Determinants of Smallholder Farmers' Market Orientation for Small-Scale Crop Commercialization in West Gojjam Zone, Amhara Region, Ethiopia[1]

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Abstract

The study examines the determinants of smallholder farmers' market orientation considering agro-ecology and transaction costs. Multistage sampling procedure was used to collect quantitative data from 405 randomly selected smallholder farmers. Qualitative data were collected through key informant interview and focus group discussions. Descriptive statistics, one-way ANOVA and zero-inflated beta regression were used to analyze quantitative data while narration data analysis used to analyze the qualitative data. The results have revealed that smallholder farmers in the lowlands and midlands are more market oriented than they are in the highlands. Education increases the probability and proportion of market orientation. Farmland size and farmland rental contracts positively influence the probability of market orientation. Distance from home to nearby markets negatively affect the proportion of smallholder farmers' market orientation. Mobile possession positively influences the probability of market orientation. Membership to farmers cooperatives enhances extent of market orientation. The findings have suggested that human capital, physical resource endowments and arrangement, transaction costs, cooperatives, and agro-ecological endowment affect smallholder farmers' market orientation. Therefore, education, farmland rental contracts, infrastructure development, and soil fertility improving technologies are needed to increase market orientation and promote small-scale commercialization.

Keywords: market orientation; agro-ecology; transaction cost; zero-inflated beta regression

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1. Introduction

Crop production in Ethiopia has dominant role in the agriculture sector of the economy. It is a source of livelihood for large number of populations, which contributes for food and nutrition security, and export earnings. The smallholder farmers cultivate more than 96 percent of the cultivated farmland (Taffesse et al., 2011). This implies commercialization of smallholder farmers crop production have vital role to transform the economy. The Ethiopian government in its Agriculture Development Led Industrialization (ADLI) economic development policy and consecutive Growth and Transformation strategic plans give due attention for smallholder farmers crop commercialization.

Crop commercialization leads to greater market orientation of farm production which is manifested through increase in purchase of traded inputs and decline in utilizing non-traded inputs and the decline of mixed farming system to specialized production (Pingali, 2001; Pingali and Rosegrant, 1995). Small-scale crop commercialization necessitates product choice and input use decisions, and allocation of resources based on market signals (Abafita et al., 2016; Gebremedhin and Jaleta, 2010; Pingali, 1997; Pingali and Rosegrant, 1995). In other words, it is market-orientation, which can be defined as production decision manifested through a relative choice of crop products and allocation of inputs to meet the market demand. It is higher input allocation for marketable products than households' food products. Consequently, market orientation of smallholder farmers implies decisions towards the production of marketable crop species and the allocation of more agricultural land and other inputs.

Market orientation is commonly affected by socio-demographic characteristics, physical resource endowments, commodities productivity, and input and output markets (Gebremedhin and Jaleta, 2010; Micheels and Gow, 2008; Pingali and Rosegrant, 1995). The resource endowments comprise farm households' socio-demographic characteristics such as household head, age, education, family size, and labor. Physical resource endowments contain farmland size and equines. Institutional services include access to market information, credit and agricultural extension services. Commodity production is affected by agro-ecological endowment (Behera et al., 2007; Eledu et al., 2004). Agro-ecology induces diversity of agro-ecosystem services, which affects crop types production because, certain type of agro-ecosystem services is suitable for production of specific crop type (Behera et al., 2007). Therefore, agro-ecology affects crop production and revenue (Taffesse et al., 2012). Access to market is affected by transaction costs (Alene et al., 2008; Baraka et al., 2019; Holloway et al., 2000; Olwande et al., 2015; Williamson, 1981). Thus, the transaction cost associated with exchange of inputs and outputs in markets increases, leading to the inefficiency of input and output markets (Baraka et al., 2019; de Janvry et al., 1991).

The previous literature focuses on the theoretical explanations in factors affecting market-oriented farming with less attention to empirical analysis to smallholder farmers. The exception is the work by Gebremedhin and Jaleta (2010) who analyzed the determinants of market orientation. The previous literature has explained that agro-ecology affects crop production and revenue; however, it does not reveal its association with smallholder farmers decision in resource allocation to marketable crop types based on market signal. Moreover, the literature employs Ordinary Least Square (OLS) and Tobit regressions, which assume normal distribution. However, the market orientation is an index that has both Bernoulli and beta distributions. Thus, zero-inflated beta regression enables better treatment of beta and Bernoulli distribution. Lastly, from practical point of view, understanding the factors affecting smallholder farmers market orientation focusing on agro-ecology and transaction costs plays an important role in turning smallholder mixed production systems into specialized and market-oriented production thereby enhance small-scale commercialization.

2. Literature Review

Market orientation is smallholder farmers' production decision manifested through a relative choice of crop products and allocation of inputs to meet the market demand. In practical terms, market orientation is decisions towards the production of marketable crop species and the allocation of more agricultural land and other inputs. Resource endowments, the productivity of commodities and output markets are considered important determinants of the market-oriented decision of smallholder farmers (Gebremedhin and Jaleta, 2010; Micheels and Gow, 2008). Resource endowment such as farmland and labour affect crop type choice (Behera et al., 2007; Donovan and Poole, 2014; Hitayezu et al., 2016). The smallholder farmers cultivate multiple crops. The relative allocation of farmland size for mix of crops is affected by farmland size and farm household labour. Farm household labour constrains cultivation of crop types demand intensive labour for management practices where as larger farmland size encrourages production of marketable crop types (Donovan and Poole, 2014). Commodity productivity and market price, on the other hand, are key criteria for resource allocation (Micheels and Gow, 2008), which is a response to changing market prices, comparative advantage, and economic opportunity (Rosegrant et al., 1995). Farmers' decision on the relative allocation of farmland to the product mix to be produced is often based on considerations that could maximize benefits. In this regard, empirical evidence shows that market-oriented producers consider both the productivity of commodities and the market price to maximize profits (Micheels, 2010; Micheels and Gow, 2008; Suh and Moss, 2018).

On the other hand, crop production varies by agro-ecology, as differences in agro-ecological endowments increase the production of specialized commodities increases (Timmer, 1997). Agro-ecology refers to the interaction of the ecology, agronomy, local knowledge and social settings of a particular community that creates an agro-ecosystem suitable for a local context (Hazard et al., 2017). The agro-ecosystem affects the diversity, interaction and synergy of crop and livestock species (Conway, 1983; Tittonel, 2015). Diverse agricultural systems include diverse agricultural practices, landscapes and species diversity (Kremen et al., 2012). The interaction process stimulates the function of the agro-ecosystem, which increases resource use efficiency and commodity production potential (Tittonel, 2015).

Transaction cost is the cost of carrying out transaction of goods and services between the buyer and seller (Fischer and Qaim, 2012). Transaction cost includes costs for searching of a trading partner with whom goods or services are exchanged, negotiating a price and bargaining with potential trading partner, and transferring the product (Fischer and Qaim, 2012; Holloway et al., 2000). Transaction cost is classified in to fixed and proportional transaction cost (Key et al., 2000). Fixed transaction costs are costs that are invariant based on the volume of traded good or service. Whereas proportional transaction costs are variable costs that differ based on the volume of traded good or service. Markets in developing countries are characterized by poor infrastructure and limited access to information (Ingenbleek et al., 2013). As a result, the transaction cost associated with exchange of input and outputs in markets increases, leading to the inefficiency of input and output markets (Baraka et al., 2019; de Janvry et al., 1991). With this regard, transaction cost is expected to affect smallholder farmers’ market orientation but still there is a need to analyze the empirical data.

3. Methodology

3.1 Description of the study area

West Gojjam zone is one of the 13 administrative zones of Amhara region. It is located in north west of Ethiopia. Its capital, Finote Selam, is 385 km far from Addis Ababa, on the other hand, 171 kms far from the Amhara region capital, Bahir Dar. West Gojjam zone has fourteen woredas and six town administrations. The total population is 2,758,806 and the population density is 158.25 persons per square kilometer (CSA, 2008). The rural and urban dwellers are 2,306,999 and 451,807, respectively (ibid). The zone covers an area of 13,311.94 square kilometers. Elevation ranges from 684 to 3656 masl[5] (meter above sea level) (West Gojjam zone plan commission, 2013).

