

Full Length Research Paper

Off-farm participation decision and its impact on crop yield in Northern Ethiopia

Berihun Kassa^{1*}, Bihon Kassa² and Kibrom Aregawi²

¹College of Social Sciences and Humanities, Samara University, P. O. Box 132, Samara, Ethiopia.

²College of Business and Economics, Mekelle University, P. O. Box 450, Mekelle, Ethiopia.

Received 13 July, 2016; Accepted 15 November, 2016

One of the most important facets of off-farm activities is providing employment opportunities and additional income for rural households and thereby accommodates the seasonal and fluctuating agricultural production. Given this, identifying the underlying determinants of off-farm participation and its impact on crop yield was found to be of the essence. Cross sectional data was collected through structured questionnaire administered on 384 randomly selected farmers. Descriptive statistics, probit and Ordinary Least Square (OLS) models as well as t and chi-square tests were used to analyze the data. The regression result revealed that off-farm participation was positively influenced by gender, education, working people, number of pack animals and credit access; while age and land size carried a negative sign. Off-farm participation was also found to have a negative and statistically significant impact on crop yield where non-participants were better producers; since majority of off-farm participants participate only on food-for-work which has nothing to add for crop yield rather than compromising farm activities. Hence, training on non-farm activities need to be given; the current adult education, being propagating, need to be strengthened; and there is a need to solve liquidity problem through credit access that could serve as startup capital.

Key words: Off-farm, participation, smallholder farmers, probit, Ordinary Least Square (OLS).

INTRODUCTION

As engine of economic growth and poverty reduction, in developing countries, agriculture should be integrated with sectors that have direct or indirect linkages. According to Babatunde et al. (2010) financial capital appears to be the most limiting factor for farming, so that cash income from off-farm activities helps to expand farm production; increase household income and reduce risk of crop failure. Hence, off-farm is one among the

activities whereby agriculture is believed to be integrated with. World Bank (2008) has reported that, in most developing countries, the importance of off-farm activities is increasing and estimated to account for 30 to 50% of rural incomes. According to Rios et al. (2008), the higher the off-farm income is, the larger capital endowments will be; and having higher capital endowments will in turn help to produce more and more and even to be

*Corresponding author. E-mail: berihun2@gmail.com. Tel: +251 913 28 55 45.

productive. According to Asenso-Okyere and Samson (2012), Haggblade et al. (2010) and Diao and Nin Pratt (2007), modern agricultural inputs can result with ample production and productivity of marketable commodities that results with trade linkage; the requirement of agricultural inputs and marketing facilities by itself, then, induces off-farm activities.

As per the view of Haggblade et al. (2010), those who live in arid areas where production is sluggish tend to participate in off-farm activities and diversify their income sources. Similarly, in Burkina Faso, Zohonogo (2011) purport that a decline in farm income and farm production let farmers to participate in off-farm activities; and increment in farm production and income do the opposite. Furthermore, in areas where agriculture is grown, the rural off-farm economy was also been founded to be grown (Haggblade et al., 2009). While quantifying this direct linkage between agricultural growth and off-farm economy, Haggblade et al. (2009) reported that a one dollar value invested on to agriculture generates 0.3 and 0.5 additional dollar on to rural off-farm income in Africa and Latin America, respectively.

In Africa, off-farm economic activities, as a means of income diversification, are very much indispensable for improving the livelihood of rural poor (Asenso-Okyere and Samson, 2012; Diao and Nin Pratt, 2007). Besides, it can serve as source of input supply for agricultural production and employment opportunity for those who do not have arable land and do not further want to rely on agriculture. Despite its vitality, in Africa, off-farm activities participation is low; and according to Haggblade et al. (2007), 37% of the rural households' income is really extracted from off-farm activities where surprisingly not more than 20% of the labor force is being participated. Likewise, in Nigeria, a study by Adewunmi et al. (2011) revealed that participation in off-farm activities more particularly wage employments of skilled and unskilled had resulted in a reduction of rural poverty by 11.02 and 10.68%, respectively; participants lessen poverty better than non-participants (Alaba and Kayode, 2011).

