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Determinants and effects of off-farm participation on income diversification among farmers households in hadiya zone, Central Ethiopia

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Abstract
This study was analyze the determinants and effects of off-farm participation on income diversification among farmer's households in selected districts *in Hadiya Zone, Ethiopia using cross-section data. Primary data were collected from 260 sample respondents using simple random sampling. Descriptive statistics were applied to characterize the sample households by table, figure and percentage. Probit model and PSM were used for estimation of determinant participation of rural households in off-farm activities and impact level of annual income from off -farm activities. The result of factors affecting participation of rural households in non-farm activities indicate access to credit, access to road services, access for telephone service, access to medical facilities and nutritional status had a positive effect on off-farm participation of households at 1% significant level and also age of respondents, education status, family size, farm size and demand for product had a positive effect on off-farm participation of households at 5% and 10% significant level. The infrastructure development of the study area is below average in researcher observation. Therefore, road construction, electricity and telephone services should be developed in order to facilitate annual income households and participate off-farm activities to improve their welfare. Finally, there should be policy and program intervention to facilitate and stimulate participation of rural household in off-farm activities due to non-farm activities has play a great role for increasing rural employment and improving wellbeing of the rural household.*
Key words: average income, off-farm activities, Probit model , Prosperity Score Matching, welfare

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1. INTRODUCTION

Farm sectors as the center of economic development, governments in developing countries may intervene in the rural economy. Development policies of rural sector have often targeted in improving farm productivity to fight the major economic problems like rural poverty, food insecurity and inequality among the rural families (Reardon, Berdegue & Escobar, 2001). However, there is growing evidence that the rural sector is more than farming in developing countries.

Non-farm activities in Africa has been underscored with 48 percent of rural African households participate in non-farm wage employment or self-employment and that off-farm incomes accounts for 23 percent of farmers' incomes (Davis et al., 2017; Adjognon et al. 2017; Haggblade, Hazell, and Reardon, 2007). Thus, the agricultural sector and the rural-non-farm economy typically coexist. The motivations of farm families for off-farm labor employment may differ across geographical areas, communities and households. For some households it is due to the existence of missing credit markets in which case off-farm earnings can be a crucial means of overcoming working capital constraints. That is, to purchase necessary variable inputs for farming or to make capital improvements. On the other hand, farm cash income may not be sufficient to satisfy the households' cash requirements. In this case also, off-farm earnings may be essential to finance the family cash requirement and households welfare improvements (Idowu, Awoyemi, Omonona, and Falusi, 2011). The poor households face a binding credit constraint, and so cannot afford the investment required in the off-farm labour market, while this would not be a problem for rich. As a result off-farm employment may exacerbate income inequality rather than reducing it.

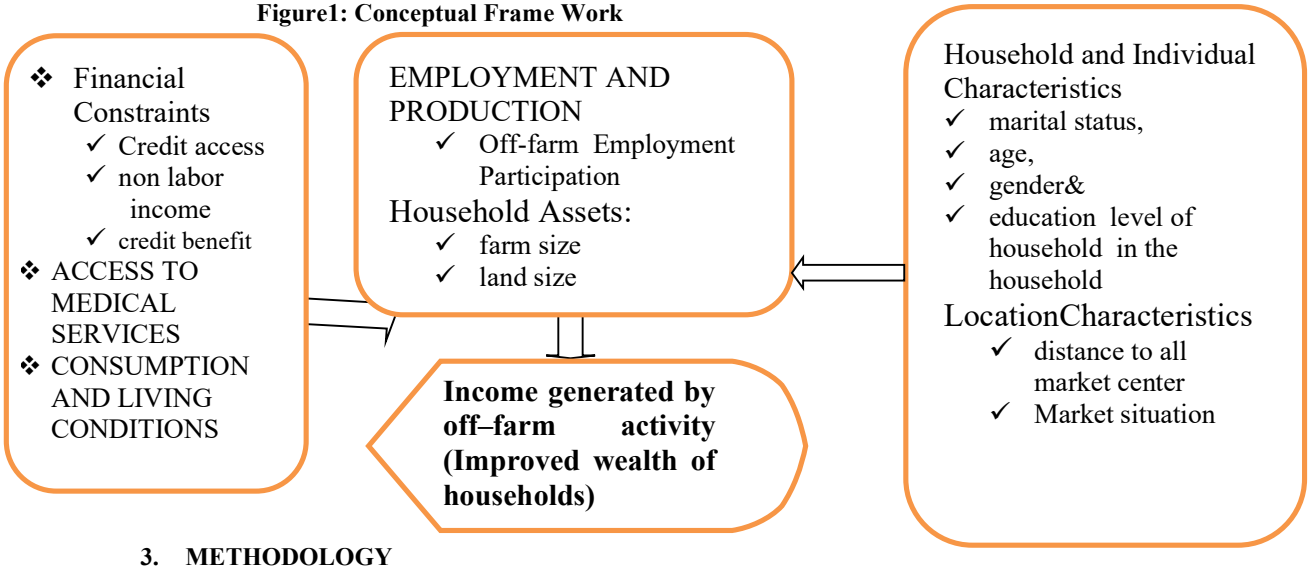
Non-farm sectors improve productivity in agriculture and promote self-sufficiency in food. The potential role of off-farm activities on-farm households' reduction of poverty, there no clear-cut development policies that identifies and include the rural off-farm activities as an integral component of the rural economy and a source of employment in Ethiopia. However, the country faces income fluctuation from agricultural production due to high