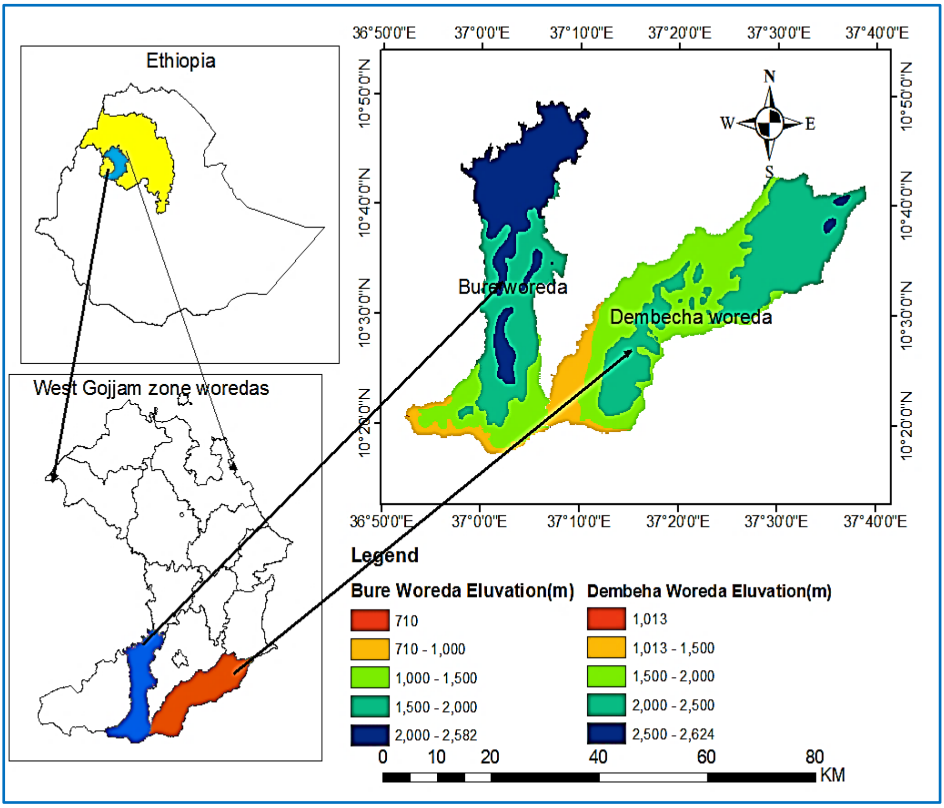
Crop production is unevenly distributed throughout the study area in line with the altitude, soil type and fertility, temperature, rainfall, infrastructure and market access. Altitudes, rainfall, and average temperature ranging from 1700 to 3000 masl, 1057 to 1657 millimeter and 15 to 27.5 degree Celsius, respectively (Amede et al., 2017; Deressa et al., 2010). The area has a favorable environment for the production of different crops (Amede et al., 2017); consequently, the study area is potential producer of diversified crop types such as cereals, pulses, oilseeds, vegetables and fruits. According to Central Statistical Authority (CSA, 2014), in west Gojjam zone, the cultivated farmland size is estimated to be 612, 297.16 hectare covered by teff, maize, wheat, pepper, millet, barely, potato, onion, beans, peans, chickpea, grass pea and niger seed and vegetables and fruits. The annual crops covered more than 93 percent of the total crop cultivated farmlands (Gebremedhin and Jaleta, 2010b; Taffesse et al., 2011). To this effect, the study analyzes smallholder farmers' annual crop types market orientation. The per capita farmland holding size in the study area ranges from a minimum of less than 0.1 to a maximum of 10 hectares and average of 1.23 hectares. The study area has also a strong livestock component, dominated by cattle, followed by sheep, goats and equines, which supports crop production through providing draft power and market access.

Market oriented production to transformation the agriculture sector is the major development strategy in the last more than 20 years, which have effect on smallholder farmers market-oriented production. The institutions responsible in commercial transformation of agriculture are Amhara Region Agriculture

[5] above sea level

Bureau, Amhara Region Research Institute (ARARI), Farmers' cooperatives and unions, and Amhara Credit and Saving Institute (ACSI). The institutions involve in assisting the smallholder farmers in technology generation, provide extension advisory and credit services, and supply improved agricultural technologies such as improved seeds, chemical fertilizer, herbicides, and pesticides. Thus, the study area is purposively selected as the region is more prone to crop production and there have been efforts by public and private organizations to enhance market-oriented crop productions to transform the economy.

Figure 1: Map of the study area



3.2 Research Design

A mixed research design combines quantitative and qualitative research design (Creswell, 2013; Graff, 2013; Howe, 1988). The mixed research design is useful if quantitative or qualitative research approach is inadequate to understand the research problem (Creswell, 2009). In other words, the purpose of using mixed methods is for triangulation and complementarity (Greene et al., 1989). Triangulation is seeking convergence of research findings using multiple methods. Complementarity is using different methods to assess different study components or phenomenon. Quantitative research is used to quantify the resource endowments, biophysical and institutional variables and its association with market orientation. The qualitative research is used to collect qualitative data through individual interview and focus group discussions to conceptualize the market orientation. and also, justify why and how the explanatory variables affect the market orientation. A variety of qualitative and quantitative methods give deeper insights and clear picture of the complexity of research problems in the local context (DFID, 1999; Mushongah and Scoones, 2012). Thus, mixing quantitative and qualitative research approach are in-deed compatible in investigating the research problem (Howe, 1988).

3.3 Sampling Procedure, Sample Size, Data Collection and Analysis

Sampling procedure:- proportion to the size and multistage random sampling strategy were employed to select respondent farmers. Accordingly, Dembecha zuria and Burie Zuria woredas were selected through lottery method among fourteen woredas administered in west Gojjam zone. Dembecha zuria and Burie Zuria woreda has 31 and 21 kebeles, respectively. Woreda agriculture offices clustered the number of kebeles as lowland, midland and highland based on their altitude and crop production system. Accordingly, a kebele from each agro-ecology for both districts were randomly selected. Hence, seven kebeles[6] namely Zeyushewen, Wadera and Ambaye from Burie Zuria district; and Astevoch, Egziabhierab, Yesheboch and Gelila from Dembecha Zuria district were selected randomly from list of highlands, midland and lowland kebeles, respectively. Proportion to size sampling strategy was employed to select sampled farmers from each *kebele* (Table 1).

Sample size:- Cochran sample size determination formula was used as the study area has large population size (Israel, 1992). Cochran formula make the sample size 385 and then, we add contingency 5 percent making the total sample size 405 respondents. Since we do not have much information about market orientation of the population, to get maximum variability we assumed 50% of the

[6] Kebele is the lowest administrative unit in the government structure

population was market oriented and also, employ 95% confidence interval with 5 % precision.

$$n_0 = \frac{z^2pq}{e^2} \quad \textbf{(1)}$$

Where: z is 1.96, p is the estimated proportion of the population who is market oriented (0.5) q= (1- p) =0.5 and e is the precision level (0.05).

Data collection method: Quantitative and qualitative data were collected to analyze the determinants of smallholder farmers' market orientation. Quantitative data were collected using structured questionnaires through personal interview. The questionnaire, translated to Amharic, contains farm households' socio-demographic characteristics, physical and financial assets, agro-ecology, crop production, input-output markets, transaction costs and access to institutions. Qualitative data were collected using checklist through individual interview and focus group discussions to substantiate the quantitative data, which is moderated by the first author.

Data analysis: quantitative data analysis is done through descriptive statistics, inferential statistics such as chi-square test, one-way ANOVA and zero-inflated beta regression. Qualitative data was analyzed through narration method of analysis.

3.4 Conceptualizing Market Orientation

As it is discussed earlier, market orientation is about smallholder farmers' economic decision-making in the allocation of resources to the mix of crops produced for both household consumption and market. In the livestock-crop mixed farming system of the study area, the farmers produce different types of food and high-value crops both to meet their household consumption and marketed surplus. The annual crops types produced by the farmers, in the study area and used for analysis, are pepper, maize, teff, wheat, millet, barely, faba bean, chickpea, field pea, niger seed, potato, and onion. Market orientation entails people's allocation of farmland to the mix of crop types produced to maximize benefit based on productivity and market price. In this process of farmers' decision, the smallholder farmers' want to maximize their expected utility in deciding the allocation of resources to produce both for household consumption and marketable surplus.

