Journal of World Economic Research
2022; 11(2): 64-76
http://www.sciencepublishinggroup.com/j/jwer
doi: 10.11648/j.jwer.20221102.11
ISSN: 2328-773X (Print); ISSN: 2328-7748 (Online)

The Determinants of Commercialization to Smallholder Farmers in West Hararghe Zone, Oromia Region, Ethiopia

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To cite this article:

Firew Hailemariam Mamo, Aman Kiniso Beguije. The Determinants of Commercialization to Smallholder Farmers in West Hararghe Zone, Oromia Region, Ethiopia. *Journal of World Economic Research*. Vol. 11, No. 2, 2022, pp. 64-76. doi: 10.11648/j.jwer.20221102.11

Received: June 14, 2022; **Accepted**: July 22, 2022; **Published**: August 31, 2022

Abstract: Taking into account the importance of commercialization in relation to agricultural and its priceless impacts on rural development and food security, studying the determining factors of commercialization had given a particular attention in this research. Smallholder commercialization as the strength of the linkage between farm households' markets and consumption at a given point in time have a particular concern in this research. Among the others, computing household commercialization index and pinpointing the critical factors affecting household commercialization, considered reference points. Sampling involved a multi-stage random sampling procedure and pursued the required representative samples. Household Commercialization Index was equated by the ratio of the total sold agricultural product values to the total production. To determine the impact of independent variables involved, the research applied: Generalized Regression Model. In statistics, generalized linear model is the theoretical extension and application of an Ordinary Least Square Regression (OLS). This model weight the dependent variable to some scale, combines count and continuous variables (Tweedie probability distribution) and transform estimated values via a log-link function. The research compared results taking from two parameter estimation models for hypothesis testing: Parameter estimation through full log-likelihood model and bootstrapped parameter estimation in constrained model. The parameter estimation through maximum log-likelihood function bring in to light, potential cases of errors, which may lead to wrong conclusion while the bootstrapped estimation had trimmed outliers, measure values with high precision, and provide consistent out puts reliable to generalization. Results after the model revealed that: sex of household head (at 5%), years of cultivation (10%), distance from market (at 10%), means of transportation, (10%) and credit access (5%) had drained their proportionate substantial impact. The average value of commercialization index is 35% that likely considered very lower when compared to the average (52%) in Ethiopia. The condition of smallholder farmers in the study area appeals collaborative effort. Empirical research results reviewed that the issues that matters most varies among farmers in different locations; although sometimes overlap. Beyond merely conducting research, initiations to transform research outputs in to long-term project should be coordinated by volunteers and multiplying successful projects to similar suitable location should take in to practice.

Keywords: Commercialization, Commercialization Index, Smallholder Farmer, Agriculture

1. Introduction

Agricultural commercialization refers: the gradual increase on the share of agricultural output sold from what the farm household has been producing and this is a key phenomenon in agriculture, called as process of agricultural transformation and justified its link with rising agricultural productivity, surplus above producers consumption level, individual producer's economic decision on volume of sale, and improvements in infrastructure which facilitate the sale of agricultural output [1]. Although shifting from low-valued (staple food crops) to higher-valued commercial crops attribute in raising farm household income, it along brings some causalities [2].

The issues constraining smallholder agricultural commercialization in African countries have been criticized for its pro-poor growth model and three key arguments are identified against the theoretical bedrock of the model. These include achievement of food security and poverty reduction through large scale agriculture, replication of the Asian model, and marginalization of the poor through polarization of assets and income [3, 4].

In Ethiopia, escalating smallholder farmers' commercialization and strengthening the integration into the market has been one of the policy direction was boldly indicated under the Growth Transformation Plan-I and Growth Transformation Plan-II of the country's development goal through which societies escape out of poverty and sustainable development maintained [5, 6]. Even if efforts has been in progress acceleration of the market participation and the degrees of commercialization, as most token, not yet satisfactorily achieved [7]. However, others still, believed that since a great majority of Ethiopia's poor people reside in rural areas and depend on agriculture as their livelihood, eradicating poverty through agriculture and economic transformation should continue to be the top development strategy [8].

Measuring the level of smallholder commercialization are important to make comparisons of households according to their degree of commercialization, it also helps to gauge to what extent a given farm household is commercialized and the make consumption versus market decisions, and to analyze the determinants of commercialization [9].

Studies conducted in Ethiopia particularly relating to 'commercialization' in Ethiopia mainly focus on a single crop market orientation and participation, and a few others view smallholder commercialization as a dynamic process: at what speed the proportion of outputs sold and inputs purchased are changing over time at household level using longitudinal data from country census. Apart from previous researches conducted in Ethiopia this research, comprise the following justifications.

Partly related to other researchers work, smallholder commercialization as the strength of the linkage between farm households' markets and consumption at a given point in time have a particular concern in this research. The research measured commercialization index as factors of crops and milk products sold per total values produced.

This study generated important results on major determinants of commercialization of smallholder crop and livestock producers in West Hararghe Zone[i], Oromia region[ii] of Ethiopia holding the following specific objectives:

1) Computing commercialization index;
2) Estimating the extent of impacts of the independent variables on commercialization index;
3) Forwarding important policy implications.

2. Literature Review

2.1. Definition

Commercialization of agriculture refers: the production of agricultural products to meet specific demands with the sale of fresh or processed product to consumers or to manufacturers in the case of raw material for industries [10, 11]. Commercialization occurs both on the input and output sides and characterized by increased marketed surplus, purchase of modern inputs, product choice (based on profit maximization), substitution of non-traded inputs for purchased ones, specialization of production, and creation of input-output markets [12, 11].

2.2. Instruments of Commercialization

The major instrument of commercializing agricultural products in market had categorized into three: grain, commercial crop and livestock markets in most developing countries [13].

