Horn of Africa Journal of Business and Economics (HAJBE), 2020, 3(2), PP: 29 – 46

ISSN: 2617-0078 (Print), 2617-0086 (Online)

Impact of Rural Infrastructure on smallholder Output Market Participation in South West Ethiopia: The Case of Jimma Zone

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Abstracts

The objective of this study was analyzing the impact of rural infrastructure on smallholder farmer decision to participate in output market in Jimma Zone. By using multi-stage sampling method, the primary data was collected from a total of 397 through structured questionnaires. Heckman two-stage selection model was employed to analyze data collected from sampled household. The significance of coefficient of inverse Mill's ratio (λ) indicates the presence of selection bias and the effectiveness of applying Heckman two stage model. The results of the study show that smallholder participation in output market were positively influenced by farm size, sex, education, oxen, road infrastructure, telecommunication and electric services accessibility, access to extension and accessibility of credit. On the other hand, size of family and distance to market place discourage probability of farmer market participation decision. Moreover, in the second stage; sex, education, farm size, amount of crop produced, road infrastructure, telecommunication and electric services, access to extension, accessibility of credit and access to information increase the intensification of farmers market participation. The policy that geared towards providing rural infrastructure for rural community is believed to enhance the level and intensity of smallholder's farmer output market participation.

Key words: ***Heckman-two stage, market participation, rural infrastructure, Smallholder farmer***

1. BACKGROUND OF THE STUDY

One way or another any development agenda geared towards Poverty reduction and improving the livelihood of the rural smallholders has strong relationships with their market participation in turn determines whether farmers are accessed by infrastructure or not (Mathenge et al., 2010; Dercon et al.,2007). About 1.3 billion people globally do not have enough food to eat and Sub-Saharan Africa host 22.8% of the undernourished population. Being the dominant livelihood in Africa, agricultural growth remains unable to feed the growing population (FAO, 2019). Smallholder agriculture has long been the dominant economic activity in the sub-Saharan region, and it will remain enormously important for the foreseeable future (Gollin, 2014). However, the subsistence nature of the sector and low market integration and participation remains a big challenge due to lack of rural infrastructure linkage. The Ethiopian case is no exception (Megerssa et al, 2020).

World Bank (2010) estimated that 13% of the agricultural produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers. This is because poor rural road infrastructure limits the ability of the traders to travel to and communicate with remote farming areas, limiting market participation from these areas and eliminating competition for their produce. Provision of infrastructure for agricultural households make easier access to market and allows expansion of perishable and transport-cost intensive products.

As known in literature, markets act as a main catalyst in the agricultural transformation process. In Ethiopia following policies reform from 1991, imposition of different agricultural policies that encourage courage of the potential of markets to smallholderôs farmer gave rise to market-led rural development paradigm in Ethiopia. Moreover, the government previously used to play a role in assisting farmers with marketing of agricultural produce. However, the problem of poor market participation, which manifests as little marketable surplus, has been seen due to poor linkage of rural infrastructure. Majority of the smallholdersô farmers are located in remote areas with poor transport and poor market infrastructures, contributing to the high transaction costs faced. Transaction costs have been the key reasons for smallholder farmersô failure to participate in the markets (Makhura, 2001). These transaction costs include costs of searching for a trading partners, of bargaining, monitoring, enforcement and eventually, transferring the product to its destination (Delgado, 1999).

To best of our knowledge, around the world, work by Govereh , Jayne and Nyoro (1999) and Strasberg et al.(1999) are the studies that measure the effect of market participation on productivity. Other studies report by Karanja (2004); Boughton et al. (2007) found positive relationship between infrastructure and market participation decisions while other studies by Lapar, Holloway & Ehui(2003) and Holloway and Lampar(2007) indicate rural infrastructure is not contributing to farmers market participation and other early study by de Janvry and Sadoulet(2000) forwarded that the linkage between rural infrastructure and farmer market participation is found to differ based socio economics and geographical characteristics of study area population which point out that there is contradicting finding on the linkage between rural infrastructure and market participation of farmers which makes difficulty to draw a conclusion for specific study area.

Moreover, in Africa case, there are also few studies such as Dorosh et al. (2009) using cross-country regression in SSA stressed the link between rural infrastructure and agricultural production; Kingombe and di Falco, (2012) on impacts of rural road improvements on farm productivity and crop choices in Zambia and Gachassin(2013) studied the impact of rural road accessibility on migration to have decreased in Tanzania. All these study neglected the level and intensity of linkage of rural infrastructure and output market participation.