accommodation of population growth with corresponding limited farmlands and climate variability and manmade related shocks that lead to as continual increase rural poverty and food insecurity problems.
Furthermore, the rural off-farm sector not only contributes directly to rural households income, but also it creates employment opportunities, provides avenues for input supplies to the farming sector and value-adding opportunities for the farm production. Beside of research method gap, the rural households' participation in off-farm activities and the effect of these activities on households' welfare were not well identified empirically in the study area. This study attempts to address the gap to identify the determinants of off-farm activities on household participation a probit model and to determine impact on welfare proxed by income of household's prosperity score matching method would be applied. Therefore, we analyze the determinants and effects of off-farm participation on income diversification among farmer's households in selected districts. Therefore, to address this issue, the objectives were as follows: (1) to assess the impact of participation in off-farm activities on income of householder farmers in the study area, (2) to analyze the determinants of off-farm employment participation, (3) to identify factors that affects the amount of income earned from off-farm activities and (4) to examine a characterize of the livelihood activities of the study area.

2. Conceptual Framework for Analyzing Nonfarm Activities participation

Several rural households decided to engage in nonfarm activities as a strategy of raising their income (Assan, 2014). Other studies shows that adaptation of rural household livelihood diversification strategies is based on efforts to create extra or alternative enterprises that can manage to recover from shocks and stress (Dary and Kuunibe, 2012; Ellis, 2000 and Ebaidalla, 2014). In addition, within the context of a sustainable livelihood framework, the success of source of revenue diversification is determined by the policy and institutions within which it operates (Lanjouw and Lanjouw, 2001). Furthermore the sustainability of livelihood strategies of rural household is determines by the access, the use and establishment of different type of resources (Katega and Lifuliro, 2014). The said resources encompass different stocks of capital asset such as financial, human and physical capital that can be applied either direct or indirectly in livelihood generation (Ellis, 2000). The application of these resources is vital for rural household participation in nonfarm sector which results into the improvement of rural household wafer.

Figure1: Conceptual Frame Work



3. METHODOLOGY

3.1 Description of Study area

The study was conducted in Hadiya Zone selected three woreda: Lemo, Misha, and Gibe woredas. Hadiya is bordered on the south by Kembata zone and Tembaro special woreda, on the west by the Omo River which separates it from Oromia Region and the Yem Special Woreda, on the north by Gurage, on the northeast by Silte, and on the east by the Alaba zone; the woredas of Mirab Badawacho and Misraq Badawacho form an exclave separated from the rest of the zone by KT. The administrative center of Hadiya was Hossana. It was founds at a distance 232 Km far from Addis Ababa, capital city of Ethiopia. Its geographical location lies Latitudinal between 7° 39' 60" N and; Longitudinal lies between 37° 44' 60" E. Total area of the Hadiya administration zone covers about 3,593.31 square kilometres and it consists of Thirteen Rural Weredas with four town administrations. According to the estimation from 2007 house and population census, the total population of the zone is around 1,231,196. The main rainy season is during April to September. Furthermore,

the weather condition of the selected woreda is divided in to combination of warm, dry and abundant sun shine. Most population of studied area is engaged in agriculture. The dominant farming practice of the selected woreda was under taken using a pair of oxen. The selected woredas are suitable for production of staple crops such as coffee, teff and wheat crops like wheat, teff and fruits and along with livestock's.