In Ethiopia, being part of developing regions in general and sub-Saharan Africa in particular, agriculture is the real backbone that enables 85% of Ethiopian people to walk upright and be able to feed the remaining 15% of the fortune coincidence urban residents. In line with this, Ministry of Agriculture and Rural Development (2010) acclaimed smallholder farmers in producing majority of the country's total production. Furthermore, World Bank (2010) inferred that 90% of the foreign earnings and 70% of the raw materials for industry are being sourced from agriculture. Hence, 85% of the Ethiopian people believe that agriculture is the way out to be food secured and even be luxuriant in the long run. Given this deep rooted belief, starting from recent past, arable land size and agricultural production are dwindling and thereby the society is being forced either switching to off-farm activities or stretch their hand for food aid basically for

clothing the food longing mouths at home.

According to Merima and Peerlings (2012) and Abebe (2008), in Ethiopia, farmers tend to participate in off-farm activities to satisfy consumption needs by supplementing the sluggish agricultural income caused by erratic and seasonal rain fall; and due to crop failure and the resultant abundant labor force. Besides, farmers are vulnerable both for natural and manmade disasters and shocks that could be weather related, pests, death of livestock and others. As a means of relief, rural farm households prefer to participate in off-farm activities and diversify their income thereby (Berg and Kumbi, 2006; Dercon and Woldehanna, 2005). Hence, a certain farm household is tempted to participate in off-farm activities due largely to push factors, like drought. They further inferred that, Ethiopian rural poor prefer to participate in off-farm activities that require less entry costs like fire wood collection and charcoal production, while the most lucrative off-farm activities are left for the haves. Contrary to this, some rural farm households tend to participate in off-farm activities basically to widen their income sources given their ample agricultural production and the resultant accumulated wealth, as a pull factor.

In line with the above inclination, Rijkers et al. (2002) as cited in Woinshet (2010) purported that 25% of Ethiopian rural households own more than one labor intensive off-farm activities, although 23% of these rural households did their off-farm activities parallel with their agricultural practices. Hence, only 2% of Ethiopian rural households were those who exclusively rely on off-farm activities. Besides, according to Merima and Peerlings (2012) for the past eight years, back from 2012, not more than 25% of the rural households had engaged in off-farm activities which are minimal compared with 42% of the sub-Saharan Africa average; and its contribution for employment creation in Ethiopia is 1.14%. From this one can deduce that Ethiopian rural households' off-farm participation is insignificant and its effect onto crop production as well as its overall benefit has not yet been exploited. Hence, identifying determinants of off-farm participation decision and examining the impact of participation on crop yield is found to be imperative for a clear and sound policy indication whereby farm households would participate and diversify their income and cope up food security challenges.

MATERIALS AND METHODS

Site selection, sampling method and data collection

As far as the study area selection was concerned, compared with the rest districts of Southern zone, Raya-Azobo and Raya-Alamata are more of promising and lucrative with plenty resource reservations basically fertile land resource, ground water, flat plain land supported by runoff rain water from the surrounding hilly parts. Despite these endowments, since production is decreasing, these districts were reported to face recurrent drought and food insecurity; and the society is been engaged in off-farm activities basically to

Table 1. Targeted sub-districts and villages with their total population and sample size taken (CSA, 2007; Own Computation, 2016).

S/N	Name of sub-district	Population size (N)	Sample size (n)
1	Bala-Ulaga	2164	89
2	Kukufito	3784	155
3	Lemeat	1697	70
4	Tao	1697	70
-	Total	9342	384

curtail the food shortage. As a result of this researchers were intended to have a look on the impact of off-farm activities participation on crop yield.

Multi-stage sampling procedure was followed to reach on to final respondents. Firstly, Raya-Azebo and Raya-Alamata districts were selected from Southern Tigray; followed by the randomly selected four sub-districts, Bala-Ulaga, Kukufito, Lemeat and Tao. Thirdly, on the basis of Yamanes' sample size determination formula, as cited in Israel (1992), 384 sample respondents were calculated. Finally, 384 respondents were randomly selected from the list provided from each sub-district, as its proportion is shown in Table 1 and these people were considered to collect primary data mainly through structured questionnaire in 2014 cropping year. In-depth interview with crop production personnel and farmers who were on the verge to leave agriculture were interviewed. Besides, four focus group discussions with off-farm participants and non-participants, including female participants, were held to support the questionnaire based data. Interviewees and focus group discussants were selected purposively with the assumption that these people could provide us with tangible and pertinent information in the ground.