Market orientation is calculated as the smallholder farmland allocation to each type of crop cultivated, weighted by the marketability of each crop at farmer level, divided by the total area cultivated per crop. In previous studies, market orientation is calculated as the smallholder land allocation to each type of crop cultivated, weighted by the marketability of each crop in a specific location divided by the total area cultivated per crop (Abafita et al., 2016; Gebremedhin and Jaleta, 2010; Tefera, 2014). This study, however, employs the marketability index of smallholder farmers, which weighs the allocation of land that can measure variability at the farmer level, for fear that the location specific marketability index may overestimate or underestimate the marketability index of the farmer. Therefore, it is calculated that market orientation as the sum of farmland allocated for each crop cultivated, weighted by the marketability of the same type of crop at the farmer level, divided by the total cultivated land in a given production year. The higher the allocation of farmland for marketable crops, the higher the farmer market orientation index will be. No market orientation means that the smallholder farmer do not market produced crop(s) in a particular production year, while Market Orientation Index (MOI) equals one means that a farmer allocated the total farmland for a single crop production and has marketed the total quantity produced.

$$MOI_i = \sum_{i=1}^{n} \frac{l_{ji}}{l_{ti}} * M_{ji} \qquad 0 \leq MOI < 1 \qquad (2)$$

Where;

MOI_i Market orientation index of farmer i

l_{ji} farmland size (hectare) allocated to crop j by the farmer i

l_{ti} total farmland size cultivated for crop production by the farmer i

M_{ji} Marketability index of crop j of the farmer i

Marketability index is the amount of crop j marketed divided by the total crop j produced by the farmer i, in a specific production year.

$$M_{ji} = \frac{c_{mji}}{c_{pji}} \qquad (3)$$

Where;

c_{mji} amount of crop (quintal) j marketed by the farmer i

c_{pji} amount of crop j produced by the farmer i

M_{ji} marketability index of crop j of the farmer i

3.5 Econometric Model: Application of Zero-Inflated Beta Regression

The empirical MOI data is continuous proportion contains zero (0≤MOI<1). Linear regression is not appropriate in the restricted proportional, indexed and rate of dependent variables between 0 and 1 (Ferrari and Cribari-Neto, 2004). This is because, the same source states that proportions are asymmetry and the predictions based on normality assumption are misleading. Zero-inflated beta regression assumes that the dependent variable has mixed continuous-discrete distribution with a probability of mass at zero (Ospina and Ferrari, 2012). Cognizant to this fact, the empirical MOI contains zero values that make a mixed continuous-discrete distribution. The discrete distribution is Bernoulli distribution at a farmer did not allocate farmland to cultivate crop for market in the production year (MOI=0). The beta distribution parameterized in terms of smallholder farmers' market orientation mean and precision parameter, and Bernoulli distribution is the probability of farmers that do not allocate farmland to cultivate crop commodity for sale in a production year. Thus, zero-inflated beta regression computes the smallholder farmers market orientation mean and the precision parameter of beta distribution and the probability of smallholder farmers' do not allocate farmland to cultivate crop commodity for sale in the production year. The precision parameter shows the dispersion of the distribution of smallholder households' market orientation index. As the precision parameter increases dispersion of the distribution of smallholder farmers' market orientation (MOI) decreases. Zero-inflated beta regression is specified as the probability and conditional mean function of a response of households' market orientation is:

$$b_{ic}(MOI;\ \alpha, \mu, \phi) = \begin{Bmatrix} \alpha & if\ MOI = 0 \\ (1-\alpha)f(MOI; \mu, \phi) & if\ MOI\ \varepsilon(0,1) \end{Bmatrix} \quad \textbf{(4)}$$

$(1-\alpha)$ is the conditional mean of smallholder farmers market orientation when its value is between zero and one, in a beta density function; α is a probability mass at smallholder market orientation index is zero.

The mean of MOI and its variance is computed as:

$$E(MOI) = \alpha c + (1-\alpha)\mu \quad \textbf{(5)}$$

$$var(MOI) = (1-\alpha)\frac{\mu(1-\mu)}{\phi+1} + \alpha(1-\alpha)(c-\mu)^2 \quad \textbf{(6)}$$

$E(MOI)$ is the weighted average of the mean of the Bernoulli distribution at c or MOI=0 and beta distribution $B(\mu,\phi)$ with weights α and $(1-\alpha)$ and also $E(y/y\,\varepsilon\,(0,1)) = \mu)$; $var\ (y/y\ \ \varepsilon\ (0,1) = \frac{\mu(1-\mu)}{\phi+1}$

Zero-inflated beta regression functional form is the market orientation index as the probability at zero and conditional mean (Pereira and Cribari-Neto, 2010).

The probability of smallholder farmers output commercialization at zero functional form:

$$h(\alpha_t) = \gamma_0 + \gamma_1 z_{t1} + \varepsilon \quad \textbf{(7)}$$

The output commercialization conditional means functional form:

$$g(\mu_t) = \beta_0 + \beta_1 x_{t1} + \varepsilon \quad \textbf{(8)}$$

The precision parameter function is

$$b(\phi_t) = \lambda_0 + \lambda_1 s_{t1} + \varepsilon \quad \textbf{(9)}$$

Where: $h(\alpha_t)$ the probability of household output commercialization at zero function; $g(\mu_t)$ the smallholder farmers output commercialization conditional mean function; $b(\phi_t)$ the households output commercialization precision parameter function. γ_1, β_1 λ_1 Vector of parameters to be estimated. z_{t1} x_{t1}, s_{t1} Vector of explanatory variables. The explanatory variables are socio-demographic characteristics, resource endowments, transaction costs, and agro-ecology. ε random errors distributed as normal distribution with zero mean and unitary variance

Equation 4 to Equation 6 provides interesting features. The variance of MOI is a function of (α_t, μ_t, ϕ_t) and the consequence of the covariate values (Ospina and Ferrari, 2012). The covariates and the parameters influence the precision of the conditional distribution of MOI. Therefore, zero-inflated beta regression offers the effect of the heterogeneity among market-oriented farmers and nonmarket oriented farmers on the extent or probability of market orientation, respectively.

3.6 Hypthesized Determinants of Market Orientation

Smallholder farmers' market orientation varies due to heterogeneity in socio-demographic characteristics, resource endowments, transaction costs and access to institutional services. The theoretical and empirical review reveals the association between heterogeneity among smallholder farmers and its influence on market orientation.

Socio-demographic characteristics such as education, sex and dependency ratio could affect market orientation. Education enables the smallholder farmers access to market information and process it (Gebremedhin and Jaleta, 2010). For instance, education increases the ability of the farmer technology and innovation adoption (Admassie and Ayele, 2011; Yigezu et al., 2018), and also, it might enable them have inputs for optimum allocation for production of marketable crops. Therefore, education is expected to increase resource allocation to produce marketable commodities. Men and women headed farm households have difference in production efficiency and selection of marketable crop types. Teklu (2005) documented that male-headed farm households are more efficient in production than women-headed farm households. This might be due to the cultural taboo that women are incapable to plough farmland (ibid); and women access to productive farmland is limited (Ali et al., 2016), which limits allocation of farmland to marketable crops. In addition, women have less access to market information, which affect the allocation of resources for marketable crop types. Thus, male-headed farm households are expected to increase market orientation more than their counterparts.

Household consumption demand could affect market orientation because household consumption requirements reduce the investment to improved technologies and make more risk averse. Real-dependency ratio is a proxy for consumption demand, which shows the proportion of unproductive household members over productive household members. It measures the dependency of the household based on labour capacity of the household. Sharp (2003) calculated real dependency ratio as:

$$real\ dependency\ ratio = \frac{family\ size - labor\ capacity}{labor\ capacity}$$

The higher the real-dependency ratio demands the higher the amount of food crops for consumption and the lower the income gain and investment on marketable crop types.