3.2. Research Design

Research design was the blue print for fulfilling research objective and answering research questions (John et al., 2007). In other, it was a master plan specifying the methods and procedures for collecting and analyzing the needed information. It ensures that the study was relevant to the problem and that it use economic procedures. In this study a cross- sectional research design would be used. To obtain the information properly, the investigator would be employed both descriptive and inferential types of statistics. In order to address the stated objectives both qualitative and quantitative approaches would be used. Quantitative research design would be proposed highly structured and produce data that are responsive to statistical analysis.

3.3. Target Population of the Study

Target population refers to the entire group of individuals or objects from which the study seeks to generalize its findings (Cooper and Schindler, 2003). The main objective of this study was to analyze the determinants and effects of off-farm participation on income diversification among farmer's households in selected Three woreda of hadiya zone such as Lemo, Misha and Gibe woreda. The researcher will be focused on the selected two kebele from each woreda such as from Gibe woreda Omocora and Soda kebele, from Misha woreda Shiro and Siko and from lemo woreda shurmo dubancho and Lisana kebele households. The total households of the Omocora kebele has 925; Soda Kebele has 880 ; Shiro kebele has 825, Siko Kebel has 784, Shurmo Dubancho Kebel has 674 and Lisana Kebel has 742. The total number of households within selected six kebele have 4,830 formed the population for the study.

3.4. Sampling Technique and Sample Size Determination

3.4.1. Sampling Technique and procedures

Multistage sampling method was applied to select the respondents. From hadiya zone three woreda was be selected. This was first stage and from three woredas the researcher choice six kebele purposively. The reason why the Kebele's have chosen: first, there was a substantial variation in the nature and availability of off-farm activities. Second, there were variations and distance between the each kebele in their access to information, market and infrastructure facilities. Due to limited time and resources, including all districts of the kebele households in this study was be considered as difficult in effecting the intended in-depth study within the time frame available for fieldwork.

3.4.2. Sample size

The size of the sample was one of the most important decisions in the planning of the survey. Therefore, to determine the sample size variability, confidence level and margin of error was considered the simple size determined by using the following formula (Yamane, 1967).

$n = \frac{N}{1+Ne^2}$ Where, n =required sample of size study.

N= total number of Targeted households

e = margin of error

The total sample size obtained for the study based on the given information as follow: N= 3960 total Households size of sampled Kebele's. At confidence level is 95%, and then margin of error is (e) was 0.05. Total sample size of the study (n)

Targeted households size (N) =4,830

Margin of error is (e) = 0.06

$$n = \frac{N}{1+N(e^2)} \; ; \quad n = \frac{4{,}830}{1+4{,}830(0.05^2)} \; ; \quad n = \frac{4830}{13.075} \quad n = 369$$

Therefore, in order to determine the Proportional allocation of total sample in each town the following formula has been applied / suggested.

$$n_i = \frac{n \times N_i}{N}$$

Where, n_i = required Sample sizes of each Kebel's (sample of i^{the} Kebele)

Ni =the number of households in each selected Kebel's (households in i^{the} Kebele)

Table 1 : proportional allocation of sample households in kebele

No_	Sample Town	Total Number of households in selected kebele	Sample size	Method of selection
1	Omocora kebele	925	$n_1 = \frac{369 \times 925}{4830} = 71$	Simple Random sampling method
2	Soda Kebele	880	$n_2 = \frac{369 \times 880}{4830} = 67$	
3	Shiro kebele	825	$n_3 = \frac{369 \times 825}{4830} - 63$	
4	Siko Kebel	784	$n_4 = \frac{369 \times 784}{4830} = 60$	
5.	Shurmo dubancho	674	$n_5 = \frac{369 \times 674}{4830} = 51$	
6.	Lisana Kebele	742	$n_6 = \frac{369 \times 742}{4830} = 57$	
	Total	4830	369	

Source, Researcher survey, 2024

3.5. Sources and methods of data collection

3.5.1. Data Sources

For this paper, the data was collected with a purpose of off-farm activities and its impact on households' income. Both primary and secondary sources of data would be used for this study. The primary data would be collected by using structured questionnaire and key informant interview. In addition, focus group discussion would be held with a group in each six sample kebeles. The structured questionnaire would be used the cross-sectional data on pertaining to socio-economic, demographic, and institutional variables that influence off-farm of the household head and his/her family members. And also, secondary sources of data would be gathered from different published and unpublished documents.