Method of data analysis and econometric model specification

To analyze the data, descriptive statistics like mean, percentage and standard deviations were used to assess socio-economic and demographic characteristics of sample respondents; while probit model was used to examine determinants of participation, Ordinary Least Square (OLS) model was employed to examine the impact of participation on crop yield. Besides, to test the relationship between dependent and independent variables vis-à-vis the two groups of individuals, t-test and Chi-square tests were used, respectively, for continuous and dummy variables. Data collected through interview and focus group discussion was basically analyzed qualitatively.

Regardless of the amount of money earned and the duration farmers relied on off-farm activity, in this article, a farmer was taken as off-farm participant if he/she did out of his/her farm land; while those who solely dependent on their farm land were considered as non-participants. Due to this dichotomous classification, the dependent variable (off-farm participation) has a binary nature taking the value of "1" for participants and "0" for non-participants that paved the way to employ binary outcome models particularly probit model. The reason behind employing probit model was due to its normal distribution assumption of error terms and farmers' unobserved or latent behavior by which households are assumed to make decisions pertaining to utility maximization; and hence in this model there is a latent or unobservable variable that takes all the values in $(-\infty, +\infty)$. As a result, probit model can be expressed by the following general formula:

$$\Pr (Y=1/X_i) = \Phi (\beta_1 X_i + \varepsilon_{it}) \tag{1}$$

The latent variable Y_i^* is not observable and is represented by its proxy Y_i taking a value one (1) for participants and zero (0) for non-

participants.

$$Y_i = \begin{cases} 1, & Y_i^* > 0 \\ 0, & Y_i^* \leq 0 \end{cases}$$

$$Y_i^* = x_i' \beta + \varepsilon_i \tag{2}$$

where $\varepsilon | x$ is a normally distributed error term.

Thus, for the household i , probability of participation is given by:

$$P(1) = \Phi (\beta X_i) \tag{3}$$

where $P(1)$ is the probability of participation, Φ is the cumulative distribution function of the standard normal distribution, β is the parameters that are estimated by maximum likelihood, x' is a vector of exogenous variables which explains off-farm participation. Therefore,

$$OFP = \Phi(\beta_1 GENDER + \beta_2 AGE + \beta_3 EDUC + \beta_4 WORKING + \beta_5 DEPENDENT + \beta_6 LANDSZ + \beta_7 MRKTDIS + \beta_8 LOCATION + \beta_9 TLU + \beta_{10} PACKANIM + \beta_{11} CREDIT) \tag{4}$$

Besides, to estimate magnitude of parameters or variables mainly to clearly put the percentage likelihood of participation, marginal effect of variables was calculated. Marginal effect of a variable is the effect of unit change of that variable on the likelihood of participation and it can be seen as $P(Y = 1|X = x)$, given that all other variables are constant. Hence, it is expressed as:

$$\frac{\partial P(Y=1/X_i)}{\partial X_i} = \frac{\partial E(Y_i/X_i)}{\partial X_i} = \varphi(X_i' \beta) \beta \tag{5}$$

As far as examining the impact of participation on crop yield was concerned, Ordinary Least Square (OLS) regression model was employed due to the continuous nature of the dependent variable, crop yield measured in quintal. Furthermore, according to Gujarati (2006), with the assumption of classical linear model, OLS estimators are with unbiased linear estimators with minimum variance and hence they are Best Linear Unbiased Estimators. Hence, its specification is given as follows using the same independent variables used in probit model earlier.

$$Y = \beta_0 + \beta_i X_i + U$$

where Y is the dependent variable (crop yield), X_i is a vector of explanatory variables, β_i is a vector of estimated coefficient of the explanatory variables (parameters) and u_i indicates disturbance term which is assumed to satisfy all OLS assumptions (Gujarati, 2006).

$$CropYield = \beta_0 + \beta_1 GENDER + \beta_2 AGE + \beta_3 EDUC + \beta_4 WORKING + \beta_5 DEPENDENT + \beta_6 LANDSZ + \beta_7 MRKTDIS + \beta_8 LOCATION + \beta_9 TLU + \beta_{10} PACKANIM + \beta_{11} CREDIT \tag{6}$$

Table 2. Variables and expected signs (Hypothesis).