1) Grain markets: commercializing grain needs special attention because grain (wheat, maize, *Eragrostis tef*, etc.) is a staple crop in most sub-Sahara African countries, so its market availability and price matters to the population both individually and collectively. Secondly, grain that produced seasonally but consumed daily.
2) Commercial crop markets: this includes markets for two types of crops; perishables (fruits, vegetables, flowers, milk, egg etc.) and cash crops (beverage, fibers, coffee, cotton etc.). Unlike in grain trading which becomes ready for final sale with only on-farm processing, commercial crop trading requires relatively large scale processing. The structure of such markets favors the emergence of integrated production with the disappearance of small-scale producers. The demand for most commercial crops is a derived demand, i.e. it derives from input demand of processing industries relative to food crops, and is elastic.
3) Livestock market: it includes markets for mainly sheep and cattle. In most cases, the farmer can control volume, timing and location of sale. In most African countries there are formal livestock centers like slaughter houses in addition to the small farmers who breed animals.
4) As the three types of commercial activities of agriculture expand, the developmental process shifts the technology from traditional to modern. As the purchased input use increase, puts pressure for development of input markets. In addition, as the technology modernizes output of farmers increase which in turn implies an even faster growth for products traded.

2.3. Arguments for Commercialization

The transformation of peasant agriculture from a subsistence economy to a more commercialized system, based on well-developed markets, is critical in promoting economic growth and poverty reduction based on the following different theoretical arguments [11].

1) Specialization argument: commercializing encourages specialization of farmers that raises their productivity, expands trade and raises their standard of living.

2) Induced demand argument: commercialization based on well-developed markets provides incentive for farmers to grow and produce for sale.
3) Efficient resource utilization: markets contribute to development by providing a way to allocate resources ensuring highest value production and maximum consumer satisfaction.
4) Extraction of fund for industrial development: agricultural growth can provide surplus to industrial investment only if there are market channels to transfer the agricultural surplus also viewed an instrumentalist view of the value of agriculture, assessed the market contribution of agriculture to industrial development in two ways: I) purchasing some inputs from other sectors and II) selling some of its product to other sectors. In other words, marketing strengthens the backward and forward linkages in agriculture.
5) Addressing food insecurity: one of the major roles of agriculture is to ensure sufficient amount of domestic food production and food security at the household level and to decrease dependence on external food sources. Nevertheless, with the absence of appropriate markets farmers output cannot reach the increasing urban population food demand.

2.4. Determinants of Commercialization

There are a number of determinants in commercializing smallholder agriculture. These determinants categorized broadly as external and internal factors [14]. External factors that could affect the commercialization process would be: development of input and output markets, changes in property rights and land tenure, changes market regulation mechanisms, cultural and social factors affecting consumption preferences, production and market opportunities and constraints, and agro-climatic conditions [15]. On the other hand, factors like smallholder resource endowments including land and other natural capital, labor, physical capital, human capital etc., are household specifics and considered internal determinants [15].

3. Materials and Methods

This research is a survey method of research design. This section discusses the sampling procedures, method of data collection and technique of data analysis used under this study. It further adds definition of the dependent and independent variables and theoretical frame work and practical application procedures of regression model.

3.1. Sampling Procedure

Several reasons make sampling useful rather than complete enumeration. These include considerations regarding time, cost and available resources, and redundancy of data. Hence, this study had limited to publish its content, particularly on the determinants of commercialization of smallholders' agriculture. It involved a multi-stage sampling procedure. Sampling, at first started with stratified simple random sampling of the population, based on ecological setting, thus, Chiro, Gemechis and Meiso were selected as being under sub-humid, humid and arid areas respectively; secondly, followed random selection of the woredas[iii]; thirdly, selecting the Peasant Association[iv] (PAs); and at fourth stage simple random selection of household, to draw the required number of representative sample respondents.

3.2. Sample Size Determination

There are several approaches to determine the sample size. These include using a census for small populations, imitating a sample size of similar studies using published tables, and applying formulas to calculate a sample size.

This study applied a simplified formula provided by [16] to determine the required sample size at 95% confidence level, the degree of precision (d) or the margin of error that is acceptable at 0.05 level and applied a finite population correction factor to reduce the sample size required. The formula used looks like:

$$n = \frac{Z^2(pq)}{d^2}, n_{adj} = \frac{n}{\left[1+\frac{(n-1)}{N}\right]} \quad (1)$$

Where; n = the original samp0ple size;
n_{adj}. = adjusted sample size;
Z = standard normal deviate;
p = the proportion of population;
q = 1-p;
d = the level of statistical accuracy;
N = the number of total population.

Table 1. *Sample size.*

Location	Household size	Proportion	Adjusted	Woreda
Kuni Segeriya	1207	0.3	39	Gemechis
Lgelfto Soro	686	0.2	22	
Husse Sodoma	485	0.1	16	Meiso
Husse Menidera	508	0.1	16	
Yabdo Shembeko	714	0.2	23	Chiro
Wachu Efabas	563	0.1	18	
Sum	4163	1	134	

Source: Computed based on [17].

3.3. Methods of Data Collection

To undertake this study successfully, use of both primary and secondary data sources has used. Combinations of structured key informant interviews, personal observation, group discussions and individual questionnaires prepared used for the collection of primarily data. Secondary data collection considers government reports and publication, books, articles, and reports of related institutions.

Individual questionnaires prepared to acquire data on socio – economic factors affecting commercialization, demography dynamics, and challenges in farming system, of target households. The questionnaire included both open and close-ended type of questions to capture more ranges of information.

The key informant interview also carried out with those individuals who have wider concept and idea about the issue under study. This was to understand the efforts or attention given to the subject under investigation, their level of awareness, status quo, social stability, or insecurity matters and vulnerabilities toward not to commercialize.

Three focus group discussions (one group in each study area having 10 members) carried out to obtain relevant and sufficient data, from those who have exposure and vulnerable to the matters under study, also triangulate with other data collected using other methods. Therefore, two individuals from traditional Community Leader, two individuals from Peasant association administration, two individuals from local level agricultural practitioners, two from Agricultural and Pastoralist office, two from traders and two individuals from Non-Governmental Organization (NGOs) incorporated.

3.4. Data Analysis

Prior to analysis, completed questionnaires coded, inputted, and organized. A coding system of some variables were prepared at the time of the questionnaire design. After the completion of coding, all valid questionnaires inputted in a comprehensible format of SPSS.