3.6. Methods of Data Analysis

The raw quantitative and qualitative data were collected from the survey households and then edited, coded, entered, cleaned and analyze the data by using STATA-14 software. Descriptive, inferential statistics and econometric model would be used for this study. In this study, both descriptive and inferential statistics would be used to analyze the survey data. We applied probit model to identify the determinant variables and their marginal effect on households' participation for the two sets of off-farm employment activities. This because we assume households participation decision in those activities may not be independent Babatunde and Matin (2010).

3.6.1. Probit Model Analysis

The Probit model represents another type of widely used statistical model for studying data with binomial distributions. In order to fulfill objectives the following functional form was used.

$$Yi = f(X1, X2, X3, X4) \quad (1)$$

The econometric model for the functional form stated in equation (1) can be specified as: $Prob(y=1) = 1 - F(-\sum_{i=1}^{K} Bi \, .Xi$

$$Yi = \beta 0i + \beta\, 1i\, Z1 + \beta\, 2i\, Z2 + \beta\, 3iZ3 + \beta\, 4iZ4i + \varepsilon_i \quad (2)$$

Where,

Yi= dichotomous variable representing participation of households in off-farm work type i = 1, 2 for the probit model; and it was equal to one if the household participates in off-farm work and zero otherwise. For the income model, Yi represents the amount of income and X1, X2, X3 and X4i denotes for the vector of independent variables used during analysis. β0i, β1i, β2i, β3i, and β4i represent for the row vectors of coefficients to be estimated, and εi error term with standard properties.

3.6.2. Propensity Score Matching Model Specification

The PSM was applied based on two assumptions: first the Conditional Independence Assumption that was the key assumption made in PSM was that selection into a program would be captured with observable data. Average treatment effect on the treated (ATT) wass the parameter of interest in propensity score matching

analysis. Thus, we use ATT to assess the effects of participation on household welfare. ATT was computed by matching off farm and non -off farm participant households that are closest in terms of their propensity scores. In this study, the treated group were referred to as off farm participant households and the ATT was calculated as follows:

$$ATT= E(T/1=1)= E(Y/1)/D=1) = E(Y(0)/D=1$$

Where E(Y/1)/D=1 represents the expected welfare outcome of off farm participant households and E(Y(0)/D denotes the counterfactual welfare of non-participant households. The counterfactual estimates represent what the income of outcome of off farm participant households would be, if they have not engaged in non-farm activities participant households.

Table 3.2 The definition of outcome and independent variables and Expected sign

No	Variables description	Variables type	Measurement of variables in (value)	Expected effect on Participation	Expected effect on income
Treatment variable					
	Binary off-farm participation	Dummy	It is treatment variable which is participation in off-farm (participants=1, if yes; =0 non-participants)		
Outcome variable					
	Income status	continuous	It is the outcome variable which is the average annual income		
Independent variable					
	Age of the household head	Continuous	Age of respondent in years	+sign	Positive
	Sex of the household head	Dummy	Sex of the respondent (1=Male and 0= Female)	+sign	Positive
	Education level of household head	Continuous	Formal education in year of schooling grade	+sign	Positive
	Household size	Continuous	Total household members in adult equivalent.	+sign	Positive
	Total cultivated land size	Continuous	Size of cultivated land in hectare	+sign	Positive
	Utilization of formal credit	Dummy	If the respondents to utilized formal credit (1= if yes; 0=if no)	+sign	Positive
	Availability of other sources of credit	Continuous	Alternative source of credit	+/- sign	Positive
	Distance to the nearest market	Continuous	Walking from home to the nearest market in minute.	+/- sign	Positive
	Access to electricity	Dummy	If the respondents did have access to electricity power =1 or otherwise= 0	+sign	Positive
	Training in off-farm work	Dummy	If the respondents get training (1= if yes, 0= if no)	+sign	Positive
	Special skill	Dummy	It takes a value of 1 if the households have special skill (making traditional medicine, masonry, handcrafts etc.) and 0 otherwise	+sign	Positive

Source: Own Design, 2024.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive Statistics

4.1.1 Socio-economic and demographic characteristics of the respondents

The socio economic status between off-farm participants and non-participants varies considerably, as captured in Table 2. There are also considerable differences in outcome levels between the two groups. Households participating in off-farm activities earned an average annual income of 516,268.4 birr compared to their

counterparts in the non-participant group who earned an average of 448,755.1 birr. The nature of income diversification was examined to establish if nonfarm participant helped diversify the income base of beneficiary households in order to improve welfare by raising their expenditure.