Smallholder farmers' physical resource endowments and arrangements affect the decision to allocate resources (Poole et al., 2013; von Braun, 1995). These are owned farmland size, farmland fragmentation and farmland rented contract. In the study area, farmland is undoubtedly the most important input for crop production. Larger farmland size increases the relative allocation of farmland size to marketable crops because the household food consumption demand is expected to be less elastic. Thus, the smallholder farmers' allocation of farmland size for marketable crops expected to increase. Land fragmentation refers to the number of parcels of farmlands an individual farmer owns. Farmland fragmentation increases the production costs and reduce productivity (Latruffe and Piet, 2014) thereby reduces smallholder farmers allocation of resources for marketable crops. In other words, the smallholder farmers try to allocate more farmland for food crop types to meet household food consumption demand while reducing investment on marketable crop. Simpson index takes in to account the number of parcels and the size of the parcel in estimating land fragmentation (Wu et al., 2005). The index increases as the number of parcels increases. Similarly, it increases when the size of the parcels tends to be similar; it decreases when the plot size increases,

$$SI_i = 1 - \frac{\sum_{j=1}^{k} a_{ij^2}}{(\sum_{j=1}^{k} a_{ij})^2} \qquad 0 \leq SI < 1 \qquad \textbf{(10)}$$

Where;

SI_i is Simpson land fragmentation index of farmer *'i';*

a_i the area of parcel '*j'* of farmer *'i'* , where *'j'* ranges from *1* to *k;*

$SI=0$ means the farmer have one parcel of land (land consolidation).

As the household owns large farmland fragmentation index, market orientation is expected to reduce.

Scarcity of farmland is an important constraining factor for crop cultivation accompanied by legal prohibition of land selling and buying by the government (Alemu, 2009). To alleviate this, the community have a practice of farmland rental contracts7 for crop production for specific production seasons (Zeng et al., 2018). The rented farmland increases the cultivated farmland size and thus, the smallholder farmers are expected to allocate large farmland size for marketable crops. Moreover, irrigation enhance cash crop production (Pender and Alemu, 2007); thus, it is expected that irrigation would increase smallholder farmers production of marketable crops.

Transaction cost imped market access (Dillon and Barrett, 2017; Janvry et al., 1991); thereby reduce specialized crop production (Omamo, 1998). Transaction costs are difficult to measure (Alene et al., 2008). Thus, smallholder farmers transaction cost measured in proxies such as residence distance to the all-weather roads and nearby market places and access to mobile phones. Thus, as the smallholder farmers' residence distance from the nearby markets and all-weather roads, the smallholder farmers are expected to reduce allocation of resources to marketable crop types. Moreover, smallholder farmers access to cell phone would able them to get market information, used for market entry thereby the smallholder farmer allocation of resources for marketable crops enhances.

Last but not least, access to institutional services such as agricultural extension, cooperatives and credit services can enhance smallholder farmers access to technologies, market and finance that would enhance smallholder farmer's capability in market-oriented production (Timmer, 1997; von Braun, 1995; Woldey and Peck, 2010).

[7] Farm land rental contracts is a land tenure arrangement which includes share-in and rented-in farmland sizes cultivated by the smallholder farmer in the crop production season. Rented-in and share in arrangements are made between the landowner and the land renter in cash and in-kind, respectively.

4. Result and Discussion

4.1 Market Orientation and Smallholder Farmers' Characteristics by Agro-Ecology

Table 3 depicts that the sampled respondents' average market orientation index was 0.150. Among the sampled respondents 18.68% is non-market oriented while 81.32% are market oriented at varied extent. Market orientation significantly varies among the lowland, midland and highland farmers. The farmers in the lowland are higher than the midland, and the midland ones are higher than the highland. The farm household heads average educational status was grade 1.290. The farm households' average real-dependency ratio was 0.433.

Regarding physical resource ownership and characteristics, the smallholder farmers average owned farmland size was 1.286. The lowland farmers owned farmland size is greater than the midlands and highlands; and also, the midlands farmland size is greater than it is in the highlands. Land fragmentation was significantly lower in the lowlands than it is in midlands and highlands. Smallholder farmers' average farmland rental contract size is 0.471 hectare. The average farmland rental contract size is significantly larger in the lowlands than it is in midland or highland agro-ecology. It implies farmland rental contract is important for crop cultivation. Moreover, smallholder farmers who have an access to a small-scale irrigation varied among agro-ecologies. The proportion of sampled smallholder farmers who have an access to a small-scale irrigation in the highlands, midlands and lowlands were 45.2, 22.7 and 3.74 percent respectively. The small streams in the highlands have an access for small-scale irrigation whereas, in the lowlands rivers flow in the deep gorges makes inaccessible for irrigation.

The smallholder farmers travel on average 42.425 minutes to reach to the nearby market place. Smallholder farmers' residence from the all-weather road takes on average 26.129 minutes. The farmers' residence distance to all-weather road was significantly lower in the lowlands than it is in the highlands. The proportion of mobile owned farmers was significantly varied among highlands, midlands and lowlands. These suggest the farmers in the lowlands incurred less transaction cost relative to the farmers in the midlands or highlands. The smallholder farmers', who are members of the cooperatives, accessed public extension services, and accessed formal credit service varied among agro-ecologies.

The results generally indicate that farmers in the lowlands endowed with resources and have access to infrastructures that increase crop productivity and reduce transaction costs. Consequently, smallholder farmers' market orientation in the low land is higher in comparison with their counterparts in the midland and highland agro-ecologies.

4.2 Crop Production and Marketability by Agro-Ecology

Table 4 depicts there is significant variations in farmers' all crop types (pepper, maize, teff, wheat, barely, millet, niger seed, fababean, chickpea, field pea, potato and onion) average crop produced value among the three agro-ecologies. The average crop produced value in lowlands (126256.4), midlands (51341.14) and highlands (34641.31) in Ethiopian Birr (ETB) shows the smallholder farmers' average income gain from crop production in the lowlands was larger than the other agro-ecologies. This is in line with the view that agro-ecology affects crop production and revenue (Taffesse et al., 2012). Similarly, the area's agricultural production potential affects the smallholder farmers' commercialization (Bernard et al., 2008; Gebremedhin and Jaleta, 2010). Based on the agro-ecologies, crop types and productions are varied in lowlands, midlands and highlands. For instance, in the highlands, potato, barley and field pea production are higher than midlands and lowlands. In the midlands, almost all crop types are produced and the average production is in between the highlands and lowland productions. Nevertheless, teff (*Eragrostis Teff*) production, in the midlands, excel the other agro-ecological zones production potential. In the lowlands, farmers' average pepper, maize and wheat production are higher than midlands and highlands; whereas, barley and field pea are not produced. This result has revealed that potato, barley and field pea are accessed better agro-ecosystem service in the highlands than other agro-ecologies; whereas the lowlands agro-ecosystem services are favorable for pepper, maize and wheat production but not favorable for field pea and barley. In line with this, all farmlands are not favorable for all crop species production (von Braun and Kennedy, 1994). This is, therefore, the smallholder farmers' market orientation in the lowlands is greater than the other agro-ecologies (Table 3).

The crop marketability has varied among agro-ecologies. The smallholder farmer's average marketability of crops in the lowland is greater than the midland and highland. The proportion of paper, maize and wheat sold in the lowland is greater than in the midland and highlands. However, the proportion of teff and potato sold in the highland is greater than they are in the lowland. Furthermore, the proportion of millet, niger seed, faba bean, chickpea and bean were negligible though there is variation among agro-ecologies. This means that agro-ecology affects the production of crop species and their marketability, thereby affecting the market orientation of smallholder farmers.

4.3 Determinants of Market Orientation: Estimates of Zero-Inflated Beta Regression

Prior to zero-inflated beta regression estimation, specification tests were done. Variable inflation factor (VIF-test) has shown maximum 2.29 and contingency test depicted the correlation coefficients are less than 0.5. Therefore, there is no multicollinearity among the covariates. Breusch-Pagan / Cook-Weisberg test have shown there is heteroscedasticity problem (chi-square, 62.67 and p=0.000); which is alleviated through robust estimation. Market orientation is estimated using zero-inflated beta regression shows among 380 (MOI) sampled farmers included in the model, 337 (88.684 percent) are correctly estimated. The link test, *_hatsq* was not statistically significant (p=209), reveals the model is correctly specified. In addition, the precision parameter estimate shows there is significant variation in conditional distribution of market orientation index at 1% significance level.

