marginal Effect |
|--------------------------------|------------|------------|-----------------|-----------------|
| Sex of household head          | 4.42**     | 0.41       | 0.26            | 1.51            |
| Family size                    | −1.53***   | −0.26      | −1.28***        | −0.47           |
| Market experience              | 0.87**     | 0.03       | 0.44***         | 0.06            |
| Irrigation access              | 1.42       | 0.42       | 1.36            | 0.42            |
| Off-farm income (dummy)        | −0.11      | −0.02      | −3.22***        | 1.09            |
| Grade (education)              | 0.46**     | 0.32       | 0.26            | 0.18            |
| Proximity to the nearest market| 0.23       | 0.10       | 0.14            | 0.10            |
| Credit excess                  | 1.01       | 0.30       | 8.46***         | 1.70            |
| Frequency of extension contact | 0.06       | 0.04       | 0.75***         | 0.09            |
| Yield                          | 0.01       | 0.03       | 0.12            | 0.59            |
| Constant                       | 3.83       | 0.12       | 0.12            |                 |
| Pseudo R²                      | 0.9545     |            |                 |                 |
| Wald/LR Chi square             | 480.89     | 314.82     |                 |                 |
| Log-likelihood                 | −1.46      | −817.87    |                 |                 |
| Observation                    | 384        | 244        |                 |                 |

Source: Survey 2019.
Note: ***, ** and * indicates the rejection of a null hypothesis of a non-stationary at 1%, 5%, and 10% level of significance, respectively.
Avocado Market Experience
The expected influence of experience in the marketing of avocado was positive by believing that as producers become more experienced in the marketing of avocado, avocado producers will gain skills and participate in the market. This variable affects both the likelihood of avocado market participants and the level of participation at a 1% significance level. The marginal effect showed that a one-year increase in the experience of the avocado market increases the probability of participation by 3% and the level of participation by 0.44. Abbey (2007) illustrated as farmers’ experience increased the volume of tomatoes supplied to the market increased in Fogera, District found in South Gonder. Our result is in lines with Mossie et al. (2020) and Musah (2013) that farming experience has a positive significant effect on both market participation and intensity of participation.

Off-farm Income
As we hypothesized non-farm income affected the level of avocado market participation negatively and significantly at a 1% significance level. Since they devote their time to non-farm activities, they did not carefully manage their farm from its preparation to harvesting like that of pineapple; it causes a reduction in production. The marginal effect of income from non-farm activities increased by one Ethiopian Birr the volume of market participation decisions decreased by 3.22. This result confirms the results of Martey et al. (2012) and Musah (2013).

Education Level
This variable affected pineapple producers in a positive and significant way at a 5% significance level. As a result of the marginal effect, a one-year increase in producer education increases the level of participation in the pineapple market by 46%. These results are consistent with those of Randela et al. (2008); Mossie et al. (2020) who found that well-educated farmers are more involved in the market. Our results contrast with Ouma et al. (2010) who found that the level of schooling had a negative impact on participation in the banana market.

Access to Credit Service
We expected that access to credit would have an impact on the level of participation in the avocado market (1%). The marginal effect of this variable indicates that if producers get access to credit levels, avocado market participation will increase by 8.46. As producers need financing for inputs like fertilizers and other facilitations, they need access to credit for this purpose. We confirm the findings from Jaji et al. (2018) that access to credit has had a positive and significant impact on the quantity of pineapple provided.

Extension Contacts (Frequency)
Based on our assumption, this variable affects avocado level market participation at a 1% significance level. The marginal effect showed that an extra day of extended visits would raise the level of producer participation in the market by 0.75. Implies that frequent extension contracts with farmers increase the volume of avocado brought to market. Our conclusion is similar to Tufa et al. (2014), Tarekegn et al. (2020) and Abhra et al. (2020). This result is highly relevant as an extension service plays a vital role in the production and marketing of cash crops, such as apple and mango.

Conclusions
The fruit sector in Ethiopia is a promising sector compared to other crops as it offers high returns on small investments. The smallholder producers’ market participation is a genuine issue in improving household welfare in rural areas and poverty reduction in developing countries. Yet, given the area coverage and high production of major crops, such as avocado by smallholder farmers, they face various restraints to participate in the agricultural markets. This study focused on the Kaffa area of southwestern Ethiopia on factors affecting market participation and intensity of avocado participation. The study
generated vital evidence by employing double-hurdle model approaches on major factors affecting the smallholder farmers’ participation decision in the avocado market. Results of the cross-sectional survey indicate that, out of total of 384 avocado producers, 236 households are avocado market participants, and 148 households are non-participants in the 2019 production year. The double hurdle model selected based on limited dependent model selection criteria result shows that avocado’s market participation decision and level of market participation jointly and significantly affected by family size, and market experience. However, the market participation decision taken by avocado producers is positively and significantly influenced by the gender of the head of household, the experience of the producers’ market, and the level of schooling. Family size has had a negative and significant effect. The level of producer participation in the avocado market is positively and significantly affected by the market experience, access to credit services, and frequent contact with extension workers. While negatively and significantly by family size and off-farm income. The finding of this research indicates that increased production of crops enhanced smallholders’ market participation, this entails those strategies that aim at improving household capability to produce surplus production through optimal allocation of resources could have high returns in promoting commercial transformation.