Variable type	Character	Unit of measure	Expected sign
Sex of household head (GENDER)	Dummy	1 if Male, 0 if Female	+
Age of household head (AGE)	Continuous	Years	+/-
Education of household head (EDUC)	Dummy	1 if literate, 0 otherwise	+
Number of Working people (WORKING)	Continuous	Numbers	+/-
Number of Dependents (DEPENDENT)	Continuous	Number	+
Cultivated land size (LANDSZ)	Continuous	<i>Tsimad</i> ¹	+
Tropical Livestock Unit (TLU ²)	Continuous	Number	+/-
Number of pack animals (PACKANIM)	Continuous	Number	+
Distance to the nearest market (DISMRKT)	Continuous	Kilometers	-
Location effect (LOCATION)	Dummy	Across locations	+/-
Access to Credit (CREDIT)	Dummy	1 if Yes, 0 otherwise	+
Non-farm Trainings (NFTGS)	Dummy	1 if trained, 0 otherwise	+

¹One *Tsimad* is equivalent with 0.25 hectare or one hectare is equivalent with 4 *Tsimad*; ²TLU was calculated excluding pack animals basically to solve problem of multicollinearity. +, Positive; -, Negative.

where CropYld=Continuous dependent variable indicating crop yield measured in quintal.

Therefore, description of variables indicated earlier and their expected sign or hypothesis has shortly been summarized in Table 2.

RESULTS AND DISCUSSION

Socio-economic and demographic characteristics of sample households

Examining farm households' socio-economic and demographic characteristics is believed to be an important indicator for probability of off-farm participation in such a way that farm households can be determined with. As a result of this, an attempt has been made to describe some socio-economic and demographic characteristics where differences between participants and non-participants were tested using t and Chi-square tests.

Table 3 clearly purports that majority of the sample respondents (73.44%) were off-farm participants. In line with this rate of participation, majority of participants (78%) were male headed households supported with a significant Chi-square test result. Compared with non-participants, participants were male headed households, younger in age, educationally better, large in number of working people, wealthier in pack animals possessed and farm income and then with better credit access. On the other hand, non-participants were owners of large arable land size and better crop producers. These all differences were supported with significant t and Chi-square tests for continuous and dummy variables, respectively.

Types of off-farm activities vis-à-vis place of work

Types of off-farm activities along with place of work were

discussed in Table 4.

As it can be seen in Table 4, 65.6% of the total off-farm participants were engaged in food-for-work under the umbrella of Productive Safety Net Program (PSNP). These people were paid employees where one person was expected to do five days per month and will be awarded birr 19 in cash and 3 kg (0.03 quintal) in food/kind. As far as place of work was concerned, 76.95% of off-farm participants have been doing with in their respective sub-districts. To engage in food-for-work and transacting goat, sheep and cereals by buying and selling on market day time mainly on weekly and monthly basis, farmers were not forced to go out of their residence and thereby lose their social tie and family kinship.

Table 4 further reveal that, 67.02% of the total participants were instigated to participate due to the advent of and access to PSNP; followed by their residences' proximity to urban area that is believed to expose them to new and updated information as well as market identification mainly for petty trading activities like trading egg, coffee, honey, selling local beer (ale) and using cart.

Table 4 also indicated that, more than 57.84% of non-participants were seriously inhibited by absence and the resultant farness of off-farm opportunities coupled with shortage of startup capital. Had there been off-farm opportunities, they would not have been exploited opportunities due largely to shortage of startup capital. From this one can infer that, farm respondents were highly intended to do activities that requires startup capital like trading camel-the then costly animal being transacted and trading cereals across different regions. On the other hand, opportunities' farness highlights that, respondents were intended to do off-farm activities without compromising their farm activities, their family's love, affection and social ties.

Table 3. Descriptive statistics of variables used in regression analysis and important ones (Own Survey Result, 2016).