Specifically, in Ethiopia, Mohammed (2011), Efa et al. (2016) and Azeb et al. (2017) studied the determinant of market supply of smallholder farmers of particular cereal crops without addressing the issues of rural infrastructure and the others. However, no research to date asks to what extent rural infrastructure influence farmer output market participation. In other words, there was no research that has been done concerning the impact of rural infrastructure on market participation of small farmers in Jimma zone. Therefore, the objective of this study was to analyze the impact of rural infrastructure on smallholder farmer decision to participate in output market in Jimma Zone.

2. REVIEW OF EMPIRICAL LITERATURE

2.1. Theoretical Literature Review

Market participation of farmers is both a cause and a consequence of economic development (Reardon & Barrett: 2000; Timmer, 2008).It is a major pathway for rural people in assuring better income and improving food security. The existence of markets and improved market access are important for smallholder farmers since it can draw agricultural and economic development. Improved access to markets has paramount importance in increasing smallholder market participation and the extent of their participation, ceteris paribus (Key, Sadoulet & Janvry, 2000). Moreover, rural infrastructure accessibility is the most crucial in improving the quality of human life through accelerating the process of agricultural development. Rural infrastructure has direct and strong relationship with farmersô access to markets, and increasing crop yields, thereby promoting agricultural growth. On other hand, market access to rural farmers is highly related with rural infrastructure provision in which it has the potential to transform the existing traditional agriculture or subsistence farming into a most modern, commercial and dynamic farming system (Amrit, 2000). Infrastructure, such as irrigation, watershed development, rural electrification, and roads in close coordination with institutional infrastructure, such as credit institutions, agricultural research and extension, rural literacy determines the nature and the magnitude of agricultural output and thereby encourage farmer to supply their surplus for output market and improve their likelihood in general (Wharton, 1969).

Barrett (2008) and Deaton (1997) outlined that rural farmerôs market participation is the most important weapon to boost economic growth and poverty reduction. Market participation leads to market-oriented production where the household specializes in the production of those goods for which it holds comparative advantage. But in order to participate actively in markets, households require adequate access to production technologies and infrastructure. Market participation is directly associated with the generation of a market surplus, thus production technologies and productive assets affect a householdôs market participation by influencing its productivity (World Bank, 2017). On the other hand, local market conditions influence incentives to increase productivity: in integrated markets the returns to increased production

decrease less rapidly than they do in isolated markets. Moreover, poor infrastructure and weak institutions raise transaction costs that considerably alter production and market participation decisions (Rios et.al, 2008; 2009).

2.2. Empirical Literature Review

Study by Dorosh et al.(2009) examines the relationship between road infrastructure and agriculture particularly crop production and choice of technology in Sub-Saharan Africa using new data obtained from geographic information systems (GIS) and found that agricultural production is highly correlated with road connectivity (as measured by travel time) to urban markets where as adoption of high-productive/high-input technology is negatively correlated with road infrastructure (travel time to urban canters) and recommended that substantial scope for increasing agricultural production in Sub-Saharan Africa by providing road infrastructure, particularly in more remote areas.

Mohammed (2011), analyzed factors determining market supply of creal crops in Halaba special district in southern Ethiopia. He found that quantity of output, access to market information and extension service were statistically significant factors affecting output market supply. Using double hurdle model, Efa et al (2016), indicated that family size, credit access, farm size, agro-ecology and road infrastructure affect the market participation of teff supplier in Bacho and Dawo districts of Oromia region. The analysis by Azeb et al. (2017) on factors determining smallholder teff farmersô market supply in Ambo district of West Shewa Zone by employing multiple linear regression model and found that quantity of output ; family labour force, income from nonfarm and market price of teff significantly affect the market decision of smallholder farmers. All previous studies have ignored the role rural infrastructure on farmer commercialization.

3. MATERIALS AND METHODS

3.1. Data Type and Data Collection

This study is limited to Jimma Zone of Oromia regional state. Geographically, Jimma zone is located in South Western part of the country, Ethiopia. According to the official report from Jimma Zoneôs administration office in 2016/17, the zone is totally composed of 21 administrative districts locally called, woredas. There, the total number of population was reported to be over 3 million under 516, 321 households in general. We employed both primary and secondary data sources. Primary data were sourced from the individual respondents included in the study. Moreover, we also obtained secondary data from Jimma zone agricultural office, Finance and Economic Development office, and Trade Departments of the zone and the respective woreda offices.