3.5. Multiple Linear Regression Model

Under this heading, theoretical background, the assumptions, goodness of fit measurement, linking functions and parameter estimation methods of generalized regression method will be explained.

The multiple regression models have the following form:

$$y = \beta o + \beta_1 \aleph_1 + \beta_2 \aleph_2 + \cdots + \beta_k \aleph_k + \upsilon \tag{2}$$

Where, y is the outcome;

β_o is the intercept;

$\beta_1 \ldots \beta_k$ is the parameter associated with $\aleph_k$;

$\aleph$ is the independent variable.

3.5.1. Assumptions of Multiple Linear Regressions

1) Homoscedasticity: The residuals have constant variance whatever the value of the dependent variable. This is the assumption of homoscedastic. The homoscedasticity assumption for multiple regression, states that the variance of the unobserved error, u, conditional on the explanatory variables, is constant. Homoscedasticity fails whenever the variance of the unobserved factors changes across different segments of the population that determined the explanatory variables. Sometimes textbooks refer to heteroscedastic. This is simply the opposite of homoscedastic. This means that the variance in the error term, u, conditional on the explanatory variables, is the same for all values of the explanatory variables.

$$\mathrm{E}(\upsilon/\mathcal{E}) = 0 \tag{3}$$

2) Outliers: There are no extreme values in the data. That is, that there are no outliers. As with simple linear regression, it is important to look out for cases which may have a disproportionate influence over your regression model.
3) Zero conditional mean: the error u has an expected value of zero given any values of the independent variables. Meaning that, all factors in the error term have no correlation with the explanatory variable. It is the most important of the three assumptions and requires the residual u to be uncorrelated with all explanatory variables in the population model. When Assumption 3 holds, we say that the explanatory variables are exogenous.

$$\mathrm{E}(\upsilon/\aleph_1, \aleph_2 \cdots \aleph_k)=0 \tag{4}$$

Multi-co linearity: Multi-co linearity exists when two or more of the explanatory variables are highly correlated. This is a problem as it can be hard to disentangle which of them best explains any shared variance with the outcome. It also suggests that the two variables may actually represent the same underlying factor. In the sample, none of the independent variables is constant and there are no exact linear relationships among the independent variables.

3.5.2. Checking the Assumption

1) By plotting the predicted values against the residuals, we can assess the homoscedasticity assumption. Often, rather than plotting the un-standardized or raw values, we would plot the standardized predicted values against the standardized residuals. (Note that a slightly different version of the standardized residual is called the "student-zed" residual, which are residuals standardized by their own standard errors.
2) In many cases, an outlier will affect the general estimate of the regression line, because the least squares approach will try to minimize the distance between the outlier and the regression line. In some cases, the extreme point will move the line away from the general pattern of the data. That is, the outlier will have advantage on the regression line. In many cases, we would consider deleting an outlier from the sample, so that we get a better estimate of the relationship for the general pattern on the data. The above plot suggests that, for our data, there are no outliers.
3) The third assumption that the residuals are not related in some way to the explanatory variables. We could assess this by plotting the standardized residual against the values of each explanatory variable.
4) Multicolloneality: By carrying out a correlation analysis, before we fit the regression equations, we can see which if any of the explanatory variables are highly correlated (avoid this problem or at least this will indicate why estimates of regression coefficients may give values very different from those we might expect). For pairs of explanatory variables with have very high correlations > 0.8 or very low correlations < 0.8 we could consider dropping one of the explanatory variables from the model.

3.5.3. Generalized Linear Models Application

Generalized Linear Models (GLM) are the commonly used analytical tools for different types of data. Generalized linear models cover not only widely used statistical models, such as linear regression for normally distributed responses, logistic models for binary data, and log linear model for count data, but also many useful statistical models via its very general model formulation. A GLM of y with predictor variables X has the form:

$$\eta = g(E(y)) = \chi\beta + O, y \approx F \tag{5}$$

Where, η is the linear predictor; O is an offset variable with a constant coefficient of one for each observation; g (.) is the monotonic differentiable link function which states how the mean of y, E(y) = μ, is related to the linear predictor η; F is the response probability distribution. Choosing different combinations of a proper probability distribution and a link function can result in different models.

When y is a binary dependent variable which can be character or numeric, such as "male"/"female" or 1/2, its values will be transformed to 0 and 1 with 1 typically representing a success or some other positive result. If the reference category is the last value, then the first category represents a success and we are modeling the probability of it. When r, representing the number of successes (or number of 1_s) and m representing the number of trials, the response or the binomial proportion is y = r/m.

Goodness of fit for generalized linear models, displays deviance and scaled deviance, Pearson chi-square and scaled Pearson chi-square, log likelihood, Akaike Information Criterion (AIC), Corrected Akaike Information Criterion (AICC), Bayesian Information Criterion (BIC), and Consistent Akaike Information Criterion (CAIC). However, none of these goodness-of-fit statistics has validity for GEE. The two useful extensions of AIC as goodness-of-fit statistics for model selection based on the quasi-likelihood function: Quasi-likelihood under the independence model criterion (QIC) for choosing the best correlation structure, and corrected quasi-likelihood under the independence model criterion (QICC) for choosing the best subset of predictors [18].

GLM calculates Parameter Estimate Covariance using two methods. One is the model-based estimator and the other one is the robust estimator. As in the generalized linear model, the consistency of the model-based parameter estimate covariance depends on the correct specification of the mean and variance of the response (including correct choice of the working correlation matrix). However, the robust parameter estimate covariance is still consistent even when the specification of the working correlation matrix is incorrect as we often expect. Note that model-based parameter estimate covariance affected by how the scale parameter handled, but the robust parameter estimate covariance not affected by the estimate of the scale parameter because of cancellation in different terms.

GLM uses the chi-square statistic to test the null hypothesis that H_0: β = 0, for each non-redundant parameter as:

$$\chi 2 = (\beta/\sigma)^2 \tag{6}$$

Where, β is explained variance and σ is the standard error.