Variable	Average statistics (N=384)	Off-farm non- participants (N= 102)	Off-farm participants (N= 282)	t & chi-square tests (P-Value)
	Mean (Std.dev)	Mean (Std.dev)	Mean (Std.dev)	
Gender (1=Male)	0.786 (0.410)	0.706 (0.458)	0.816(0.388)	0.016**
Age	44.421 (11.481)	46.716 (12.846)	43.592 (10.851)	0.009***
Education (1=Literate)	0.349 (0.477)	0.245 (0.432)	0.386 (0.488)	0.030**
Number of Working people	3.086 (1.301)	2.931 (1.299)	3.142 (1.299)	0.038**
Number of Dependents	3.102 (1.462)	3.088 (1.695)	3.106 (1.372)	0.542
Cultivated Land Size	1.474 (0.693)	1.649 (0.884)	1.410 (0.599)	0.001***
Tropical Livestock Unit	4.853 (3.574)	4.779 (3.239)	4.879 (3.692)	0.596
Number of pack animals	0.602 (0.919)	0.324 (0.616)	0.702 (0.989)	0.074**
Distance to the nearest market	24.395 (13.023)	23.088 (9.057)	24.869 (14.172)	0.881
Access to credit (1=Yes)	0.365 (0.482)	0.127 (0.335)	0.450 (0.498)	0.000***
Non-farm Training (1= Trained)	0.099 (0.298)	0.098 (0.297)	0.166 (0.408)	0.576
Farm income in Birr	39286.2 (29614.8)	32538.2 (29009.9)	46034.3 (29880.4)	0.041**
Crop yield in Quintal	8.522 (6.145)	9.946 (7.337)	8.369 (5.659)	0.024**

Std.dev; Standard deviations; ***, ** and * is significant at 1, 5 and 10% significance level.

Table 4. Off-farm activities and place of work (Own Survey Result, 2016).

Variable	Labels	Freq.	%
Off-farm activities being done	Trading goat, sheep and cereal crops	37	13.12
	Trading cereal crops	24	8.51
	Trading egg, coffee, honey and shopping	5	1.78
	Cart and Daily work	28	9.93
	Hair dressing and selling local beer (ale)	3	1.06
	Food for work	185	65.60
	Total	282	100
Location of employment	Within village	15	5.32
	Within sub-district	217	76.95
	Within district	22	7.8
	Neighboring region (Afar)	28	9.93
	Total	282	100
Off-farm motivating factors	Proximity to urban area	51	18.09
	Education level and Excess labor at home	12	4.25
	Small land size possessed	30	10.64
	Access to Productive Safety Net Program	189	67.02
	Total	282	100
Inhibiting factors	Needed on farm	5	4.9
	Retired	12	11.77
	Shortage of startup capital	26	25.49
	No opportunity and far away to find work	59	57.84
	Total	102	100

Estimation results of probit regression model

Before rushing to regression result display, pair-wise

correlation matrix and the Brush Pagan test were used to test the problem of multicollinearity and heteroscedasticity, respectively (Table 5).

Table 5. Determinants of off-farm participation (Probit Estimates) and marginal effect (Own Estimation Result, 2016).

Explanatory variable	Coef.	Std. Err.	z	P> z	Marginal Effect (dy/dx)
-Cons	0.1731	0.4400	0.39	0.694	-
GENDER	0.5874	0.2034	2.89	0.004 ^{***}	0.1790
AGE	-0.0169	0.0074	-2.31	0.021 ^{**}	-0.0461
EDUC	0.5120	0.2085	2.46	0.014 ^{**}	0.1275
WORKING	0.2508	0.0716	3.50	0.000 ^{***}	0.2672
NUMBDEPEN	-0.1184	0.0850	-1.39	0.164	-0.0317
LANDSZ	-0.3050	0.1514	-2.01	0.044 ^{**}	-0.0817
TLU	-0.0278	0.0320	-0.87	0.385	-0.0074
PACKANIM	0.2942	0.1469	2.00	0.045 ^{**}	0.0788
DISTMRKT	-0.0028	0.0252	-0.11	0.910	-0.0010
Dummylocation1 (Bala-Ulaga)	0.7205	0.3988	1.81	0.071 [*]	0.1599
Dummylocation2 (Kukufito)	-0.7449	0.2419	-3.08	0.002 ^{***}	-0.2105
Dummylocation3 (Lemeat)	-0.2008	0.3242	-0.62	0.536	-0.0568
CREDIT	0.5857	0.2130	2.75	0.006 ^{***}	0.1455
NFTGS	0.0302	0.3784	0.08	0.936	0.0082

Log likelihood = -163.49267
Number of obs = 384
LR χ^2 (13) = 117.58
Prob > χ^2 = 0.0000
Pseudo R² = 0.2645

*, **, ***Significant at 10, 5 and 1 %, respectively.