Descriptive statistics show 195,264 birr annual average consumption expenditure for participants compared to 110,378.9 birr for non-participants. Annual average consumption expenditure variability indicates diversity in income sources within participants and non-participants. These results show that income sources for off farm participants are more than their counterparts who did not participate in the off farm activities. The mean age of a household head in participant is about 43.55 years whilst that of non-participant is about 43. 95 years.

From the household characteristics, we note that majority of the households are male headed in both participant and non-participants. The average household size of 60% of the households is headed by men. The mean farm size of 5.35hectare is comparable to the non-participants. The infrastructure variables indicate that many of the farm households do not have access to electricity, or a tarred road. The mean water availability to the nearest place is 0.38. There are significant variations in the family size of households who participated in off farm participants compared with those who did not participate in the off farm activities. The family size for the participant group averaged 0.40 whereas that of households who did not participate was at 0.38, representing a 2percent difference in family size of households. This implies that households who did participate in off farm activities were more than those who did not participated in the off farm activities.

We also observe in table bellow that a larger proportion of households who participated in participant on off farm activities were Consumption status improved than were their counterparts who were not involved in the program. Almost 91 percent of those who were engaged in participant on off farm activities were Consumption status compared to 11 percent of those who were not engaged in the participant on off farm activities.

This off-farm income share fits reasonably well into the recent literature from Sub-Sahara Africa (Barrett et al., 2001; Woldenhanna and Oskam, 2001). In our sample, the role of off-farm income increases with overall household income. The most important component is self-employed income, which makes up total off-farm income.

Table 3: Socio-economic status between participants and non-participants

Variable	**Participants off farm**			**Non- Participants**		
	Mean level	Standard Error	Observations	Mean	Std. Deviation	Observations
Gender(male = 1)	0.70	0.462	92	0.54	0.500	168
Age(years)	43.55	8.807	92	43.19	9.519	168
Education status	2.48	1.412	92	2.15	1.304	168
Family size	0.40	0.492	92	0.38	.486	168
Farm land size (hectare)	5.55	1.516	92	5.30	1.614	168
Access to credit	0.80	0.401	92	0.04	.203	168
Access to telephone	0.83	0.382	92	0.12	0.321	168
Consumption status	0.91	0.292	92	0.11	0.314	168
Annual average income by birr	516,268.4	0.203	92	448,755.1	0.112	168

Source: Author's calculation, 2024

4.2. Econometric model results

A probit model has been run to estimate the determinants of participation in off-farm activities of households. The probit model is the simplified version for the estimator that has been used previously in studies explaining household's participation in different off-farm activities by (Babatunde & Qaim, 2010). The probit model sufficiently fitted the data at 1% significant level (Wald $\chi2$ (11) = 65.78; Prob > $\chi2$ = 0.000), showing strong explanatory power of the model. The goodness of fit information of the probit model suggests that the Pseudo R2 of 0.8110 imply that the model correctly predicted 81.1% of occurrences of participation correctly. This value

represents that variables placed in the model explain high level of the probabilities of decision to participate in off farm activities.

Testing the presence of multicollinearity is the first task before conducting probit model and prosperity score matching for hypothesized variables. There are testing the presence of multicollinearity. Once VIF values are generated the R2 values can be computed using the formula. The larger the value of VIF, the more be "troublesome" or collinear the variable Xi. As a rule of thumb, if the VIF of a variable exceeds 10, there is a problem of multicollinearity. To avoid serious problems of multicollinearity, it is quite essential to omit the variable with value 10 and more from the logit/probit analysis (Gujarati, 1995). As illustrated in the bellow table the value of VIF for explanatory variables were found very small which is less than 10, this shows the data has no problem of multicollinearity. Therefore, 11 explanatory variables are retained and used for the probit model regression analysis.

Table 4. The probit model variance inflation factor

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. estat vif
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Variable	VIF	1/VIF
nutritiona~d	2.65	0.377835
accesstome~r	2.50	0.400122
accesstocr~t	2.40	0.416476
accessfort~e	2.05	0.487214
demandfory~t	1.49	0.672827
accesstoro~s	1.23	0.814829
ageofrespo~s	1.13	0.883999
farmsize	1.13	0.887304
gendar	1.08	0.928996
educations~s	1.06	0.939717
ownedlives~k	1.04	0.957132
Mean VIF	1.61	

Source: Author's calculation, 2024

4.2.1. Probit Estimates for Participation Off-farm activities

The econometric result shows, participation in off farm activities has effect on the level of generated income from off-farm activities. This section presents the result of the profit regression model, which was used to estimate the propensity score for matching the off-farm participants with off participants. Overall, almost all of the explanatory variables were statistically significant determinants of off-farm participation in study area. The results of the probit models and their marginal effects are presented in Table 4, reveals that as followings:.