3.2. Sampling Methods and Sample Size Determination

Jimma zone is structured to have twenty one woredas. As far as we are concerned with the analysis of rural market, we purposively selected four districts based on the relative availability of market oriented productions. These woredas include; Limmu Kossa, Shebe Sombo, Gomma and Manna Woredas. Afterwards, each woreda is further structured into sections based on its kebele constituents (the lowest administrative structure). Then, random proportional sample of kebele is selected from each woreda. Finally, households were then being proportionally and randomly selected from each kebeles from chosen woredas. According to Jimma zone

administration office report of 2016/17, the total population size of each considered woreda is reported to be 26, 124 for Shebe Sombo; 32, 058 for Limmu Kossa; 21, 235 for Manna; and, 22, 907 for Gomma. Hence, the population size totals 102, 324. The same source has also indicated the estimated size of households in each woreda to be 4, 354 for Shebe Sombo; 5, 343 for Limmu Kossa; 3,540 for Manna; and, 3, 818 for Gomma. It implies that the sum total of individual households in four woreda equals 17, 055. To determine the appropriate sample of households, we use the method suggested by Noel et al. (2012) given below;

$$n \geq \frac{N}{1+(N-1)\left(\frac{sd}{z}\right)2} \text{é é é é é é é é é é .é é é é é é é é é . (3.1)}$$

Where, N = the total population; n = The required sample size; d= 0.05 Margin of error; Z = 1.96 for 95 % confidence interval.

The appropriate sample size was determined using equation 3.1 above from the total households (N = 17, 055).Accordingly, the appropriate size is (n = 397). We selected 397 households out of the four chosen woredas.

Woredas	Household size	Sample size
Gomma:	3,818	87
LimuKossa:	5,343	124
Manna:	3,540	82
ShebeSombo	4,357	101
Total	17,058	397

We therefore randomly selected the corresponding sizes from each woreda thereby further structuring each woreda into kebeles. Then, each kebele has been allocated proportional size.

3.3. Model Specification

3.1.1.1. *Heckman two-stage model*

Heckman two-stage model was proposed by Heckman (1979) and has been used extensively to correct for biases arising from sample selection. The Heckman procedure provides consistent and asymptotically efficient estimates for all the parameters (Heckman, 1979; Woodridge, 2002). This model assumes that the missing value of dependent variable implies that the dependent variable is unobserved (not selected). Heckmanôs model first uses a probit regression with all variable data to estimate the probability of market participation. Then the inverse Mills ratio, computed from the Probit regression, is used with other explanatory variables to help explain variances to the continuous, non-zero dependent. To cater for the problem of selectivity bias and to relax the assumptions in the Tobit model, the study was therefore utilized a Heckman two-step procedure.

Therefore, to analyze the linkage between rural infrastructure accessibility proxy by accessibility of road, telecommunication and electrification services and smallholderôs farmer participation and its extent of participation cereal crops market, we employed Heckman two-stage selection model. The initial decision made by farmers to either participates in the market or not and level of participation considered as dependent variables and was estimated separately. Heckman two-step model involved estimation of two equations: First, is whether a household participated in the cereal crop market or not, and the second is the extent of market participation (proportion of cereals sales). The proportion of output sales were conditional on the decision to participate in the market. Heckman procedure is a relatively simple procedure for correcting sample selection bias (Hoffman and Kassouf, 2005). In the first step, selected equation was estimated using a probit model and the second step analyze an outcome equation which was estimated using OLS regression. A Probit model predicts the probability of whether an individual household participated in the output market or not as shown.

$$pr\left(Z_i = 1 \mid X_i, \beta\right) = \psi\left(f(X_i, \beta)\right) + \varepsilon_t$$

Where; $Z_i$is an indicator variable equal to unity for smallholders cereal crop farmers that participated in the marketing, ψ is the standard normal cumulative distribution function, X_i is the vector of factors affecting the decision to participate in cereal crop market, Ŭis the vector of coefficients to be estimated, and ε_t is the error term assumed to be distributed normally with a mean of zero and a variance ů2. The variable Zi takes the value of 1 if the marginal utility the household i get from participating in marketing of cereal output is greater than zero, and zero otherwise. This is shown as follows

$Z^* = \beta_0 + \beta_1 X_{1i} + \varepsilon_t$ WhereZ^* is the latent level of utility the smallholders farmers get from participating in the market, U ~ N (0, 1) and,

$$Z_i = 1 \text{ if} Z^* \geq 0$$

$$Z_i = 0 \text{ if} Z^* \leq 0$$

In the second step, according to Heckman (1979), the IMR is a variable for controlling bias due to sample selection. This term is constructed using the model in the probit regression (first stage) and then incorporate into the model of the second stage (OLS) as an independent variable. Hence, IMR can obtain:-

$$\lambda_i = \frac{\psi(\beta_0 + \beta_{1i} X_{1i})}{\phi(\beta_0 + \beta_{1i} X_{1i})}$$

Where, $\phi(.)$denotes the standard normal probability density function and $\Phi(.)$ denotes the cumulative distribution function for a standard normal random variable.