The results of the zero-inflated beta regression are presented in Table 5. As the results indicate, being male-headed farm households indicates higher probability of market orientation decision with no significant influence in the proportion of market orientation. Indeed, focus group discussion and key informant interview revealed that female-headed farm households are more involved in small businesses, such as the manufacture and sale of *Katikala*[8] and the informal market in onions and potatoes. Similarly, female-headed farm households have greater chance to participate in non-farm activities (Oxfam, 2013). In this way, female-headed farm households make money to cover their living expenses and focus less on income from selling regular crops that are produced unlike those of their male-headed counterparts.

[8] Katikala is a local beverage manufactured from cereal crops, buckthorn (rhamnus prinoides) and water.

As expected, educational status of the farm household head increases the extent and probability of market orientation. Similarly, education enhances smallholder farmers market orientation Gebremedhin and Jaleta, 2010). This suggests that the degree of market orientation requires a good understanding of the separation of production and consumption needs of farm households, and then, helps to allocate more farmland size to marketed crops.

If the smallholder farmers owned farm size increase by one hectare, the probability of a farmer to be market-oriented increase by 11.99 percent while the increase has no a significant effect on the proportion of market orientation. High cost of inputs[9] purchase can limit the production of marketable crops in large farmland size. Similarly, farmers who owned less farmland size apply chemical fertilizer and intensive crop management practices more than those who owned large farmland size (Pender and Gebremedhin, 2008). On the other hand, high cost of input purchase forces the farmers to rented-out their owned farmland. This suggests there is input market imperfections (Barrett et al., 2010; Sen, 1962) that increase production costs forced the farmers cultivate less productive crop varieties otherwise, rent-out their owned farmland.

A-one-hectare land increases in farmland rental contract size increases the probability of the farmer market orientation by 17.8 percent while it does not have a significant effect on the proportion of market-oriented. The smallholder farmers who have little or no small owned farmland have a practice of farmland rental contract to meet subsistence household consumption demand (produce for household food consumption and marketed surplus to generate cash income for subsistence needs) thereby, the farmland allocation for marketable crops reduces. On the other hand, the smallholder farmers may not afford to buy the recommended quantity of purchased inputs to cultivate marketable crops, which demands improved technology package; thereby, allocation of farmland size for marketable crops diminishes. Similarly, as the farmland size increases the farmers less intensify agricultural production (Pender and Gebremedhin, 2008). Therefore, farmland rental contract size enables smallholder farmers to allocate small portion of farmland to marketable crops; however, the smallholder farmers unable to allocate more as the rental farmland size increases due to household consumption demand and less affordability of purchased inputs.

[9] Inputs are improved crop varieties, chemical fertilizer and labor which are used for intensive crop production.

Smallholder farmers' access to irrigation positively affects the probability of market-oriented decision while it could not affect the degree of market orientation. Because smallholder farmers use small streams for irrigation and thus, water scarcity affects allocation of large farmland size for marketable crops (Abebaw, 2013).

As expected, smallholder farm households' residence distance from the nearby market place negatively affects the proportion of market-orientation due to high transaction costs, and consequently reduces profitability. Owning mobile phone positively affects the probability of market-oriented decisions but insignificant on the proportion of market orientation. This suggests market information is quantity invariant transaction cost (Alene et al., 2008).

Smallholder farmers' membership to farmers' cooperatives increase the extent of their market orientation. Since there is scarcity of chemical fertilizer and improved seeds supply, the members of the cooperatives have the opportunity to access more quantity of chemical fertilizer and improved seed in comparison with non-members of the cooperatives.

The farmers who live in the midland agro-ecological zone relative to highland farmers positively influence the probability farmers market orientation. In the same vein, the farmers farming in the lowlands in comparison with farming in the highlands agro-ecological zone positively affected both the farmer decision and the conditional mean of market orientation. According to the focus group discussants and key informant interview data, the undulated topography and amount of rainfall in the highland is higher than it is in the midland and lowland and also, the midland undulated topography and amount of rainfall are higher than it is the lowland. This results in severe soil degradation in the highland in comparison with the midland and lowland; and also, the midland soil degradation is higher than the lowland. Thereby, the soil fertility status in the highland, midland and lowland affects cultivated crop types, productivity, and production. Accordingly, the empirical analysis in Table 4 states that cultivated crop types, productivity, and marketability varied among the highland, midland and lowland agro-ecologies. Therefore, agro-ecology affects the relative farmland allocation to marketable crops. Similarly, agro-ecological resource endowments increase the production of specialized commodities (Timmer, 1997).

5. Conclusion and Policy Implications

The study has sought to contribute to the understanding of determinants of market orientation by focusing on agro-ecologies and transaction costs. Results from the empirical analysis show physical resource endowment and arrangement, agro-ecological favourability and access to market infrastructure enhance crop production, marketability, and reduce transaction costs. The agro-ecologies such as lowland followed by midland are favourable for the high production of crop types relative to the highlands. The crop types marketability is higher in the lowlands followed by midlands and highlands. The lowlands and midlands have better market infrastructure in comparison with the highlands thereby reduce transaction costs in the lowlands and midlands than highlands. Moreover, resource endowments and arrangements such as owned farmland size and farmland rental contracts are higher in the lowlands followed by midlands and highlands. The econometric analysis shows lowland and midland agro-ecologies enhanced market orientation in comparison with highlands while transaction costs harmed market orientation. On the other hand, owned farmland size and farmland rental contract size increase the probability of market orientation but not the extent of market orientation. This might be due to households' consumption demand and imperfect factor markets that hinder expansion of market-oriented production. Cognizant to these facts, the agro-ecology, infrastructure development, and physical resource endowment and arrangement accompanied with imperfect factor markets caused significant variation in smallholder farmers' market orientation.

The result provides pathway to explain the smallholder farmers' market orientation. Though smallholder market orientation is affected by socio-demographic characteristics, resource endowments, transaction costs and access to institutional services; agro-ecologies and transaction costs are important determinants in the smallholder farmers′ decision. The smallholder farmers′ relative farmland allocation to the mix of crop types to maximize the benefit is varied by agro-ecologies, access to market infrastructure and factor market imperfections. Therefore, investment in smallholder households′ education, developing all-weather roads and interventions in soil fertility improving technologies in the highland and midland that enhance crop productivity and production, are important intervention areas to enhance market orientation thereby prompt small-scale commercialization.

References

Abafita, J., Atkinson, J., & Kim, C. S. (2016). Smallholder Commercialization in Ethiopia : Market Orientation and Participation. *International Food Research Journal*, *23*(4), 1797–1807.

Abebaw, L. (2013). Challenges and Opportunities of Irrigated Crop Production in Gedeb River Catchment: Machakel Woreda, East Gojjam Zone. *Journal of Agricultural Extension and Rural Development*, *5*(8), 174–188.

Admassie, A., & Ayele, G. (2011). Adoption of Improved Technology in Ethiopia. *Ethiopian Journal of Economics*, *19*(1), 155–180.

Alemu, G. (2009). The Challenges of Land Tenure Reform to Structural Transformation of the Economy : Lessons from Country Experiences. In S. Ege, H. Aspen, B. Teferra, & S. Bekele (eds.), Proceedings of the 16th International Conference of Ethiopian Studies, Vol.1-4 pp. 761-778. Norwegian University of Science and Technology, Trondheim. NTNU-trykk.

Alene, A. D., Manyong, V. M., Omanya, G., Mignouna, H. D., Bokanga, M., & Odhiambo, G. (2008). Smallholder Market Participation Under Transactions Costs : Maize Supply and Fertilizer Demand in Kenya. *Food Policy*, *33*, 318–328.

Ali, D., Bowen, D., Deininger, K., & Duponchel, M. (2016). Investigating the Gender Gap in Agricultural Productivity: Evidence from Uganda. *World Development*, *87*, 152–170.

Amede, T., Auricht, C., Boffa, J. M., Dixon, J., Mallawaarachchi, T., Rukuni, M., & Teklewold-Deneke, I. (2017). A Farming System Framework for Investment Planning and Priority Setting in Ethiopia. Technical Reports 90, Australian Centre for International Agricultural Research, Canberra.

Baraka, B., Mburu, J., & Muriithi, B. (2019). Transaction Costs Magnitudes , Market Participation , and Smallholder Profitability in Rural-Urban Vegetable Supply Chain. *International Journal of Vegetable Science*, *DOI: 10.1080/19315260.2019.1700204*.

Barrett, C. B., Bellemare, M. F., & Hou, J. Y. (2010). Reconsidering Conventional Explanations of the Inverse Productivity-Size Relationship. *World Development*, *38*(1), 88–97.