Chi-square statistics and their corresponding p-values are set to system missing values for redundant parameter estimates and not calculated for scale parameter.

Given a test statistic T and a corresponding cumulative distribution function G, the ρ-value for the chi-square test defined by:

$$\rho = 1 - G \tag{7}$$

Due to the non-linear link functions, the predicted values for the linear predictor and the mean of the response computed separately. Since estimated standard errors of predicted values of linear predictor are calculated, the confidence intervals for the mean easily obtained. Predicted values also computed as long all the predictor variables have non-missing values in the given model.

$$residuals = e_k = y_k - \widehat{y_k} \tag{8}$$

Where e_k is the residual, y_k is the predicted population mean and $\widehat{y_k}$ is the actual mean.

Standard linear regression models assume that errors in the dependent variable are uncorrelated with the independent variable(s). When this is not the case (for example, when relationships between variables are bidirectional), linear regression using ordinary least squares (OLS) no longer provides optimal model estimates. Standard linear regression models also assume that variance is constant within the population under study. When cases that are high on some attribute show more variability than cases that are low on that attribute linear regression using ordinary least squares (OLS) no longer provides optimal model estimates, if for example, to predict the differences in variability from another variable. On the other side the Weight Estimation, procedure in GLM can compute the coefficients of a linear regression model using weighted least squares (WLS), such that the more precise observations (that is, those with less variability) are given greater weight in determining the regression coefficients. The Weight Estimation procedure tests a range of weight transformations and indicates which will give the best fit to the data. Generalized estimating equations (GEE) extend the GLM algorithm to accommodate correlated data.

Outliers can be identified either through visual inspection of histograms or frequency distributions, or by converting data to z-scores. Outlier (univariate or bivariate) removal is straightforward in most statistical software. However, it is not always desirable to remove outliers. In this case transformations (e.g., square root, log, or inverse), can improve normality, but complicate the interpretation of the results, and should be used deliberately and in an informed manner.

GLM (General Linear Model) is a general procedure for analysis of variance and covariance, as well as regression. It can be used for both univariate, multivariate, and repeated measures designs. In statistics, generalized linear model is flexible generalization of ordinary regression. The GLM generalized linear regression by allowing the linear model to be related to the response variable via a link function and by allowing the magnitude of the variance of each measurement to be a function of its predicted value.

4. Result and Discussions

4.1. Respondents' Demography

Under this research, the average age of household head found to be around 37 years of age. From the total 134 households found 716 family members. Their average family size is five numbers of persons per family. The table below shows the frequency distribution and percentage of household head's education level of the study areas.

Table 2. *Educational status.*

Education level	Gemechis		Meiso		Chiro	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No formal education	10	16.4	12	28.6	2	4.8
Primary level	38	62.3	13	31.0	1	2.4
Secondary and high school	11	18.0	4	9.5	31	73.8
Preparatory level & above	2	3.3	3	7.1	7	16.7
Sum	61	100	32	76.2	41	97.6

Source: own survey computation (2019)

Primary level indicates grade level attained between one and six, secondary and high school indicates grade levels 7 to 10, preparatory indicates grade levels 11, and above where as categories outside these categories termed as households with no formal education.

As shown under table 2 the highest number of household respondents particularly in Gemechis and Meiso woredas attended up to primary education level were 62.3% and 31% but household respondents around Chiro woreda attended secondary and high school, and preparatory and above education were 73.8% and 16.9% respectively. Cross tabs between those groups of education level indicated that the education statuses of the three research areas have low difference (χ^2 = 6, N = 9 & sig. = 0.213). However, the overall result indicated that the number of households was significantly and inversely related as the level of education grows, at 5% level (kappa = -.816 & sig. = .014).

Table 3 below shows the frequency distribution of households based on their sex along the percentage proportion.

As shown in all the three-study areas, male- headed households are exceedingly larger than the female-headed-households are. In sum, the number of male-headed households that randomly selected were 123 that constitute 91.8% of the total respondent. T-test indicated that the number of male-headed households outweighs female headed households at 5% level of significance (t = 5.562, DF = 2 & sig. = .031).

Table 3. *Sex of household head.*

Sex	Gemechis		Meiso		Chiro	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	55	90.2	30	93.8	38	92.7
Female	6	9.8	2	6.3	3	7.3
Total	61	100	32	100	41	100

Source: own survey computation (2019)

Chi-square test showed that there is no significant variation in proportion between the two sexes across the study areas (χ^2 = 2.00, DF =1 & sig. = 0.157).

Table 4 showed the frequency and percentage figures by religion of household. Most households included under this research were Muslims. Of the total number 109 (80%) were Muslims, 21 of them (15.7%) were Orthodox Christianity followers and three in number (7.3%) were Protestants.

Table 4. *Religions of respondents.*

Religions	GEMECHIS		MEISO		CHIRO	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Muslim	48	78.7	29	90.6	32	78
Orthodox	13	21.3	2	6.3	6	14.6
Protestant	0	0	1	3.1	3	7.3
Total	61	100	32	100	41	100

Source: own survey computation (2019).

T-test showed that there exists a significant difference at 5% in number of Muslim followers from Protestant followers and Orthodox followers (t = 6.161, DF = 2 & sig. = 0.025) across the study areas at 5% level of significance. Also, correlation indicated similarity in religion distribution between Chiro and Meiso at 5% level of significance (r^2 = .998, N = 3 & sig. = .040).

Table 5. *Livelihood strategies.*

STRATEGY	GEMECHIS		MEISO		CHIRO	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Crop only	21	0.34	6	18.75	12	29.27
Livestock only	1	1.6	1	3.13	1	2.44
Both	39	98.06	25	78.13	28	68.29
Total	61	100	32	100	41	100

Source: own survey computation (2019)

Table 5 contains the household livelihood strategies. This topic helps to understand on which farming strategy from either crop producing or livestock raising do farmers best rely for making their living. Majority of the farm households used to practice mixed farming system. In sum 27.5%, 2.4%, & 70.1% was crop only growers, only livestock raisers and both respectively. Pearson correlation indicated that similarity between Gemechis and Chiro at 10% level (r^2 = .9991, N= 3 & sig. = .087) but correlation between Gemechis and Meiso (r^2 = .938, N = 3 & sig. = .226) as well as between Meiso and Chiro is not significant (r^2 = .976, N=3 & sig. = .139).