But the value of λ_i is not known, the parameters β_0 and β_{1i} can be estimated using a probit model, based on the observed binary result. Therefore, the second-stage equation is given by:

$$(Y_i / Z_i = 1) = \alpha_0 + \alpha_i X_i + \lambda_i \frac{\psi(\beta_0 + \beta_{1i} X_{1i})}{\phi(\beta_0 + \beta_{1i} X_{1i})}$$

$$(Y_i / Z_i = 1) = \alpha_0 + \alpha_i X_i + \mu_i \lambda_i + v_i$$

Where Y is the (continuous) proportion of output sold, x is a vector of independent variables affecting the quantity of output sold, and Ŭ is the vector of the corresponding coefficients to be estimated.

Table 3.2. **Variables in Heckman Two Stage model**

Variables	Variable code	Nature of variable	Variable definition and measurement	Sign
Dependent variable				
market participant or non-market participant	HHP	Binary	(1 = market participant, 0 = Non-Market participant.	
Quantity of output marketed	Qtt	Continuous	output sold in kg	2nd stage
Independent variable				
Sex of Head	SEX	Dummy	(1 =Male, 0= Female	+
Age of HH	AGEHH	Continuous	Age of the household head in year	-/+
Farm size	FSI	Continuous	Farm land size in hectare	+
Asset endowment	ASST	Continuous	Number of oxen owned	
household labor	HHL	Continuous	number of family in working age	+
size of family	FS	Continuous	number of family members	-
Quantity of output produced	Qtt	Continuous	output yield in kilogram	+
Distance to the market	DMKT	Continuous	Distance from selected farm household to the market place in Km	-
Access to information	ACIF	Binary	Access to information (if have access Yes=1, 0 Otherwise)	+
Access to input use	AVINP	Dummy	Access seed, fertilizer, urea (if have access Yes=1, 0 Otherwise)	+
Price of output	P	Continuous	Ethiopia birr per kg	+
Education	EDU	continuous	Years of education	+
Off-farm participation	OFFI	Dummy	participation in nonfarm activity(if off-farm income =1,0, otherwise)	-
Road accessibility	RDACC	Dummy	Road condition (if Good=1, 0, Otherwise)	+
Membership of cooperative	COMM	Dummy	Households membership to cooperative (if member Yes=1,0 Otherwise)	+
Access to extension services	ACEX	Dummy	Access to extension agent support (if have access Yes=1, 0 Otherwise)	+
Access to telecommunication&electric services	ACCTE	Dummy	Access to telephone services (if have access Yes=1, 0 Otherwise)	+
Access to Credit	ACCER	Dummy	use of credit (having access=1, 0, otherwise)	+

Source: own computation 2019/20

4. RESULTS AND DISCUSSION

4. 1. Descriptive Analysis

This study was under taken on total sample size of 397cereal crop producer farm households in south west Ethiopia in case of Jimma zone. Out of these interviewed farmers, 297(74.8%) participated in output market, while the remaining 100 (25.2%) did not joined output market at the time when the survey was conducted

Table 4.1 presents summary statistics of sampled householdôs demographic features by segregating survey data as participant and non-participants. However, there was a statistically significant difference between output market participants and non-participants in farm household size at 5% level. The mean age of the sample household head is 46.8 with the minimum of 26 and the maximum 82 years. The average household age of participants and non-participants in

output market is 46.8 and non-participants is 47.1 years respectively. The average household size of the total survey household was 6.2 persons, with minimum of 2 and maximum of 16 family members. The mean family size of the market participant household was 6 persons, with minimum of 2 and maximum of 12, whereas non-participants have 6.58 average persons with 2 and 16 minimum and maximum of family members respectively (table 4.1).