Behera, U. K., Sharma, A. R., & Mahapatra, I. (2007). Crop Diversification for Efficient Resource Management in India: Problems, Prospects and Policy. *Journal of Sustainable Agriculture*, *30*(3), 97–127.

Bernard, T., Taffesse, A. S., & Gabre-madhin, E. (2008). Impact of Cooperatives on Smallholders' Commercialization Behavior: Evidence from Ethiopia. *Agricultural Economics*, *39*, 147–161.

Conway, G. R. (1983). Agroecosystem Analysis. ICCET Series E No 1, Centre for Enviromental technology and Department of Pure and Applied Biology, Imperial College of Science and Technology, London, UK.

CSA. (2014). Agricultural Sample Survey: Area and Production of Major Crops. In The Federal Democratic Republic of Ethiopia, Central Statistical Agency (CSA): Volume I, Statistical Bulletin 532.

_______. (2008). Summary and Statistical Report of the 2007 Population and Housing Census. Federal Democratic republic of Ethiopia Central Statistical Agency, Addis Ababa.

de Janvry, A., Fafchamps, M., & Sadoulet, E. (1991). Peasant Household Behaviour with Missing markets: Some Paradoxes Explained. *The Economic Journal*, *101*(409), 1400–1417.

De Leeuw, E., Hox, J., & Huisman, M. (2003). Prevention and Treatment of Item Nonresponse. *Journal of Official Statistics*, *19*(2), 153.

Deressa, T., Ringler, C., & Hassan, R. (2010). Factors Affecting the Choices of Coping Strategies for Climate Extremes: the Case of Farmers in the Nile Basin of Ethiopia. ACCFP Report, International Food Policy Research Institute.

Dillon, B., & Barrett, C. B. (2017). Agricultural Factor Markets in Sub-Saharan Africa : An Updated View with Formal Tests for Market Failure. *Food Policy, 67*, 64–77.

Donovan, J., & Poole, N. (2014). Changing Asset Endowments and Smallholder Participation in Higher Value Markets: Evidence from Certified Coffee Producers in Nicaragua. *Food Policy*, *44*, 1–13.

Eledu, C., Karamura, E., & Tushemereirwe, W. (2004). Agroecological Distribution of Banana Systems in the Great Lakes Region. *African Crop Science Journal*, *12*(1), 33–42.

Ferrari, S. L. P., & Cribari-Neto, F. (2004). Beta Regression for Modelling Rates and Proportions. *Journal of Applied Statistics, 31*(7), 799–815.

Fischer, E., & Qaim, M. (2012). Linking Smallholders to Markets : Determinants and Impacts of Farmer Collective Action in Kenya. *World Development*, *40*(6), 1255–1268. https://doi.org/10.1016/j.worlddev.2011.11.018

Gebremedhin, B., & Jaleta, M. (2010). Commercialization of Smallholders: Is Market Participation Enough? Paper Presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, 19-23, September 2010, Cape Town, South Africa.

Hazard, L., Steyaert, P., Martin, G., Couix, N., Navas, M., Duru, M., Lavuvie, A., & Labatut, J. (2017). Mutual Learning Between Researchers and Farmers During Implementation of Scientific Principles for Sustainable Development: The Case of Biodiversity-Based Agriculture. *Sustainability Science*, *13*, 517–530.

Hitayezu, P., Zegeye, E. W., & Ortmann, G. F. (2016). Farm-Level Crop Diversification in the Midlands Region of Kwazulu-Natal, South Africa: Patterns, Microeconomic Drivers and Policy Implications. *Agroecology and Sustainable Food Systems, DOI: 10.1080/21683565.2016.1156595*.

Holloway, G., Nicholson, C., Delgado, C., Staal, S., & Ehui, S. (2000). Agroindustrialization Through Institutional Innovation Transaction Costs, Cooperatives and Milk-Market Development in the East-African Highlands. *Agricultural Economics, 23*, 279–288.

Howell, D. C. (2007). *The Treatment of Missing Data.* Outhwaite, William Turner, Stephen P. eds. The SAGE Hand Book of Social Science Methodology, First edition, pp. 208-224, SAGE Publications, Inc, London.

Ingenbleek, P. T., Tessema, W. K., & VanTrijp, H. C. (2013). Conducting Field Research in Subsistence Markets, with an Application to Market Orientation in the Context of Ethiopian Pastoralists. *International Journal of Research in Marketing*, *30*, 83–97.

Israel, G. D. (1992). Determining Sample Size. IFAS Extension Fact Sheet PEOD6, Institute of Food and Agricultural Sciences, University of Florida. Available at *https://d1wqtxts1xzle7.cloudfront.net/58812033/samplesize1.pdf?1554552120=&response-content-disposition=inline%3B+fi* (No. PEOD6).

Kang, H. (2013). The Prevention and Handling of the Missing Data. *Korean Journal Anesthesiol*, *64*(5), 402–406.

Key, N., Sadoulet, E., & de Janvry, A. (2000). Transactions Costs and Agricultural Household Supply Response. *Amer. J. Agr. Econ.*, *82*, 245–259.

Kremen, C., Iles, A., & Bacon, C. M. (2012). Diversified farming systems : an agroecological , systems-based alternative to modern industrial agriculture. *Ecology and Society*, *17*(4), 44.

Latruffe, L., & Piet, L. (2014). Does Land Fragmentation Affect Farm Performance? A Case Study From Brittany, France. *Agricultural Systems, 129*, 68–80.

Little, R. J. A. (1988). Missing-data Adjustments in Large Surveys. *Journal of Business and Economic Statistics*, *6*(3), 287–296.

Micheels, E. T. (2010). Market Orientation in Production Agriculture: Measurement, Relationships, and Implications. Ph.D. thesis, University of Illinois, Urbana, Illionis.

Micheels, E. T., & Gow, H. R. (2008). Market Orientation , Innovation and Entrepreneurship : An Empirical Examination of the Illinois Beef Industry. International Food and Agribusiness Management Review, 11(3), 31–56.

Olwande, J., Smale, M., Mathenge, M. K., Place, F., & Mithöfer, D. (2015). Agricultural Marketing By Smallholders in Kenya : A Comparison of Maize , Kale and Dairy. *Food Policy*, *52*, 22–32.

Omamo, S. W. (1998). Farm to Market Transaction costs and Specialisation in Small-Scale Agriculture : Explorations with a Non Separable Household Model. *The Journal of Development Studies*, *35*(2), 152–163.

Ospina, R., & Ferrari, S. L. P. (2012). A General Class of Zero-or-One Inflated Beta Regression Models. *Computational Statistics and Data Analysis*, *56*, 1609–1623.

Oxfam. (2013). *Women ' s Collective Action: Unlocking the Potential of Agricultural Markets: An Oxfam International Research Report*. https://oxfamilibrary.openrepository.com

Pampaka, M., Hutcheson, G., & Williams, J. (2016). Handling Missing Data: Analysis of A Challenging Data Set Using Multiple Imputation. *International Journal of Research and Method in Education*, *39*(1), 19–37.

Pender, J., & Alemu, D. (2007). Determinants of Smallholder Commercialization of Food Crops: Theory and Evidence from Ethiopia. In IFPRI discussion papers 00745, International Food Policy Research Institute, Washington, USA.

Pender, J., & Gebremedhin, B. (2008). Determinants of Agricultural and Land Management Practices and Impacts on Crop Production and Household Income in The Highlands of Tigray, Ethiopia. *Journal of African Economies*, *17*(3), 395–450.

Pereira, T. L., & Cribari-Neto, F. (2010). A Test for Correct Model Specification in Inflated Beta Regressions. http://www.ime.unicamp.br/sinape/sites/default/files/reset_beoi.pdf

Pingali, P. L. (1997). From Subsistence to Commercial Production Systems: The Transformation of Asian Agriculture. *American Journal of Agricultural Economics*, *79*(2), 628–634.

Pingali, P. L., & Rosegrant, M. W. (1995). Agricultural Commercialization and Diversification: Processes and Policies. *Food Policy*, *20*(3), 171–185.

Poole, N. D., Chitundu, M., & Msoni, R. (2013). Commercialisation: A Meta-Approach for Agricultural Development Among Smallholder Farmers in Africa? *Food Policy*, *41*, 155–165.