Implication of gender on participation decision is positive and statistically significant at 1% level. Male headed households, *citrus paribus*, have 17.9% higher probability of participation than female headed households who are more probable to be sandwiched with child rearing practices. In fact, in the study districts, letting females to be a household head is not yet well developed and recognized. Consequently, female headed households mostly are those who are widowed and divorced; and hence, challenged by districts' labor division culture. In line with this, the prior proposed hypothesis is not rejected at 1% significance level. The finding corroborates with the findings of Haggblade et al. (2010) in North Africa, Latin America and West Asia; Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe (2008) in Ethiopia where by female-headed households are less probable to participate and influenced by cultural influences. However, it strongly disagrees with the findings of Merima and Peerlings (2012) in Tigray, Amhara, Oromia and Southern Nations Nationalities and Peoples regions of Ethiopia; Alaba and Kayode (2011) in South West Zone of Nigeria; and Kaija (2007) in rural parts of Uganda where female-headed households were better off-farm participants unlike male headed households.

Effect of age on participation is negative and statistically significant at 5% level that lets not to reject the prior proposed hypothesis. By its very nature, off-farm

participation does require physical strength and fitness whereby younger farmers are better than older ones. Keeping other things constant, as age increases by a year, probability of participation would decrease by 4.61%. Old aged farmers really have an accumulated farm experience like plot preparation and in clearly identifying what and when to sow crops. Besides, they are too stable and mostly could not think some other off-farm activities and migration. Due to this, they are more probable to invest their time on farm activities that participating in off-farm activities.

Contrary to old aged farmers, younger farmers are improbable to be stable and be motivated to do their farm activities. They really wonder here and there in search of some lucrative off-farm activities. Typically, inter and intra migrations were their features and hence they engage in farm activities consciously to buy time. The finding is consistent with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe (2008) in Ethiopia; and Kaija (2007) in Uganda in such a way that probability of participation decreases as age increases. Nevertheless, the finding contradicts with the finding of Zahonogo (2011) in Burkina Faso and Berg and Kumbi (2006) in Ethiopia where older farmers tend to participate better than middle or younger farmers.

The probit estimation result also reveals that, the effect of education (literate and illiterate) is positive and statistically significant at 1% level. In fact, majority of the

sample households have engaged in food-for-work, as their typical and best off-farm activity. Food-for-work, therefore, did not require education and for that pointing finger signature is enough basically to take the salary either in cash or in food. Despite this, the implication here is that, the more farmers become literate the higher will be their probability of searching off-farm work in non-agricultural sectors. Magnitude of the positive sign suggests that literate households, keeping other things constant, have 12.75% higher probability of participation unlike their counter parts. The finding confirms the findings of Zhu and Luo (2006) cited in Babatunde and Qaim (2009) in such a way that the more literate the household is, the more probable to search and participate in profitable off-farm activities. Hence, the prior hypothesized positive coefficient is accepted at 1% level of significance.

Off-farm participation decision is positively related with number of working people or active labor force at home; and statistically significant at 1% level. Presence of larger number of working people in a certain house can really do and manage both farm and off-farm activities without compromising each of the activities. A unit increase in number of working people, *ceteris paribus*, would raise the probability of off-farm participation decision by 26.7%. From this inference can be made that households with large active labor force would more be probable to participate in such a way that labor division would prevail more; and besides, enough labor force at home would let family members to participate in off-farm activities. The finding is consistent with the findings of Zahonogo (2011) in Burkina Faso. As a result of this, the prior indeterminate hypothesis is liable to be positive and statistically significant at 1% level.

The regression result indicated that, the effect of land size on off-farm participation decision is negative and statistically significant at 5% level of significance. As land size increases by one *Tsimad*, keeping other things constant, the probability of participation would decrease by 8.17%. In the study districts, households who owned an arable land size ranged in between 1 and 2 *Tsimad* are young farmers while the larger land share was positioned on modal age group interval of 40 to 56 years and the preceding age group interval of 57 to 73 since they have had a great share from the last regional land redistribution held twenty five years back.