Table 4.1: Demographic characteristics of smallholder's farmers

Variables	Participant (OBS=297)			non-participant (OBS=100)			total survey (OBS=397)			t-value
	Mean	Min.	Max.	Mean	Min	Max.	Mean	Min.	Max.	
Age of HH	46.76	26	82	47.01	26	80	46.8	26	82	0.1821
Size of family	6.02	2	12	6.58	2	16	6.15	2	16	2.2391**
Family labor	3.51	1	8	3.01	2	10	3.38	1	10	-0.1763

***, ** and * imply statistically significant at 1, 5 and 10% respectively.
Source: Own survey data (2019)

The active family member is about family labor that can be able to participate in cereal crop production and marketing. According to data in table 4.1 on average, there were 3.4 active family members for survey house hold with minimum of 1 person per family to maximum of 10 labor force per family. The average output market participant household have 3.5 with 1 and 8 minimum and maximum family labor force respectively while mean non-participant sample farm household own 3.01 with having 1 and 10 minimum and maximum family labor force respectively.

Out of 397 sampled farm households, 92(23.3%) are female headed and the remaining 305(76.8%) were male headed households. When we recognize the comparison by market participation; out of the 297 participant households, 233(78.5%) are headed by females and the analogous figure for non-participants is about 64(38.3%) headed by females.

Access to rural infrastructure

Table 4.2: Accessibility of rural infrastructure to sample survey household

Variables		Participant (OBS=297)		non- participant (OBS=100)		total survey (OBS=397)		Chi2(1)
		Frequency	%	Frequency	%	frequency	%	
Have access to telecom & electric services	Yes	51	17.2	36	36	109	25.5	10.5333***
	No	246	82.8	64	64	288	74.5	
	Total	297	100	100	100	397	100	
Road accessibility	Good	76	25.5	33	33	109	25.5	18.4364***
	Bad	221	74.5	67	67	288	74.5	
	Total	297	100	100	100	397	100	

Source: Own survey data (2019)

The results in Table 4.2 indicate that 17.2% of the market participants have access to telecommunication and electrification services while remaining 82.8% did not get accessibility of telephone services and electrification services. On other hand, out of total non-market participant 36% of respondents have access to telecommunication and electric services while the

remaining 64 % did not get accessibility. From the total smallholder farmer, those who have access to telephone and electric services accounts 25.5 while the majority, about 74.5% of sample farmers was still lacked basic infrastructure services in rural area. Based on chi square result, we found that accessibility of rural infrastructure particularly telecommunication and electric services has significant difference among output market participant and non-participant in study area (1% level of significance). Therefore, giving priority for rural infrastructure has positive impact on farmer output market participation decision. Regarding to road infrastructure, the result shows that, out of total respondents, around 25.5% had no access to all weather roads. In term of comparing market participant and non-participant; 74.5% participants have no access to all season roads, while 67% of non-participant slack access to road. This implies that improving roads connectivity enhances market participation for perishable farm produce by smallholder farmers living in remote areas.

Econometric Analysis

It is mandatory to undertake diagnostics test before running the regression analysis, i.e. the existence of multicollinearity, the problem of heteroscedasticity, and the normality distribution of variables are needed to be checked both for the continuous and discrete explanatory variables. Accordingly, the computed results of variance inflation factor (VIF) suggests that, the absence of serious multicollinearity problem in our model (VIF = 1.225) or no variables had a pair wise correlation above 0.5, which shows that the data has no fear of multicollinearity problem. The Breusch-Pagan test evaluates the null hypothesis of a constant variance in the data which show that there was no evidence of heteroskedasticity in data set included in this study (Prob > chi2 = 0.2454).

Factors that Determine the Decision by Smallholder Farmers to Participate in the Market

The result in Table 4.3 highlighted the likelihood of small farmersô output market participation decision positively and significantly influenced by land size, household head being male, education status of household, the number of oxen, road accessibility, accessibility of credit service, access to extension services, access to telecommunication and electricity while family size and distance to market place have found to be negative and significant effect on probability of farmers output market participation decision.