Table 6. *Cropping system.*

Cropping system	GEMECHIS		MEISO		CHIRO	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Irrigated	0	0	0	0	1	2.4
Rain fed	56	91.8	29	90.6	39	95.1
Both	5	8.2	3	9.4	2	4.9
Total	61	100	32	100	41	100

Source: own survey computation (2019)

Cropping in general is rain fed pattern as shown by farmers' response under table 6. From all the study areas 0.8% depend on irrigation, 92.5% depend on rained and 6.7% depend farming practice on both methods particularly in producing crops.

A t - test conducted based on their percentage point indicated that rain fed agriculture was notably higher in practice than irrigated farming (t = 68.58, df = 2 & sig. = 0.031). Pearson correlation indicated that the study areas have similar pattern in cropping system significantly at 5% between Meiso and Chiro (r^2 = .997, N=3 & sig. = .045), between Gemechis and Chiro (r^2 = .998, N= 3 & sig. = .037) and at 10% between Gemechis and Meiso (r^2 = 1.000, N=3& sig. = .009).

The table below (Table 7) shows the land holding of household respondent. Land in rural area is the predominant asset for householders. There is farmer who have as large farm as 4.5 hectare also there were farmers who have no land at all. Those who have no land at all constitute 6.6% householders in Gemechis, 12.5%, in Meiso and 2.4% in Chiro study areas. The overall average land size per household was 0.83 hectares. The lower and upper boundaries for their common mean were 0.682 and 0.985 respectively.

Table 7. *Land holding.*

Research area	Range	Minimum	Maximum	Mean	Std. Deviation
Gemechis	4.5	0	4.5	0.82	0.623
Meiso	1.5	0	1.5	0.78	0.447
Chiro	1.75	0	1.75	0.9	0.392

Source: own survey computation (2019).

ANOVA (Analysis of Variance) result indicated that the mean difference was significant between Chiro and Meiso at 10% level (F = 2.161, DF = 7 & sig. = .075) but do significant difference between Gemechis and Chiro (F = .911, DF = 6 & sig. = .503) as well as Gemechis and Meiso (F = 8, DF = .516 & sig. = .835).

4.2. Computation of Commercialization

This research measured commercialization by computing the household commercialization index as the ratio of out puts sold to total values of out puts produced per year weighed in monetary terms. It particularly contains all crops and milk from livestock products marketable and consumed values. Other sales or out puts available such as beef sold and commercial cash crops such as *Cata edulis* and coffee have not included. The increase in commercialization can be caused by farmers shifting from subsistence crops to commercial crops. On the other hand, the increase in commercialization can be the result of an increase in the commercialization of individual crops, even without any change in the crop mix of farmers [2]. The formula that had used in this research for the household commercial index looks like:

$$HCI = \frac{GROSS\ VALUE\ OF\ CROPS\ SOLD + MILK\ SOLD}{GROSS\ VALUE\ OF\ CROPS + GROSS\ VALUE\ OF\ MILK} \tag{9}$$

$$\text{HCI} = (\text{GROSS VALUE OF CROPS SOLD} + \text{MILK SOLD})/(\text{"}GROSS\ VALUE\ OF\ CROPS\text{"} + GROSS\ \ VALUE\ OF\ MILK)\ \text{"}X100\text{"} \tag{10}$$

Equation (9) indicated commercialization index in ratio and equation (10) indicates commercialization index in percent.

A value of zero for the HCI signifies total subsistence while a HCI value approaching 100 indicates higher degrees of commercialization.

The study [19] examines pulse producers' commercialization using a cross-sectional data obtained from 385 randomly and proportionately selected sampled households from East Gojjam zone, Amhara National Regional State of Ethiopia and found that mean commercial index for the sample households being 0.345 which indicates that on average a household sold 34.5% of his/her total pulse produce. The result from this study have found nearly similar output which was 0.349 unit or 34.9%.34.5% of his/her total pulse crop produce. This shows that the level of crop output commercialization in the study area was very low as compared to the national average which is about 52% [20].

The sections following now onwards present, the variable' information entered into SPSS software through Generalized Regression Model. Generalized regression model in this case is preferable because of its technical advantage in holding and processing both categorical or dummy variables and discrete or continuous variables at the same time.

4.3.1. Variable and Model Information

Table 8 below incorporated some descriptions and computation on dichotomous variables that were used for analysis.

Table 8. *Dichotomous variables.*

Factor	Response	N	Percent
Credit access (CRAC)	YES	24	18.3
	no	107	81.7
	Total	131	100
Education level (EDLV)	No education	3	2.2
	Primary level	107	81.7
	secondary and high school	20	15.3
	Preparatory	4	3.1
	Total	131	100
Non-farm access (NNFA)	YES	50	38.2
	no	81	61.8
	Total	131	100
Sex of household head (SXHH)	male	120	91.6
	female	11	8.4
	Total	131	100

In the above table credit access is a dichotomous variable, "yes", coded "0" and "no" coded "1" response. Educational level is a dichotomous variable and respondents with no education at all assumed illiterates and coded "1" and literates coded "0". Sex of household head is a dichotomous variable and in it male headed households are coded "0" and female headed households are coded "1". Non-farm access refers whether farmers have the access to non-farm activities by which they earn additional income than own farming and those who have no access to non-farm earning activities coded "1" and those whose response is "yes" coded "0'

Here below, under table 9, some descriptions on continuous variables and descriptive data computed values were found.