Young age groups, therefore, are more liable to meager land size transfer from their fathers' and mothers' lottery, a single dead bodies and if possible, expanding to the frontier. In the study region, Tigray, for instance, 4,005 hectare was given for 15,198 youngsters through inheritance; and 27,924 hectare was divided among 23.6 thousand youngsters in the frontiers (Bureau of Agriculture and Rural Development (BoARD), 2011). It is possible, therefore, to deduce that when we come across higher age groups, it is fortunate to find higher land holding size. This large land holding size is found to be

imperative for producing a relatively higher crop production that would retain them to do farm activities and not to participate in off-farm activities. Hence, it is possible to infer that, participation in off-farm activities was in response to farm land constraints. The finding is in line with the findings of Asenso-Okyere and Samson (2012) in Africa at large; Alaba and Kayode (2011) in South West Zone of Nigeria; Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe (2008) in Ethiopia. The prior hypothesized positive coefficient is rejected at 5% level of significance.

Presence of pack animals has positive relationship with participation and statistically significant at 5% significance level. The finding reveals that a unit increase in draft animals would raise the probability of participation by 7.88%. Farm households who possess pack animals are more probable to participate in activities like trading cereals, doing with cart, transporting sand and stone for construction purpose, charcoal production, fire wood selling and the like. This finding is similar with the findings of Abebe (2008) and Berg and Kumbi (2006) in Ethiopia as if households who possess pack animals would participate better than those who did not possess. Nonetheless, the finding strongly contradicts with the finding of Rios et al. (2008) whereby pack animals would transport manure from home to farm land and thereby increase crop production that finally decreases the probability of off-farm participation decision. The prior hypothesized positive coefficient is accepted at 5% significance level.

As a liquidity factor, access to credit is one best option whereby smallholder farmers could be instigated in diversifying their economic base. Access to credit has a positive effect on participation and statistically significant at 5% level of significance. In line with this, credit non-rationed farm households, keeping other things constant, have 14.55% higher probability of participation unlike credit rationed farmers. Hence, access to credit and taking credit influences participation, indicating that the more farmers have access to source of finance, the more likely to decide and participate in off-farm activities. The finding agrees with the findings of Adebisi and Okunlola (2013) in Oyo State of Nigeria and Abebe (2008) in Ethiopia; as if taking credit is imperative for solving liquidity problem and thereby increases the probability of participation. On the other hand, the finding contradicts with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where liquidity problems, while intending to participate in off-farm activities, could not be solved by accessing and taking credit. The prior proposed positive coefficient is not rejected at 5% level of significance.

Location can serve as a proxy of rain fall availability, productive potential of districts, sub-districts and villages; and it is worth to note discrepancy of participation among sub-districts. Consequently, sub-district dummies have been created; *Tao* was taken as a reference group due to its middle crop production position. Relative to *Tao*, the

Table 6. Impact of off-farm participation on crop yield: OLS estimation result (Own Estimation Result, 2016).

Explanatory variable	Coef.	Std. Err.	t	P> t
-Cons	2.74336	2.02551	1.35	0.176
OFFPARTICI	-1.9905	0.708387	-2.81	0.005***
GENDER	1.873583	0.6550402	12.86	0.004***
AGE	-0.0724498	0.0308629	-2.35	0.019**
EDUC	0.3936218	0.1460205	2.70	0.007***
WORKING	0.4806521	0.2401594	2.00	0.046**
NUMBDEPEN	-0.8965219	0.2908585	-3.08	0.002***
LANDSZ	3.224635	0.4980494	6.47	0.000***
TLU	0.3633074	0.1102191	3.30	0.001***
PACKANIM	0.5429241	0.442973	1.23	0.221
DISTMRKT	0.6491295	0.4892841	1.33	0.185
Dummylocation1(Bala-Ulaga)	-3.62553	2.151253	1.69	0.093*
Dummylocation2 (Kukufito)	-3.077394	1.014261	-3.03	0.003***
Dummylocation3 (Lemeat)	0.238694	1.141905	0.21	0.835
CREDIT	0.00045	0.0001032	4.36	0.000***
NFTGS	0.0302	0.3784	0.08	0.936
Number of obs = 384				
R-squared = 0.3647				
F (14, 369) = 15.13				
Adj R-squared = 0.3406				
Prob > F = 0.0000				
Root MSE = 5.14				