Table 4.3; Factors that determine small holder farmersô output market participation decision

Number of obs =397; LR chi2 (16) = 317.62

Log

Variables	Parametric estimation		Marginal effect	
	Coefficient	Std. Err.	Coeff/dF/dx	Std. Err.
Age of HH	.0006757	.0112394	.0000269	.0005214
Sex	.4655926	.1624261	.0216244***	.0124379
Family size	-.0628866	.0600677	-.0031961*	.0032653
family labor	.09122	.0917358	.0046148	.0047685
Farm size	.088889	.1523774	.0037316***	.0072835
Education of HH	.6572917	.298823	.0303401**	.0190624
No of oxen	.7665391	.1655262	.036174***	.0173352
off-farm Participation	.1704634	.2785703	.007558	.0116978
Road accessibility	.6175324	.3098935	.0285049**	.0192568
Membership to coop.	.2435054	.3056111	.0106242	.0138523
Access to extension	1.644246	.2564754	.0758973***	.0408359
Access to credit	.1225986	.3804224	.0281285**	.018342
Distance to market	-1.530234	.6136256	-.0056591**	.0035886
Access to telecommunication	.7579576	.2701083	.0349868***	.0221496
Access to information	1.486237	.4855607	.054847	.0951689
Constant	-3.624108	1.149195	-	-

likelihood = -65.256633 Prob> chi2 = 0.0000; Pseudo R2 = 0.7088

****, ** and * imply statistically significant at 1, 5 and 10% respectively.*

Source: Survey data (2019)

Gender of the household head has statistically significant and positively influenced farmerôs output market participation at 5% level. This suggests that male headed households are more market oriented than female, hence they participate more in the market for cereal output. This finding is in line with the argument by Mohammed (2011) who argued that men are responsible for providing output income to the household and to accomplish this they grow cash and export crop.

The farm size was found to have a positive and significant effect on small holdersô farmersô possibility to participate in output market at 1% level of significance. It is justified that availability of more arable land enables farmers to allocate more land to produce cereal crop leading increment in output and the rise in output widens the chance of farmers to supply more output to the market. This result is similar to the finding by Efa et al.(2016), which identified a farmer who has a large farm land measured in term of hectare would have high probability to allocate more land for production of cereal output as result the likelihood of market participation would increase. Similarly, Rehima et al. (2013), also found the positive effect of land on grain farm household market participation, i.e. since additional land increases both high valued grain

(like teff or wheat or barely) and non-grain farm output; this leads to a higher marketable surplus then increment in household income.

In line with theoretical justification, family size is negatively associated with the probability of output market participation at 10% level of significance. The additional one person increases in family member results in 6.3 % decline in probability of household market participation. The large family is expected to consume the higher quantity of cereal crop compared to small family, causing smaller amount of marketable surplus were left. This finding is different from that of study by Moono (2015), which emphasize the positive and significant influence of family size on rice farmer market participation in western province of Zambia.

As hypothesized from economic theory, the number of oxen has found to be positive and statistically significant in affecting the probability of farmersô output market participation. In other word, the coefficient of oxen is found to have a statistically significant at 1% level and it is positive influence on the probability of households to participate in the output market. Therefore, farmers with high degree of participation in the output market may be associated with the number of oxen owned thereby bring highly efficient in enhancing their productivity, thus farmers have a more chance of achieving surplus production for sale

As hypothesized, distance to the nearest market place negatively influences the likelihood of farm household market participation decision significantly at 5% level. This is due to the heavy nature of cereal crops, since in study area household bring cereals by donkey, horse or manpower it would be costly and tiredly to participate in market. As distance to market place increase the rent of donkey increase, that result increased transaction cost to household. This finding was supported by Tadele (2016), who considered distance to market as proxy, to transaction cost and come up with negative effect of distance to nearest market on small dairy farm household market participation in West Showa. Therefore, smallholder farmers who are located at remote site of study area had less probability to participate in output market relative to the nearby one.

Access to credit facilities was statistically significant and positively influencing the likelihood of farmer output market participation (1% level of significance) which is increasing the propensity for input use due to the fact that farmers with access to credit facilities had advantage over those who had no access. Access to credit enables the farmers to use improved inputs such as fertilizer, improved technology, seeds, irrigation scheme and paying hired labour, which in turn have a direct positive impact on marketable output performance. On other hand, accessibility of credit enables farmers to purchase inputs like improved seed, fertilizer, which increase output through productivity increment then by enable households to supply more to market. On the other hand, accessibility of credit solves farmers cash problem that make farmers to sale at early period of crop collection with low price. This finding was supported by Mathenge(2010), who identified farmers who have access to credit are more likely to produce market- oriented crops specially sesame in study area. Randela et al. (2008) also found positive impact of loan on small farmersô production and market participation in South Africa. Therefore, farmers who have availability of credit service are more likely to enter output market than non-beneficiary.