Rosegrant, M. W., Schleyer, R. G., & Yadav, S. N. (1995). Water policy for efficient agricultural diversification: market-based approaches. *Food Policy*, *20*(3), 203–223.

Sen, A. K. (1962). An Aspect of Indian Agriculture. *Economic Weekly*, *14*, 243–246.

Sharp, K. (2003). Measuring Destitution: Integrating Qualitative and Quantitative Approaches in the Analysis of Survey Data. IDS Working Paper, December, 61.

Suh, D. H., & Moss, C. B. (2018). Examining Crop Price Effects On Production Decision and Resource Allocation: An Ex-Ante Approach. *Applied Economics*, *50*(26), 2909–2919.

Taffesse, A. S., Dorosh, P., & Asrat, S. (2011). Crop Production in Ethiopia : Regional Patterns and Trends. Ethiopia Strategy Support Program II (ESSP II), ESSP II Working Paper No. 0016, IFPRI, Addis Ababa.

Taffesse, A. S., Dorosh, P., & Gemessa, S. A. (2012). Crop Production in Ethiopia: Regional Pattterns and Trends. In P. Dorosh & S. Rashid (Eds.), In Paul Dorosh and Shahidur Rashid (eds). Food and Agriculture in Ethiopia: Progress and Policy Challenge, Philadelphia: University of Pennsylvania Press, pp. 53-83.

Tefera, T. (2014). Determinants of Smallholder Pulse Producers Market Orientation in Southern Ethiopia. *Asian Journal of Business Management, 6*(2), 97–103.

Teklu, A. (2005). Land Registration and Women's Land Rights in Amhara Region, Ethiopia. Securing Land Rights in Africa Research Report 4, Russell Press, Nothingham, UK.

Timmer, C. P. (1997). Farmers and Markets: The Political Economy of New Paradigms. *American Journal of Agricultural Economics*, *79*(2), 621–627.

Tittonel, P. (2015). Food Security and Ecosystem Services in a Changing World: It Is Time for Agroecology. In Proceedings of the FAO International Symposium on Agroecology for Food Security ad Nutrition, 18-19 September 2014, Food and Agriculture Organization, Rome: FAO Publications, pp. 16-35.

von Braun, J. (1995). Agricultural Commercialization : Impacts on Income and Nutrition and Implications for Policy. *Food Policy*, *20*(3), 187–202.

von Braun, J., & Kennedy, E. (1994). *Agricultural Commercialization, Economic Development and Nutrition*. The Johns Hopkins University Press, Baltimore and London.

Williamson, O. E. (1981). The Economics of Organization : The Transaction Cost Approach '. *American Journal of Sociology*, *87*(3), 548–577.

Woldey, A., & Peck, D. (2010). Agricultural Finance Potential in Ethiopia Constraints and Opportunities for Enhansing the System. Research Report, Association of Ethiopian Micro-Finance Institutions, Addis Ababa, Ethiopia.

Wu, Z., Liu, M., & Davis, J. (2005). Land Consolidation and Productivity in Chinese Household Crop Production. *China Economic Review*, *16*(1), 28–49.

Yigezu, Y. A., Mugera, A., El-Shater, T., Aw-Hassan, A., Piggin, C., Haddad, A., Khalil, Y., & Loss, S. (2018). Enhancing Adoption of Agricultural Technologies Requiring High Initial Investment Among Smallholders. Technological Forecasting and Social Change, *134*, 199–206.

Zeng, D., Alwang, J., Norton, G., Jaleta, M., Shiferaw, B., & Yirga, C. (2018). Land Ownership And Technology Adoption Revisited: Improved Maize Varieties in Ethiopia. *Land Use Policy*, *72*, 270–279.

Appendix 1

Table 1: Sample size by agro-ecology and kebele

Woreda	Agro-ecology	Selected kebele	Population	Sample size
Burie zuria	Lowland	Zeyushewen	696	51
	Midland	Wadera	814	59
	Highland	Ambaye	1238	86
Dembecha zuria	Lowland	Astevoch and Egziabhirab	1160	76
	Midland	Yesheboch	580	43
	Highland	Gelila	944	90
Total			5432	405

Table 2: Summary of variables description, measurement and expected hypothesis

Explanatory variables	Variable description	Measurement	Expected hypothesis
Socio-demographic characteristics			
Sex	Household head sex	Dummy1 if male; 0 otherwise	+
Education	Household head education	Continuous	+
Dependency	Household real-dependency ratio	Continuous	-
Physical resource endowments and arrangements			
Farmland	Farmland size in hectare	Continuous	+
Farmland fragmentation	Farmland fragmentation index	Continuous	-
Rented-in farmland	Rented-in farmland size in hectare	Continuous	+
Irrigation	Access to irrigation	dummy 1 if access; 0 otherwise	+
Transaction costs			
Distance from all-weather road	Residence distance from the all-weather road in minutes	Continuous	-
Distance from nearby market	Residence from distance from nearby market minutes	Continuous	-
Mobile	Mobile owned	dummy 1 if owned; 0 otherwise	+
Access to institutional services			
Cooperative	Membership to cooperative	dummy 1 if member; 0 otherwise	+
Credit service	Access to formal credit service	dummy 1 if accessed; 0 otherwise	+
Extension service	Access to agricultural extension service	dummy1 if accessed; 0 otherwise	+
Agro-ecology	Highland agro-ecology	dummy 1 if highland; 0 otherwise	+/-
	Midland agro-ecology	dummy 1 if midland; 0 otherwise	+/-
	Lowland agro-ecology	dummy 1 if lowland; 0 otherwise	+/-

Table 3: Market orientation and smallholder characteristics by agro-ecology

Variables	Obs(n)	Total mean (std. Error)	Mean (standard errors) by agro-ecology			F /X^2 test
			Lowland	Midland	Highland	
Dependent variable						
Market orientation index (continuous)	380	0.150(0.008)	0.249 (0.017)[a]	0.144(0.013)[b]	0.077(0.008)[c]	51.83 ***
Socio-demographic characteristics						
Household head sex (dummy=1 male,0 otherwise)	405	0.931(0.014)	0.925 (0.025)	0.898(0.032)	0.957(0.017)	3.1841
Household head education (continuous)	404	1.290(0.123)	1.29 (0.206)	1.136(0.205)	1.388(0.214)	0.78
Real-dependency ratio	402	0.433(0.030)	0.522 (0.0575) [a]	0.381(0.061) [bc]	0.397(0.040) [c]	3.89 **
Physical resource endowment and arrangement						
Mobile owned (dummy= 1owned; 0= otherwise)	405	0.683(0.026)	0.794 (0.039)	0.761(0.046)	0.547(0.042)	23.6007***
Farmland size owned in hectare	405	1.286(0.044)	1.641 (0.095) [a]	1.328(0.070) [b]	0.986(0.050) [c]	28.12***
Land fragmentation index	376	0.571(0.012)	0.526 (0.023) [c]	0.615(0.021) [ab]	0.579(0.02)[b]	2.39*
Farmland rental contract size in hectare	404	0.471(0.036)	0.720 (0.083) [a]	0.504 (0.067) [bc]	0.259(0.032) [c]	16.53***
Access to irrigation (dummy 1 if access; 0 otherwise)	404	0.261(0.024)	0.0374(0.0184)	0.227(0.045)	0.453(0.042)	59.0291***
Transaction cost						
Residence distance from the all-weather road in minutes	405	26.129(2.262)	16.897 (1.749) [c]	28.182(6.980) [bc]	31.935(2.772) [a]	5.54***
Residence from distance from nearby market minutes	405	42.425(1.841)	43.477(3.274)	38.148(3.216)	44.324(3.012)	1.83
Mobile owned (dummy= 1owned; 0= otherwise)	405	0.683(0.026)	0.794 (0.039)	0.761(0.046)	0.547(0.042)	23.6007***
Access to services						
Membership to cooperative (1 member; 0 otherwise)	397	0.692(0.0253)	0.729(0.0432)	0.818 (0.041)	0.583(0.042)	17.8488***
Access to credit service (1 accessed; 0 otherwise)	402	0.521(0.027)	0.626 (0.047)	0.489(0.054)	0.460(0.042)	6.7627**
Access to extension service (1accessed; 0 otherwise)	402	0.895(0.017)	0.916(0.0269)	0.955(0.022)	0.842(0.031)	8.6283**
Agroecology (highland =base)						
Midland agro-ecology (dummy=1 midland; 0 otherwise)	405	0.264(0.024)				
Lowland agro-ecology (dummy=1 midland; 0 otherwise)	405	0.320(0.026)				

Note: [a,b,c,] shows there is significant variation among the categories; ab, bc and ba shows no significant variation between the two categories. Observation(n) variation is due to unit non-response, the data is missed completely at random (MCAR) and also which is less than 10 percent of the sample size 385, thereby represents the population. Thus, "list wise deletion" of missing data and "complete-case analysis" lead to unbiased parameter estimates (De Leeuw et al., 2003; Howell, 2007; Kang, 2013; Little, 1988; Pampaka et al., 2016) Standard errors in parentheses, *** significant at 1%, ** at 5%, * at 10%.