**Recommendations**

Based on the findings of this research, the following main recommendations are necessary to develop sustainable marketing of avocado and pineapple. In general, in developing countries, especially in Ethiopia, men have more access to their own resources to produce more. This is due to work-sharing problems at home. Thus, frequent extension contacts are required for women-led households. Producers need training on how to use the large family numbers for production and marketing with assistance from extension workers and district agricultural office. All participants in the market chain can access better market information. Access to credit is seen as a fantastic way for producers to improve their production processes and increase agricultural production. If producers have access to credit, they can purchase inputs such as fertilizers, improved seeds, and labor. Thus, both private and public financial institutions should facilitate access to credit in the agricultural sector and producers should look to the market. To boost producer market participation decisions and level of market participation, the provision of formal and informal education needs to be enhanced. To enhance borrowing and use of credit, the district agriculture office and OMO Microfinance Institution together with other credit schemes and credit institutions need to formulate educational programs to educate producers on credit acquisition and use. In addition, infrastructure development needs to be improved especially the establishment of road facilities around production centers. This will reduce the transaction cost rate and enable producers to supply higher quality products for sale.

Furthermore, the main objective of this study is to study the main factors that affect the participation of avocado producers in the market and the intensity of the participation targeted only small avocado producers. Therefore, medium-scale producers and the involvement of traders in future research need special attention.

Finally, we recommend research needs to be conducted on the market chain, market integration, and commercialization of avocado in the study area for further strong policy formation.

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Interest Of Conflicts

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Appendix.

Table 1. Heckman two step model results

| Variable | Coefficients | STD. Err. | z     | P > z | [95% Conf. Interval] |
|----------|--------------|-----------|-------|-------|----------------------|
| Sex      | 0.4541819    | 1.507737  | 0.30  | 0.763 | -2.500929 3.409292  |
| Famsza   | -0.2496817   | 0.5029187 | -0.50 | 0.620 | -1.235184 0.7362207 |
| Literate | -0.7590346   | 1.032733  | -0.73 | 0.462 | -2.783154 1.265085 |
| LATT     | 2.256432     | 0.7795604 | 2.89  | 0.004*** | 0.7285219 3.784343 |
| LogACP   | 0.8919369    | 0.455714  | 1.96  | 0.050* | -0.0012462 1.78512  |
| Productivity | 0.1191837       | 0.0293994 | 4.05  | 0.000*** | 0.061562 0.1768054 |
| NExtnc   | 0.4559235    | 0.2473103 | 1.84  | 0.065* | -0.0287959 0.9406428 |
| TPEXP    | -0.0101204   | 0.0460124 | -0.22 | 0.826 | -1.003031 0.0800623 |
| LnINF    | 0.0544913    | 0.1162589 | 0.47  | 0.639 | -0.173372 0.2823546 |
| PTNM     | -0.024968    | 0.3900889 | -0.06 | 0.949 | -0.7895283 0.7395922 |
| NEO      | 0.7700033    | 0.3863215 | 2.01  | 0.045** | 0.0181189 1.521888  |
| TNOXHT   | 0.1624675    | 0.3646127 | 0.45  | 0.656 | -0.5521603 0.8770953 |
| TSOLD    |              |           |       |       |                      |
| Sex      | -0.6095981   | 0.5420354 | -1.12 | 0.261 | -1.671968 0.4527718 |
| Famsza   | -0.3326039   | 0.1385106 | -2.40 | 0.016** | -0.6040797 -0.0611282 |
| LnQCR    | -0.0001794   | 0.037947  | -0.00 | 0.996 | -0.0745541 0.0749152 |
| Literate | 0.5344993    | 0.3033742 | 1.76  | 0.578* | -0.0601033 1.129102 |
| LATT     | 1.452919     | 0.3571014 | 4.07  | 0.000*** | 0.7530127 2.152824 |
| NExtnc   | 0.1637992    | 0.0970345 | 1.69  | 0.091* | -0.026385 0.3539833 |
| Productivity | 0.1004905       | 0.0209393 | 4.79  | 0.000*** | 0.0593432 0.1416378 |
| TPEXP    | 0.0575319    | 0.0163204 | 3.53  | 0.000*** | 0.0255445 0.0895193 |
| LnINF    | -0.056696    | 0.0344925 | -1.64 | 0.100 | -0.1243 0.010908 |
| PLMP     | -0.2694572   | 0.2787901 | -0.97 | 0.334 | -0.8158758 0.2769614 |
| PTNM     | -0.1635889   | 0.1418551 | -1.15 | 0.249 | -0.4416198 0.114442 |
| NEO      | -0.051065    | 0.1259933 | -0.41 | 0.685 | -0.2980068 0.1958768 |
| TNOX     | 0.0292142    | 0.1302293 | 0.22  | 0.823 | -0.2260306 0.284459 |
| Mills    | -2.459297    | 1.283479  | -1.92 | 0.055 | -4.974871 0.056276 |
| lambda   | -1.871110    | 1.574834  | -1.19 | 0.235 | -4.957721 1.215513 |
| Rho      | -0.49641     |           |       |       |                      |
| Sigma    | 3.7692935    |           |       |       |                      |