Table 9. *Continuous Variables information.*

Variables		N	Mean	Std. Deviation
Covariate	EACN	134	2.09	1.99
	CSTR	134	50.86	37.40
	DFMT	134	16.92	7.94
	FMSZ	134	5.36	1.39
	AGHH	134	36.51	14.39
	YOLD	134	18.97	8.97
	NNFI	134	738.06	1153.50
	KCAL	134	1972.87	895.20
Dependent Variable	SP			
Scale Weight	Weight for SPV from WLS, MOD_2 GPV** -2.000			

Keys:
SPV = Sold product value;
DFMT= Distance from Market;
FMSZ = Family Size;
AGHH = Age of Household Head;
KCAL= Kilo Calorie Intake;
NNFI = Non-Farm Income;
EACN = Extension Agent Contact;
YOLD = Years of Owning Land;
CSTR = Cost of transportation;
GPV = Gross product value.

In addition to independent variables the above table contain the dependent variable; sold product value, and the scaled weight variable derived from SPV and GPV was used as a scale weight variable that represent the Household Commercialization Index (HCI).

The scale parameter is an estimated model parameter related to the variance of the response. The scale weights are "known" values that can vary from observation to observation. If the scale weight variable is specified, the scale parameter, which is related to the variance of the response, is divided by it for each observation. Cases with scale weight values that are less than or equal to 0 or are missing are not used in the analysis. In this research the gross product value was used as a scale weight variable after transformed to Weighted Least Square (WLS) value appropriate to 5% significance. Under the model, Tweedie probability distribution was used; because, it performs linking counted or Poisson probability distribution and continuous independent variables. Tweedie probability model decipher the features of Gamma distribution, log-likelihood function and identity link function.

Table 10. *Model information.*

Dependent Variable	SPV
Probability Distribution	Tweedie (1.5)
Link Function	Log
Scale Weight Variable	Weight for SPV from WLS, MOD_2 GPV** -2.000

Table 10 is the output of generalized regression model that highlights about the dependent variable used, the link function, the probability distribution, and scale weight variable.

Table 11 illustrates the succession of processes and steps taken to measure the fit of the data and to predict its accuracy.

In overall Omnibus test summarized the intercept only model as perfectly fitted (likelihood ratio =86.34, df =13 & significance = 0.000).

Table 11. *Model Goodness of fit.*

Criteria	Value	df	Value/df
Deviance	0	117	0
Scaled Deviance	210.303	117	
Pearson Chi-Square	0	117	0
Scaled Pearson Chi-Square	294.314	117	
Log Likelihood	-1364.676		
Akaike's Information Criterion (AIC	2759.351		
Finite Sample Corrected AIC (AICC)	2763.525		
Bayesian Information Criterion (BIC)	2802.479		
Consistent AIC (CAIC)	2817.479		
Dependent Variable: SPV			
Model: (Intercept), CRAC, EDLV, NNFA, SXHH, EACN, CSTR, DFMT, FMSZ, AGHH, YOLD, NNFI, KCAL			

4.3.2. Parameter Estimation

Table 12 below presents the summary of signified variables, their standardized and unstandardized coefficients Wald Chi-Square test result and exponentially transformed regression coefficients.

Table 12. *Parameter Estimates.*

Parameter Estimates					Hypothesis Test			Exponential Estimates		
Parameter	B	Std. Error	95% CI Lower	95% CI Upper	Wald Chi-Square	df	Sig.	Exp.(B)	95% CI Lower	95% CI Upper
(Intercept)	9.373	0.894	7.443	11.298	109.879	1	0.000	11762	1709	80696
[CRAC=0]	1.194	0.392	0.633	1.761	9.258	1	0.002	3.301	1.882	5.820
[EDLV=0]	-0.253	0.455	-1.744	1.239	0.310	1	0.578	0.776	0.175	3.454
[EDLV=1]	-0.637	0.359	-1.819	0.544	3.152	1	0.076	0.529	0.162	1.723
[NNFA=0]	-0.046	0.266	-0.359	0.268	0.030	1	0.862	0.955	0.698	1.307
[SXHH=0]	-0.779	0.227	-1.439	-0.120	11.780	1	0.001	0.459	0.237	0.887
EACN	-0.098	0.054	-0.186	-0.012	3.377	1	0.066	0.906	0.831	0.989
CSTR	0.003	0.002	-0.001	0.008	1.992	1	0.158	1.003	0.999	1.008
DFMT	-0.056	0.017	-0.078	-0.034	11.031	1	0.001	0.946	0.925	0.967
FMSZ	-0.123	0.061	-0.236	-0.010	4.113	1	0.043	0.884	0.790	0.990
AGHH	0.012	0.006	0.000	0.025	4.434	1	0.035	1.013	1.000	1.025
YOLD	0.032	0.013	0.014	0.051	5.813	1	0.016	1.033	1.014	1.052
NNFI	0.00	0.000	0.000	0.000	0.551	1	0.458	1.000	1.000	1.000
KCAL	0.00	0.000	0.000	0.000	4.662	1	0.031	1.000	1.000	1.000

The null hypothesis for generalized regression model stated as if, $\beta_o....\beta_{n=}0$, the variable has no impact and the alternative hypothesis stated as if, $\beta_o...\beta_n \neq 0$, the variable has impact. Since Beta coefficient is a vector parameter negative figures are indicators of opposite correlation and positive values indicate the existence of summative association.

1) CREDIT ACCESS (CRAC): credit access hypothesized to have a positive relationship with famers' commercialization assuming that it as one factors of production and leverage the farm from risk being an insurance mechanism in times of sever crop failure and to further upgrade farm enterprises. Access to credit enhances the probability of market participation but, not intensity of participation [21].

In this research the majority (80.6%) of the householders have credit access. and it positively affected their commercial ability, significantly at 1% level. Accessibility of credits, as one of the major constraint mitigating to agricultural productivity, particularly to small holder farmers, have contributed significantly and positively at 10 percent level [22].

2) EDUCATION LEVEL (EDLV): it was hypothesized that education raise famer's awareness in building and adopting new or improved technologies that help commercialization process.

The majority of households (82.1%) included in this research are literates and 17.9% of them has not attended any formal education at all; hence, their illiteracy has made their effort to commercialize dwindle significantly at 10% level (χ^2=3.15, df =1 & sig. =0.076). In similar topic, the level of education of the household head showed positive and significant effect on the level of *Ergotis Eragrostis tef* commercialization at 10%. On the same research, the marginal effect indicated that as the level of formal education of the household head increased by one grade, increase the probability to commercialize by 0.009% whereas it increases the level of *Eragrostis tef* commercialization by 0.34%.