*, **, ***Significant at 10, 5 and 1%, respectively.

probability of participation is higher in *Balla-Ulaga* sub-district by 15.99%; a sub-district basically with higher crop yield and total farm income and it is statistically significant at 10% level of significance. Compared with *Tao*, the probability of participation is much lesser in *Kukufito* sub-district by 21.05% that relatively is food-deficit and a sub-district typically credit rationed due to rules of their holly Qur'an and it is statistically significant at 1% level. Farmers with relatively better crop yield and total farm income, therefore, tend to participate in lucrative off-farm activities unlike farmers with low crop yield and farm income. Due to this, the finding completely disagrees with the findings of Zahanogo (2011) in Sudanese, Sahelian, North and South-Guinean zones of Burkina Faso and Abebe (2008) who found as participation is higher and lower in food-deficit and surplus regions, respectively.

It is believed that providing non-farm training is imperative for instigating farmers to participate and thereby diversifying their economic and income base. Although, the probit estimation result is not statistically significant, non-farm training has a positive linkage with off-farm participation decision where it gives an insight to provide and strengthen trainings pertaining to off-farm activities. In the study districts, there is a cross generational task of preparing cultural manifestation

using animal skin as well as a culture of weaving (to prepare cultural dresses). Hence, there is a need to invigorate this cross generational endowment via providing an inclusive training pertaining to the aforementioned focus areas.

Impact of off-farm participation on crop yield

Table 6 depicts the impact of off-farm participation on crop yield considering Ordinary Least Square (OLS) regression model as a measuring instrument.

As it has already been discussed earlier, the t-test statistics result inferred that yield difference between off-farm participant and non-participant is significant where non-participants produce better than participants. Consistent with the descriptive statistics, regression result revealed that off-farm participation has a negative and statistically significant impact on crop yield, at 1% level of significance. Hence, both descriptive and econometric statistics results purport the negative impact of off-farm participation on crop yield. The regression result shows that, keeping other things constant, off-farm non-participants were much better to get 1.99 quintal than their non-participant counterparts. Hence, off-farm participants produce lesser than non-participants. This

could basically be due to their participation in non-lucrative off-farm activities that could add nothing to their total production. In this case food-for-work was the most important off-farm activity on which majority of the participants engaged on. Having this activity does not mean that they could be productive rather they spent half of their time by compromising their farm activities; and at the end of a month they will be given only birr 19 in cash or 3 kg(0.03 quintal) in kind which is very negligible. On the contrary, off-farm non-participants are believed to spend their time on farm activities and thereby produce better.

CONCLUSION AND POLICY IMPLICATION

One of the most important facets of off-farm activities is providing employment opportunities and additional income for rural households more particularly during the slack time. Besides, off-farm participation has a multifaceted effect on agricultural production in such a way that it paves the way for ease access of inputs and on the other hand it negatively shares the time to be allocated for farm activities. By and large, it is one of the best means of risk minimization. This research paper has tried to examine the underlying determinants of off-farm participation and the impact of participation on crop yield in Tigray region, Ethiopia. The probit regression result revealed that off-farm participation was positively influenced by gender, education, working people, number of pack animals, credit access and dummy location one, while age, land size and dummy location two influenced off-farm participation negatively. In a nut shell, even though some people do participate in off-farm activities on the basis of their internal motivation or demand driven, majorly a push driven participation has been investigated. Ordinary Least Square (OLS) regression result revealed that off-farm participation has a negative and statistically significant impact on crop yield where off-farm non-participants were found to be better producers unlike their counter parts.

Without the shadow of doubt, instigating off-farm participation is the only way-out and the sole alternative that smallholder farmers need to follow basically to accommodate their seasonal and fluctuating agricultural production. In doing so, an inclusive non-farm activities training need to be given for the community like on weaving, leather and leather products training like shoe and mat making, leather strap; carpentry and some other activities. Hence, investment on human resource actually on to education is highly required (both short-term and long-term trainings). The current adult education, being propagating, need to be strengthened since literate households (those who simply can read and write) were found to be better participants unlike illiterate farmers. On the other hand, access to credit need to be propagated basically to solve liquidity problems and thereby serve as off-farm startup capital.

Conflict of Interests

The authors have not declared any conflict of interest.

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