Education level of the household head significantly and positively influenced cereal crop market participation at 1% level. The justification of the result can be manifested as an individual

access more education he/she is empowered with the marketing skill and knowledge that will spur individual to participate in the market. This is in line with Bittinger (2010) who illustrate that if producer gets educated, the amount of output supplied to the market increases, this suggests that higher level of education provides a greater opportunity for the farmers to participate in the output market. Moreover, farmer with formal education have better ability to obtain new market information, and new technology of production which in turn increase the farmers chance to participate in market. Education also increase decision making ability of farmers based on identified market information and opportunity. This is in line with the finding of Sebatta et al., (2014) which reported positive influence of education on smallholder farmerôs decision to enter potato market in Uganda.

In this study, results indicated that the number of extension visits from government workers particularly extension agents had a positive and significant (at 1% level of significance) effect on the decision to participate in the market. Other things constant, small farmer with access to extension service has 7.6 % more chance to participate in output market than farmer with no extension services. This is because extension agents usually provide information on market availability as well as information on new and improved varieties that enhances the farmerôs knowledge and provide a range and choice of market opportunities. Gebremedhin and Hoekstra (2007) also found a similar result when they found a positive and significant effect of extension access on the volume of teff sold. Similarly, Heltberg and Tarp(2001) come up with the same argument by stating that to commercialize, the most important factors appear to be improved were access to markets, information and risk reduction through continuous contact extension agents.

The categorical variable, access to telecommunication proxy by telephone and access to electrification has found to be statistically signiýcant and positive impact on smallholder farmersô market participation decision (at 1% significance level). One reason may be that farmer reduce market fluctuation by collecting daily information from market through using telephone which motivate them to produce more marketable output as well as it could improve agricultural productivity and increase production thus increasing the probability of market participation.

ôRoad infrastructureô is another important variable having significantly positive impact on the decision of smallholder farmers to participate in the output market. Its positive influence revealed that households with access to road infrastructure tend to participate in the output market than those with less or poor road infrastructure (at 5% level). This means that farmersô decision on market entry is significantly related to the road accessibility. Therefore, investing in public infrastructure (i.e., improving roads) and devoting efforts targeted at helping farmers increase their production could positively affect the farmersô output market participation decision.

4.2.2. Factors determining the intensity of farm household output Market Participation

The result in table 4.4 describes factors that have influence on the volumes of output sold in the market among smallholder farmers through the second step equation of the Heckman two-stage model. The second step equation showed that sex of household head, farm size, the number of oxen, road accessibility, access to credit, access to extension, access to telecommunication and electric services, quantity of output produced, availability of market information as well as

inverse Millôs ratio were all statistically signiýcant below 10% probability level. Particularly, the significance of inverse Millôs ratio reveals the presence of selection bias and the effectiveness of applying Heckman two-stage model due to its ability to handle the selection problem. The positive sign proposes that the error terms in the participation decision and outcome equations are positively correlated. This shows that those unobserved factors that make the household participate in output markets are likely to be positively associated with intensity of output marketed.

Table 4.4: Results of the second-stage selection estimation (extent of market participation)

Variables	Coefficient	Std. Err.	t
Age	-.2081273	**.2072307**	-1.00
Number of family size	1.256036	1.126796	1.11
Sex of household	4.945168**	2.199468	2.25
Education of household	3.237399	2.67933	1.21
Participation in nonfarm	-4.346177	5.233744	-0.83
Road accessibility	13.66323***	3.727781	3.67
Membership to cooperative	4.497246	5.207003	0.86
Access to extension	19.42804**	7.791143	2.49
Access to credit	12.50226**	5.21119	2.40
Access to market information	15.18195	2.429187	1.20
Farm land size	10.63852***	2.445477	4.35
Number of oxen	16.29366***	2.23536	7.29
Access to tele& electricity	34.43759****	5.964283	5.77
Family labor	2.764313	1.820894	1.52
Output produced	.0132899***	.0029986	4.43
Distance to market	-1.544499	1.232849	-1.25
Mills lambda	23.13258**	11.79919	1.96
Constant	-27.45254	23.41197	-1.17

Number of observations = 397; Censored observation = 100; Uncensored Observation = 297;
R-squared = 0.6315; Adj R-squared = 0.6091; F (17, 279) = 28.13; Prob> F = 0.0000
Wald chi2 (12) = 79.78; Prob> chi2 = 0.0000
***, ** and * imply statistically significant at 1, 5 and 10% respectively.
Source: Survey data (2019)

The sex of the farm household had a positive and significant (at 5% level) effect on the volumes of output sold into the market. Hence, by being male, a farmer had higher chances of selling more output to the market because male farmers have more contacts that are social with both cereal crop buyers and their agents whom they often meet in market center. Female farmers lack such contacts and are in most cases excluded from direct transactional negotiations with buyers. Sebatta et al. (2014) found that male gender of farmer positively and significantly influenced farmerôs volume of sales in the market. The authors argued that the reason is that women spend

much of their time doing domestic work and allocate less time to other matters like market transactions.