3) SEX OF HOUSEHOLD HEADS (SEXHH): this research assumed that male-headed household commercialized more than female household heads no matter what how household heads are extremely greater in number than women household heads.

In this research the majority (91.8%) of farmers taken as a respondent were male headed. Even if male headed householders are large in number a few female headed householders weighted the highest exposure to commercialize than male headed counterparts at less than 1% significance level (χ^2=11.8, df=1 & sig.=0.001). Sex of the household head (female headed household) negatively influenced the level *Eragrostis tef* commercialization at 10% significance level. The marginal effects showed that being female headed household decrease the probability to commercialize by 0.079% while it decreases the level of *Eragrostis tef* commercialization by 2.821%, as compared to male headed households. Household characteristics like being male headed household decreases the probability of being subsistence farmer and have positive effect on being transition and commercial farmers [11].

4) NON- FARM ACCESS (NFAC): it hypothesized that the access to non-farm income may have an opportunity to offer farmer's sale more of their product to market than those who do not have.

In this research 30.9% of household respondents responded to have income other than farming; but has no significant negative result.

5) EXTENSION AGENT CONTACT (EACN): this research assumed that the more the number of extension agent contact the more the farmer perform.

The average number of extension agent contact per year is 3. Farmers' number of contacts to extension is such is that it negatively influenced commercialization and the influence is significant at 10% critical level (χ^2 =3.8, DF=1 & sig. =0.066). The frequency of extension contacts significantly and positively related with *Eragrostis tef* commercialization at 1% significant level. In addition to that, the marginal effect shows that an increase in frequency of extension contact by one day would increase the probability to commercialize by 0.025% whereas it increases the level of *Eragrostis tef* commercialization by 0.884% [23].

6) COST OF TRANSPORTATION: it had assumed that cost of transporting materials and human being will to have negatively to influence the process of commercialization.

In this research respondents spent 50.9 Ethiopian Birr to transport 1000kg of grain to nearby market. The cost farmers spent to commercialize positive impact on their effort to commercialize; but, is not significant to conclude.

7) DISTANCE FROM MARKET (DISTM): this research hypothesized that the farthest the farmer from available market the lesser the commercialization index.

The average distance of farmers from local market is 16.9 kilometers and this has showed a far reaching negative impact in this research at less than 1% critical level with χ^2 =11, df =1 & sig. =0.001 [23]. In similar study, distance to market is negatively associated with HCI and showed significance to 99% probability level implying in turn: the greater apart from market, the less likely the farmer orient towards commercialization [22].

8) FAMILY SIZE (FMSZ): during this research larger family size is associated to have a positive correlation with commercialization.

The average family size of householders was 5.34 that deviate by 1.39 unit from the mean and this size has a negative influence at 95% confidence interval (χ^2 =4.1, df =1 & sig. =0.043) severity level.

9) AGE OF HOUSEHOLD HEAD (AGHH): it was hypothesized that age has a negative correlation with commercialization because it imposes limitation on activities of the person or household head.

The average age of household head farmers was 36.5 and regression resulted positive correlation that assure 95% confidence to generalize during this research (χ^2 =4.43, df =1 & sig. = 0.035). Other researcher believe that younger households are generally more likely to participate in selling than their older counterparts. They also tend to sell more when they participate. On the other hand, an increase in age by one year significantly decrease the probability of being subsistence farmer where as it has positive effect on being transition farmer [11].

10) YEARS OF OWNING LAND (YROL): this research assumed that the number of years of cultivation adds relevant experience and a sort of land security therefore has a positive impact.

Respondents under this research have around 19 years of average cultivation experience and this experience had contributed their potential to produce more marginal output and selling to consumers (χ^2 =5.8, df =1 & sig. 0.016) in upgrading their commercialization skill positively significant at 95% confidence interval. The number of years of the farmers' increases, the probability of commercialization also increases. This indicates experience has been known to lend the perfection to relevant activities [22].

11) NON-FARM INCOME (NNFI): this research was assumed that the increase in income from non-farm activities will trigger commercialization process.

The average income from non-farm activities of respondents involved was 738.04 and without confidentially speaking, this additional income does not resulted further commercial activities in this research; but, in similar issue, the marginal effect shows that an increase in the amount off/non-farm income by one thousand Ethiopian birrs decrease the probability to commercialize by 0.006% while it decreases the level of *Eragrostis tef* commercialization by 0.231% [23].

12) KILO CALORIE INTAKE (KCAL): this research assumed that kilo calorie to have a positive consequence on commercial ability of farmers pertaining that surpluses go for sale after consumption.

The average kilo calories taken by each member under the households was 1973-kcal and the unstandardized regression coefficient value (B) showed no value or zero. This signal is not of course by chance; but at 5% critical level (χ^2 =4.66, DF =1 & sig. =0.031).

4.3.3. Bootstrapped Estimation

Bootstrapped estimation here discusses and determines effect size as exactly assumed significance level appropriate to the sample size without overstating the power effect under unlike constrained function.

Bootstrapping is a method for deriving robust estimates of standard errors and confidence intervals for estimates such as the mean, median, proportion, odds ratio, correlation coefficient or regression coefficient. It may also be used for constructing hypothesis tests. Bootstrapping is most useful as an alternative to parametric estimates when the assumptions of those methods are in doubt (as in the case of regression models with heteroscedastic residuals fit to small samples), or where parametric inference is impossible or requires very complicated formulas for the calculation of standard errors (as in the case of computing confidence intervals for the median, quartiles, and other percentiles).

The bootstrap specifications table contains the settings used during resampling, and is a useful reference for checking how the analysis intended was performed. Summary from bootstrap specifications in this case indicated the simple random sample size to be 134, the confidence interval level as 95% and confidence interval type as percentile: Setting seed for Mersenne Twister is 4163 (the original sampling frame from which samples are drawn).