The effect of age of the household:-

The effect of age of the household on the probability of participating in off farm activities is found to be positive. The positive association indicates the preference of the age matured households for off farm jobs activates. Households' heads with one more year of age are more likely to join the off farm jobs activities compared to their younger neighbors. Due to in this matured age the households may collect initial income and finance to turn non-farm participations in study area. A one year increase in age increases significantly the probability of involvement in off farm jobs activities than farm works by 25.36%.

The effect of education status of household:-

Education status of household heads affects level off-farm participation and income positively and significantly. As results revealed that, the coefficient for education level has the expected positive sign and is statistically significant at 10% level for the off-farm participation. The coefficients of off-farm participation increase by 22.99% as household head being attended formal education and increasing their education status, all other factors remain constant. This result supports the hypothesis that human capital plays a positive role in the acquisition and evaluation of new ideas. Education improves the ability of searching out information about importance and effects of off- farm activities to income generating activities and educated household head also has better skill, experience, knowledge than the non-educated households. It determines the capability of finding a job. Thus, education is a fundamental instrument in providing necessary skills to the farmers which enable them to increase an alternative income generating sources than illiterate ones or uneducated ones. This finding is in line with that of Tafesse *et al.,* (2015) and Gecho (2016).

The effect of farm size of household:-

As results indicate, farm size is found to affect off farm activities to generate income in order to improve their welfare status positively at 5% significance level. As a result those farmers with relatively larger area of land tend to involve more in farming activities than those farmers who have smaller area of land to cultivate. Then,

from those farm activities first can generate their initial income and household can re-use for off-farm activities to generate better income and improve their living status. In general, the econometric result of this household survey indicates that, a hectare increase in farm size will increase the probability of off-farm participation by 75.43 %.(i.e, The coefficient is statistically significant at the 10% level for the Probit model used. A unit increase in farm size increases the probability of off farm participation for non-off farm participant by 75.43%). . The marginal effect result further indicates that farm size is positively related to off-farm participation of the households. An addition of one member to the farm size will increases the probability of off-farm participation by 0.3807. This is indicates that; using large farm holding the farmer can produce enough crops for satisfying his family food demand and can get marketable surplus hence will support for increasing his household income and can facilitate to start and join off farm income generating activities. This finding is consistent with (Isham, 2002; Chirwa, 2005).

The effect of Family size of household:-

Family size measured in terms of adult equivalent is an indicator of labor availability, and it has a positive influence to participate in off-farm activities. Household family size has positive effect on the probability of participation in non-farm activities; where having one extra person in the household increases participation decision by 5.35 at 5 percent statistical significant level. Or A unit increase in family size increases the probability of participation off farm activities increased by 18.4%. Thus, households with large family size would have abundant labor and send some of the family members to off-farm activities. According to marginal effects, for a households participation of off farm activities with large family size, the probability of participating off farm activities by households increases by 5.35. Family size is used as a proxy for labor availability and has a positive effect on off farm participation. (i.e, The marginal effect result further indicates that family size is positively related to off-farm participation of the households. An addition of one member to the family size will increase the probability of off-farm participation by 5.35.) More number of working group in the family increases the capacity of the household to participate in off-farm work and thus diversify its income generating activities. These findings confirm that labour availability has an impact on the decision for households participate off farm activities. This finding is in line with that of Tafesse *et al.,* (2015), Zerai and Gebreegziabher (2011).

The effect of access of credit services:-

As result revealed that, access to credit service is positively related with participation of off farm activities and significant at 1% probability level. The implication is that the result is expected since use of credit service is major source of income for startup initial of business or off farm activities in the rural area; hence finding suggests that households use credit to engage in non-farm activities, which are likely to have returns than agricultural production. As presented in results estimated from Probit model, the estimated coefficients revealed which factors influence respondent's decision to participate off farm activities by smallholder farmers (households). A statistically significant coefficient suggests that the likelihood of decision to participate off farm activities will increased by 1.425 when house households have access to get credit increased. Marginal effect is 0.315. This implies that access to credit service increased by one unit, participation of off farm activities increased by 31.5%. Small farm household heads who have the opportunity of getting credit, more participate on off farm activities than those who have no access to get credit. The possible explanation is that household heads who got credit; they would join on field of off farm participation activities more easily to boost households' average income to increase to fulfill basic needs and improve their welfare.