As it was expected from economic theory, the amount of output produced has positive and significant influence on level of output market participation at 1% level of significance. The finding reveals that farmers with more output supply more to market and more market oriented than low producer. This result was fit in to the finding by Nuri (2016), study on market participation of kocho producer in Hadya zone who found positive effect of kocho output on extent of market participation. Mignouna (2015) also found the positive influence of Yam output on extent of market participation in Yam Growing Areas of Nigeria and Ghana.

As expected, land holding size positively and significant influence on the level of output marketed at 5% level. This means that household that owns more oxen will produce more and offer more output for the market. This implies that livestock ownership plays crucial role in boosting the volume of output produced and this increases the proportion of cereal crop sales to the market. This is equivalent to study by Tura et al (2016), which identified the positive influence of farm land size on output sale volume in study area. This means that as the farm size increases, the extent of market participation for commercialization increases. This result is in line with Okezie et al.(2012); Goshu et al. (2012) and Gebreselassie & Sharp (2008). This could be due to the role of farm size in boosting total production level and thus sales of surplus produce. Moreover, farm households with large farm size could allocate their land partly for food crop production and partly for cash crop production providing them better position to supply more output to the market. Martey et al. (2012) had opined that farm size influences the intensity of agricultural commercialization in case of Ghana.

The development of infrastructure is a major factor in explaining increasing agricultural output and improving farm householdôs market participation. Although various studies have used different measures for rural infrastructure, we use how much kilometers rural farm households travel to the nearest market place to purchase raw materials and to sell farm output, accessibility of road for farmers transport farm output to the market, access to telephone and electric services, farmers access for credit institution and extension services. The result shows that the associated infrastructure facility such as access to rural road, and access to telecommunication and electrification services positively and statistical significantly contributed to the volume of sale of output marketed.

Access to credit and extension services resulted in positive and significant (1% level of significance) impact for volume of cereal output marketed. The positive effect of credit access and extension services programs indicates that farmersô accessing credit assistance enables them to invest in appropriate agricultural production technologies thereby increasing commercialization. Moreover, rural education through extension program and ýnance assistance is the most important components for agricultural production and marketing in the rural farm family.

5. CONCLUSION AND RECOMMENDATION

5.1. Summary of Result and Conclusions

Marketing of agriculture product plays a critical role in meeting the overall goals of sustainable agriculture, food security, and poverty alleviation, particularly among smallholder farmers in rural areas. This study was aimed to analyze the impact of rural infrastructure on level and extent of farmersô output market participation decision. This study found that the farmer market participation are constrained by several factors, such as socioeconomic, technological, and institutional factors, market factors and rural infrastructure services. The results of study show that the smallholder decision to participate in output market were positively influenced by farm size, sex, education, oxen, road infrastructure, telecommunication and electric services accessibility, access to extension and accessibility of credit while size of family member and distance to market place have inverse significant effect on probability of farmer market participation decision. The significance of coefficient of inverse Millôs ratio /Lambda indicates the presence of selection bias and the effectiveness of applying Heckman two-stage model due to its ability to handle the selection problem. In the second stage estimation, eight control variables and inverse Millôs ratio are statistically significant. Out of significant variables sex, education, farm size, amount of crop produced, road infrastructure, telecommunication and electric services, access to extension and accessibility of credit increase the intensification of farmer market participation thereby increase the quantity of marketable output in study area. The outcome of this study showed that rural infrastructure particularly road access, telecommunication and electrification services are important variables for level and intensification of market participation.

5.2. Policy Implications

In terms of policy, we recommend that the government should support smallholder farmers mainly through improving financial services accessibility as well as providing accurate market information for rural farmerôs could encourage market participation at large. The government extension program gives more attention to production side and as result their efforts in linking farmers to market were effective. Therefore, in agricultural and rural development strategy, joining smallholders to output market have to be given as much as equal priority with production side. Lastly, this study recommends provision of rural infrastructure including good transportation facilities which is strong enough in reducing the incurred transportation cost. This is because the high transportation cost incurred during marketing is largely attributable to bad road networks and lack of relevant social and economic infrastructure.

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