Table 13. *Bootstrap Estimates.*

Parameter	B	Bootstrap					EXP.(B)
		Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval		
					Lower	Upper	
(Intercept)	8.697	0.468	1.108	0.008***	6.769	11.624	5985
[CRAC=0]	0.933	0.018	0.481	0.040**	0.116	2.093	2.542
[EDLV=3]	0.537	-0.087	.783	.317	-1.749	1.859	0.537
[EDLV=2]	0.149	-.102	.769	.833	-2.446	1.160	0.149
[EDLV=1]	-0.102	-.088	.729	.770	-2.528	.833	-0.102
[MNTR=0]	0.765	-0.138	0.379	0.079*	-0.200	1.356	2.149
[NNFA=0]	-0.17	-0.003	0.315	0.675	-0.725	0.465	0.844
[SXHH=0]	-0.677	-0.040	0.391	0.032**	-1.483	-0.008	0.508
EACN	-0.073	-0.003	0.064	0.246	-0.203	0.044	0.930
CSTR	0.003	-0.001	0.003	0.444	-0.005	0.008	1.003
DFMT	-0.037	0.009	0.010	0.087*	-0.064	0.009	0.964
FMSZ	-0.101	-0.014	0.088	0.206	-0.315	0.063	0.904
AGHH	0.011	0.000	0.009	0.214	-0.010	0.023	1.011
YOLD	0.029	-0.005	0.015	0.087*	-0.005	0.056	1.029
NNFI	0.000	1.23E-05	0.000	0.516	0.000	0.000	1.000
KCAL	0.000	-3.97E-05	0.000	0.294	0.000	0.000	1.000
(Scale)	2.59E-07	-3.45E-08	6.09E-08	0.048**	1.10E-07	3.48E-07	1.000

** Significant at 5%
* Significant at 10%
*** Significant at 1%.

Based on constrained parameter estimation household farmers that have access to credit have got a positive significant impact at 5% critical level. Those farmers who have own animals for transporting farm out puts to market and the years of owning land have resulted a positive higher impact on commercialization index at 10% significance level. Male headed households ranked lower level to commercialize than female headed household and this is not occur by chance (but at 95% confidence). Distance from the market also markedly influenced commercialization process negatively significant at 90% confidence.

The years of experiences of smallholder farmers equipped them better commercialize than low experienced farmers at 10% critical level.

In addition to the variables under the model, the scale variable used validation for its appropriateness in accuracy and prediction with significance level at 5% level. The EXP. (B) value of the scale variable, coefficient estimates of the redundant (such as CRACS=0, EDLV=0, MNTR=1, NNFAC=1 and SXHH=1) and variables that do not have any observed impact (such as NNFI and KCAL) set to zero under B column and one under EXP. (B) column .

In sum, regarding the fit of the data, with intercept coefficient of regression, the model verified the level of precision with its two- sided significance at 0.008 and coefficient of determination at 8.697.

5. Conclusion and Recommendation

5.1. Conclusion

The research title: The Determinants of Commercialization to Smallholder Farmers in West Haraghe Zone, Oromia Region of Ethiopia was conducted successfully and draw inferences that are generalizable to geographical boundaries around West Hararghe Zone. The research, as aimed, achieved its general goal through specific starting guidelines of: computing commercialization index and identify the limiting factors of commercialization.

The primary data that had used during processing, analysis, interpretation and that could have made drawing inferences possible, was collected from 134 random sampled smallholder farmers, located in Chiro, Gemechis and Meiso Woredas of West Hararghe Zone, Oromia region of Ethiopia.

The analysis generated, outcomes stating the relationship between the dependent and independent variables. Some of these results were in agreement with the proposed hypothetical relationship and some were not. The major difference from the presupposed ones appeared on family size, non-farm income, age of household, sex of household head, and kilo calorie intake. The proposal had assumed that family size, non-farm income and kilo calorie intake will have a positive association with HCI; but, the final output got the reverse. As a result, rejecting the null hypothesis and in place, accepting the alternative hypothesis is unquestionable in such cases and in this particular study.

During the research variables such as Tropical Livestock Unit (TLU) and land size of the smallholders, pointed by detection methods as outliers; hence, researcher discretion discarded them enter in to the final model and quitted further analysis after regression. This is because, the presence of outliers distort the estimated value abruptly and unconditionally.

5.2. Recommendation

The average value of household commercialization index obtained in the study area was around 35%. This value likely considered very low when compared against the national average which is: 52%. This condition of smallholder farmers, in the study area, appeals coordinated and collaborated efforts to exert up on commercialization

The technology transfer mechanism in the study area showed “very poor”; therefore, extension strategies targeting agricultural production and marketing is required.

The food security of the study area is as such minimum to 1973 in average and deemed not to the level of further encouraging farmers motivation (produce more and sell marginal out puts); because, securing their own need precedes at preliminary rank In such instance, targeting in securing food at rural areas may give an upward lift on commercialization status.

Since farmers were located far from centers, modern transporting mechanisms to transport their product could facilitate the marketing process. In addition, construction of infrastructures such as, large storage facilities, road construction, and whole sale markets should be designed near to farm-gate and around rural household settlements.

In the research area households obtain much of their income from sell of livestock products such as milk; therefore, transforming this potential to specialization in agricultural commodity extension strategy should be designed. To expand the volume of livestock out puts: modernizing breeding, and improving domestic livestock genetic quality through scientific bio-technology laboratories is essential, among others.

Crop commercialization in the research area is very low, due the dependency of the system on naturally occurring seasonal rain fall, use of backward farming tools, and lack of improved technology. Therefore, irrigated farming schemes and improving farm machinery tools should take the place.

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[i] Zone refers the second population and land scape administrative decentralization unit in Ethiopia.

[ii] Region refers the first population and land scape decentralized administrative unit in Ethiopia.

[iii] Woreda refers the third population and land scape decentralized administrative unit in rural parts of Ethiopia.

[iv] Peasant Association refers the last population and land scape decentralized administrative unit in rural parts of Ethiopia.