The effect of access to road services:-

Access to road services was found to behave positive effect on the probability of participation in off-farm activity. The probability of participation in off farm activity increases by 31.4 percent for a one unit increase of households has access to road services at 1 percent probability level. The plausible reason for this result is that access to road services enables the off farm households activities can supported by earning more income from selling livestock, livestock's product, to connect customers and join in market simply to supply and use inputs for off farm purposes and which enables them by increasing efficiency and effectiveness in their fields. And which can able in ensuring and increase household off farm activities to generate better income in order to improve better living standards and welfare of households. The marginal effect result further indicates that road infrastructure is positively related to participation off-farm activities of the households. An addition of one member to the availability of road services for households will increases the probability of participation off-farm activities by 0.404. More number of working group in the households increases the capacity of the household to participate in off-farm work and thus diversify its income generating activities to sustain their living standards.

The effect of access to telephone services

The access to telephone services indicated a positive effect on the probability of participate in the nonfarm activities, as the availability of telephone services for households increased by 1units, the probability of decide to participation off-farm activities of the household increased by 1.239 at 5% significance level. This indicates households engaged in off farm activities have a better access to the telephone services and has an employment

opportunity to engage in off-farm due to the telephone simplify the communication between households and their customer when th households are participant in off farm activity. If not, can engage to start off farm activities. Therefore, households have availability to the telephone services were able to participate in off farm activities. Access to telephone services about the availability of high-earning off-farm activities would give an opportunity to participate in those activities. This finding is in line with that of Assefa (2011) and Tafesse *et al.,* (2015).

The effect of access to medical facility of households:-

Access to medical facility of households has also an impact on the decision of participation of off farm activities.. The result of the analysis shows that, Access to medical facility has positively and significantly effects on participation of households in off-farm income generating activities at 1% level of significant. An availability of medical facility increases one for households income rises the marginal effects of participation in off-farm activities by 35.77 percentage points. This indicates households look for off farm activities to solve their medical constraint. Whereas Nutritional status and Demand for product play significant role in influencing off-farm participation in the study area. The result indicates that, a Nutritional status improvement increase in participation of off farm activities will increases the probability of off-farm participation by 94.7% at 1% statistical significant level. Also Demand for product has a positive influence on farmers' participation in off-farm activities. Demand for product about the availability of high-earning off-farm activities would give an opportunity to participate in those activities.

TABLE 5: Marginal effect estimates for participation in off-farm activities

Variables	Probit regression				marginal effects	
	Coef.	Robust Std. Err.	Z	P>z	dy/dx	X
Gender	0 .1678649	0.3277945	0.51	0.609	0.0528917	0.6
Age of respondents	0.0253686	0.0140453	1.81	0.071*	0.0080897	43.2577
Education status	0.2299483	0.1342149	1.71	0.087*	0.0733277	2.2307
Family size	0.1841177	0.0877531	2.10	0.036 **	0.0587128	5.3538
Farm size	0.7543199	0.4489599	1.68	0.093*	0.2504758	0.38076
Access to credit	1.425606	0.383322	3.72	0.000 ***	0.4888733	0.31538
Owner livestock	0.2857688	0.2987216	0.96	0.339	0.0846844	0.85
Access to road services	0.3140437	0.1171237	2.68	0.007 ***	0.1001446	0.40384
Access for telephone service	1.239255	0.3706452	3.34	0.001***	0.414843	0.36923
Access to medical facilities	1.970767	0.4164397	4.73	0.000***	0.6399078	0.35769
Nutritional status	0.9477412	0.3083243	3.07	0.002***	0.313291	0.39615
Demand for product	.2894946	.1679971	1.72	0.085*	.0923162	.553846
_cons	-6.170953	1.501299 -	4.11	0.000 ***		
Number of obs = 260						
Wald chi2(11) = 65.78						
Prob > chi2 = 0.0000						
Pseudo R2 = 0.8110						
Log pseudolikelihood = -31.92801						