Table 4: Sampled smallholder farmers average crop production (in kilograms and ETB) and marketability by agro-ecology

Crop species	Crop production: mean (standard errors)				Marketability: mean (standard errors)			
	Highland	Midland	Lowland	F-value	Lowland	Midland	highland	F(p-value)
Crop produced value (ETB)	34,641.31 (3092.317)	51,341.14 (4239.131)	126,256.4 (9165.567)	72.61***	0.324 (0.022)[a]	0.204 (0.017)[b]	0.174 (0.015)[c]	18.98***
Pepper	182.632(42.240)	319.279(58.292)	1168.107(138.53)	39.63***	0.29 (0.0336)[a]	0.1490 (0.03)[bc]	0.131 (0.023)[c]	9.45***
Maize	768.129(47.947)	2027.404(128.184)	4101.639(248.349)	134.49***	0.334 (0.023)[a]	0.2 (0.022)[b]	0.046(0.009)[c]	76.80***
Tef	143.567(12.060)	227.837(23.547)	166.967(19.391)	5.89 ***	0.011(0.005)[c]	0.071(0.018)[a]	0.0570(0.014)[ba]	5.05***
Wheat	128.216(16.975)	343.75(38.809)	1205.738(110.85)	82.07 ***	0.086(0.016)[a]	0.078 (0.018)[ba]	0.013(0.004)[c]	12.00***
Barely	243.86(20.75)	88.942 (21.245)	0((omitted))	51.68***	0(0 omitted)	0.0009 (0.001)	0.007 (0.003)	2.51*
Millet	160.526 (18.55)	270.192(25.513)	37.295(12.785)	27.61***	0(0 omitted)[c]	0.016 (0.007)[a]	0.005(0.003)[ba]	3.70**
Niger	0(omitted)	61.635(12.145)	4.918(2.629)	31.90***	0.002 (0.0023)[b]	0.087 (0.025)[a]	0(0 omitted)[cb]	16.54***
Bean	102.193(10.844)	50.240 (9.927)	100.902(19.854)	3.96**	0.044(0.0172)[ba]	0.002(0.002)[c]	0.047 (0.012)[a]	3.56**
Chickpea	3.509(3.509)	6.25(3.463)	172.336(30.593)	32.76***	0.019 (0.0079)	0(0 omitted)	0.006 (0.006)	2.36
Field pea	5.760 (1.968)	1.442 (1.071)	0(omitted)	3.94**	0(0 omitted)	0(0 omitted)	0.01(0.005)	2.70*
Potato	698.538(70.755)	198.077 (56.603)	36.885(21.342)	37.93***	0(0 omitted)[cb]	0.028(0.015)[b]	0.083(0.015)[a]	11.27***
Onion	30.702(10.535)	17.309(14.681)	0(omitted)	2.45*	0(0 omitted)	0.012 (0.009)	0.012(0.007)	1.05

N.B Standard errors in parentheses, *** significant at 1%, ** at 5%, * at 10%

Table 5: Zero-inflated beta regression model of smallholder farmers' market orientation

Dependent	Market orientation			
	Delta-method			
Explanatory variables	Marginal effects on probability of having value 0			
	Proportion	Zero-inflate	Dy/dx	ln_phi
Socio-demographic characteristics				
Household head sex (dummy=1 male,0 otherwise)	0.0571(0.234)	-1.273**(0.576)	-.1417035	
Household head education (continuous)	0.0900***(0.0202)	-0.212**(0.0913)	-.0236254	
Real-dependency ratio(continuous)	-0.0682(0.0914)	-0.559(0.564)	-.0622544	
Physical resources and arrangements				
Farm size owned in hectare(continuous)	-0.0756(0.0752)	-1.078***(0.403)	-.1199557	
Land fragmentation index(continuous)	-0.176(0.240)	0.881(0.888)	.097996	
Farmland rental contract in hectare(continuous)	-0.0459(0.0804)	-1.600***(0.529)	-.178025	
Access to irrigation (dummy 1 if access; 0 otherwise)	-0.103(0.130)	-0.933**(0.402)	-.1038005	
Transaction costs				
Residence distance from the all-weather road in minutes(cont.)	-0.0943(0.00113)	-0.00413(0.00380)	-.0004594	
Residence from distance from nearby market minutes (cont.)	-0.0270*(0.0161)	-0.00760(0.0517)	-.0000845	
Mobile owned (dummy= 1owned; 0= otherwise)	0.0281(0.122)	-0.832**(0.358)	-.0925661	
Access to services				
Membership to cooperative (dummy = 1member; 0 otherwise)	0.242**(0.116)	0.538(0.366)	.0599068	
Access to credit service (dummy =1 accessed; 0 otherwise)	-0.0926(0.0994)	0.446(0.354)	.0495836	
Access to extension service (dummy= 1 accessed; 0 otherwise)	-0.0549(0.188)	-0.589(0.498)	-.0654899	
Agro-ecology				
Midland agro-ecology (dummy = 1 midland; 0 otherwise)	0.207(0.142)	-1.749***(0.491)	-.1946032	
Lowland agro-ecology (dummy = 1 lowland; 0 otherwise)	0.820***(0.155)	-1.897***(0.562)	-.2111428	
Constant	-1.744***(0.314)	2.923***(0.865)		2.123***(0.0859)
Observations	337	337		337

Note: highland is the base agro-ecology, robust standard errors in parentheses, *** significant at 1%, ** at 5%, * at 10%

Table 6: Variable Inflation Factor (VIF)

Variable	VIF	1/VIF
Lowland	2.10	0.476610
Rainfed farm size	1.71	0.584743
Midland	1.51	0.660121
Farmland fragmentation index	1.40	0.715415
Farmland rental contract size	1.36	0.736336
Access to irrigation	1.26	0.796285
Mobile owned	1.23	0.809839
Access to extension service	1.23	0.812999
Household head sex	1.23	0.813280
Member to farmers' cooperative	1.20	0.836021
Distance to all-weather road	1.19	0.838725
Distance to nearby market	1.18	0.849519
Real dependency ratio	1.15	0.872827
Household head education	1.07	0.935046
Access to credit service	1.06	0.941193
Mean vif	1.32	

Table 7: Contingency coefficient test

	Household head sex	Access to irrigation	Mobile owned	Member to cooperative	Access to credit services	Access to extension	Midland	Lowland
Household head sex	1.0000							
Access to irrigation	0.1486	1.0000						
Owned mobile	0.1873	-0.0589	1.0000					
Member to cooperative	0.1969	-0.0281	0.2380	1.0000				
Access to credit service	0.1213	-0.0014	0.0739	0.0358	1.0000			
Access to agricultural extension service	0.2503	-0.0530	0.2007	0.1923	0.1286	1.0000		
Midland	-0.0832	-0.0552	0.1030	0.1378	-0.0429	0.0635	1.0000	
Lowland	0.0616	-0.3242	0.1584	0.0928	0.1294	0.0956	-0.4027	1.0000

Omitted variable test

Ramsey RESET test using powers of the fitted values of MOI

Ho: model has no omitted variables

F (3, 309) = 8.29

Prob > F = 0.142

Table 8: Model fitness test (linktest)

MOI	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]
Proportion					
_hat	0.0326575	0.2540496	0.13	0.038	-0.4670979 0.5324129
_hatsq	2.870757	0.7226387	3.97	0.209	1.449214 4.292301
_cons	0.0574479	0.0191943	2.99	0.235	0.0196896 0.0952062