Source: Author's calculation, 2024

***, **, and * significant at the 1%, 5%, and 10% level, respectively

4.2.2. The Impact of off farm income participation on Household Welfare

In order to investigate the impact of off Farm participation activities on household income, outcome variables was used for welfare analysis, namely, annual average household income. The average treatment effect for the treated (ATT) was estimated using algorithms, to check the robustness of the results. The first measure of welfare which was examined was annual household average income. i.e, income increased, households can adjust and improve their living standards. Table 6, indicates that there were significant differences between matched and unmatched estimates (treated and controlled grouped) under matching estimator. Matched results using this estimator show that households who participated in off farm activities earned an average of income more than their counterparts who did not benefit from off farms. In consequence, the untreated results overestimated the impact of off farm on household income using the simple difference. The results in Table 6 show that the impact of off farm activities on annual average household income was a 36.3 percent increase, which is significant at 5 percent level of significance.

Table: 6. The Impact of off farm participation on Household income

Matching estimator	mean	Std.err	Std.dev.
Controlled units	0.0373667	0.1138761	0.0400946
Treated units	0.0366471	0.014985	0.0110418
Combined	0.0373408	0.0037652	
Diff	0.007196	0.0202942	
t-value	0.0355		
Treated observation	92		
Controlled observation	168		

Source: Author's calculation, 2024

4.2.3. Impact estimate on ATT for total average income from participate off farm activities

Table 7 bellow: shows that our impact estimate does yield an impact significantly different from zero for total household annual average income from off farm participation. The explanations for this are the participation in off farm activities in getting better income in their activities. Even Though the participating of farm facilitated auction selling base, on one hand the number of trade relation and opportunity to get different income source who appeared for the auction were few which make them to set the price they want than the competitions in off farm area. On the other hand, though one of the trader won the bid and agreed to get additional income compared to conventional non off farm participant activities.

Table 7 ATT for total average income from participate off farm activities and not participating

	Treated	Controls	difference	S.E	T-stat
Unmatched	534018.261	461060.957	72957.9037	125077.767	0.59*
ATT	504328.235	434601.961	69726.2745	2444984.31	0.09

Source: Author's calculation, 2024

CONCLUSION and RECOMMENDATIONS

This paper contributes to this issue by estimating the effects and impacts of participation of off farm activities on welfare of households in gibe woreda, Hadiya Zone, SNNPR, Ethiopia. The descriptive analysis and the econometric results reported in the paper. The main aim of this study attempts to analysis the major determinants of rural household participation in off-farm activities and its effects on households' income diversification.

The effect of age of the household on the probability of participating in off farm activities is found to be positive. A one year increase in age increase to credit, access to road services, access for telephone service, access to medical facilities and nutritional status had a positive effect on off-farm participation of households at 1% significant level and also age of respondents, education status, family size, farm size and demand for product had a positive effect on off-farm participation of households at 5% and 10% significant level. Education status of household heads affects level off-farm participation and income positively and significantly. The coefficients of off-farm participation increase by 22.99% as household head being attended formal education and increasing their education status. This result supports the hypothesis that human capital plays a positive role in the acquisition and evaluation of new ideas. As a result those farmers with relatively larger area of land tend to involve more in farming activities than those farmers who have smaller area of land to cultivate. Nutritional status and Demand for product play significant role in influencing off-farm participation in the study area. The result indicates that, a Nutritional status improvement increase in participation of off farm activities will increases the probability of off-farm participation by 94.7% at 1% statistical significant level. Finally, to estimate the effects of off-farm employment in household annual income, we have found that participation in off-farm activities on average increase the probability of annual income of households. Since, ATT indicated that households who actually participating in off-farm activities would have on average higher probability of annual income as compared with the counterfactual case of they did not participated. Therefore, the result implies that participation in off-farm activities significantly increase the probability of annual income than rural households that did not to participate in order to increase their welfare.

RECOMMENDATIONS

Based on the research findings the following recommendations are put forward.

Rural households should be equipped with basic formal education as it improves skill and knowledge of farmers to diversify their household income in order to improve their welfare.

Infrastructure development is a back bone for any development. Therefore, road construction, electricity and telephone services should be developed in order to facilitate annual income households and participate off-farm activities to improve their welfare.

Local markets (towns) should be promoted by introducing infrastructure facilities like road, electricity, water and others in order to create new and participate off farm opportunities and make profitable for the already existed ones. Connecting rural centers with all-weather roads can also help to reduce transaction costs related with searching wage employment.

Finally, rural development policies aimed to improve living standard of households should focus on off-farm sectors in addition to farm activities because off-farm activities have been increasing households' income and reinvested into agriculture for increased production.

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