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The Effect of Livelihood Diversification on Household Income: Evidence from Rural Ethiopia

Baharu Gebreyesus
Department of Sociology, Mahatma Gandhi University, Meghalaya, India

Abstract
Rural farm households are facing shortage of farm land due to population density. This has adversely affected livelihood activities in agriculture leading to low income. To overcome these problems, people tend to diversify their livelihood to improve household's income. However, the relationship between livelihood diversification and household income of the rural households requires empirical quantification in the study area. Therefore, the objective of this study is to assess the effects of livelihood diversification on the household income. The data were collected from rural Ethiopia individual farmers through personal interview using structured questionnaire. The data were obtained from 252 sample household heads that were selected through a combination of purposive and stratified random sampling techniques. The Composite Entropy Index (CEI) has been used for measuring livelihood diversification. Multiple regression model was applied to identify the determinant factors influencing the households' level of livelihood diversification. Then 2SLS model was employed to detect the effects of CEI on household income. The results indicate that livelihood diversification has a positive and significant effect on household income at $p < 0.0001$. A 1.0% increase in livelihood diversification will lead to 3.9% increase in income signifying an elastic relationship. Owning higher number of livestock and larger size of farm land with better access to improved seed and family labor use helps rural households significantly improve their farm income in particular and household total income in general. Thus, the results of this study suggested that there is a need to develop a number of strategies to facilitate successful livelihood diversification and increase household income. This includes the development of rural infrastructure in terms of road connectivity, market, credit facility and input supply.
Keywords: Livelihood diversification, Composite Entropy Index, Two-Stage Least Square model, household income, farm households, Kembata Tambaro Zone, Ethiopia.

1. Introduction

The Ethiopian economy is largely dependent on the agricultural sector. Its contribution for GDP is 41 percent, export is 90 percent, employment is 85 percent and food security is high. The small-scale farming dominates the agricultural sector and accounts for 95 percent of the total area under crop and more than 90 percent of crop output. The livelihoods of 84% of the citizens depend on various agricultural productions (Fikremarkos, 2012).
However, farming as a primary source of income has become failed to guarantee sufficient livelihood for most farming households in Sub-Sahara African countries (Babatunde, 2013). This is because the agricultural sector in the Sub-Saharan African countries is highly characterized by decreasing farm sizes, low levels of output per farm, and a high degree of subsistence farming (Jirstrom *et al*., 2011). Furthermore, the agricultural activities in rural Ethiopia is also dominated by smallholders, the majority cultivating less than 0.5 ha and producing mostly basic staples for the subsistence of their households (Arega *et al*., 2013). In view of this dependency on agriculture and the concomitant level of rural poverty, investigations in to the nature of livelihood diversification also clearly reflect the desire to understand better whether promoting diversification offers potential for livelihood enhancement and poverty reduction (Deiniger and Okid, 2000).

Thus, the diversity of rural households is an important feature of survival in rural areas (Belaineh, 2002). Because of primary dependence on subsistence crop production in Ethiopia, harvest failure leads to household food deficits, which in the absence of off/ non-farm income opportunities leads to asset depletion and increasing levels of destitution at the household level (Government of Ethiopia, 2009). Similarly, Reta and Ali (2012) indicated that in rural Ethiopia if there had not been other sources of income apart from agricultural production, the land scarcity by the farmers coupled with agricultural risks could not generate enough income to feed household members and they cannot fulfill household needs. Furthermore, livelihood diversification is believed to be a solution, and an effective strategy for the reduction of poverty and food insecurity in rural Ethiopia (Yenesew S.Y., *et al.,* 2015).

Researchers have identified two main factors that drive diversification into off-farm activities among farm households in developing countries. These factors are broadly classified into "pull factors" and "push factors". Reasons why a farm household can be pulled into the off-farm sector include higher returns to labor and or capital and the less risky nature of investment in the off-farm sector (Kilic, *et al*., 2009). The push factors that may drive off-farm income diversification include: first, the need to increase family income when farm income alone cannot provide sufficient livelihood (Minot, *et al*., 2006); second, the desire to manage agricultural production and market risks in the face of a missing insurance market (Reardon, 1997; Barrett, *et al*., 2001); and third, the need to earn

income to finance farm investment in the absence of a functioning credit market (Kilic, *et al*., 2009; Oseni, & Winter, 2009). The household income effect of livelihood diversification is particularly important for poor farm households. This is because non-farm income provides flows of cash income that can be used to purchase farm inputs and hire labor for agricultural production.

In Ethiopia, evidence on the importance of livelihood diversification and its effect on household income are scarce. Available studies such as Woldehanna and Oskam (2001) and Yenesew et al. (2015) relied only on factors influencing decision to non/off-farm diversification and determinants of livelihood diversification respectively. Besides, the study conducted by Mathewos M. (2013) using Simpson Index and OLS identified determinants of livelihood diversification and its implication on food security in Kadida Gamela district. Apart from the study mentioned above, I am not aware of other recent and related studies that have analyzed the effect of livelihood diversification on household income from a broader perspective, also taking into account Composite Entropy Index to measure level of livelihood diversification and 2SLS technique for endogenity to obtain unbiased and robust estimates of livelihood diversification impacts in rural Ethiopia.

Due to the insufficient land resource to absorb the household's full labor force, the rural farming households in rural Ethiopia are obliged to engage in different income generating non-farm activities to expand their household income. Though the rural farm households are involved in diverse livelihood activities, it is still unclear whether livelihood diversification is an ideal solution to improve household income in land scarcity context of rural Ethiopia. It is thus, so important to answer the research question: what is the relationship between livelihood diversification and household income in the study area? Therefore, the objective of this paper is to examine the links between livelihood diversification and household income of the rural households.

2. Methodology

2.1. Descriptions of the study area

The study is conducted in Kembata Tambaro Zone which is found in SNNPR, Southern Ethiopia. The zone is located around 306 km south from the capital city of Ethiopia, Addis Ababa. Astronomically it is located or extends from $7^0$10'N to $7^0$50'N latitude and from $37^0$34'E to $38^0$08'E longitude. KTZ has an area of 1,356 km^2 with elevations ranging from 501 meter at Gibe River to about 3000 meter in the Ambaricho Mountain (SNNPR, BoFED, 2013). The weighted mean annual rainfall ranges from 1001-1400 mm. The spatial variation of mean annual temperature ranges from 12.6℃ to 27.5℃ (KTZ, DoARD, 2012). Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia, Kembata Tambaro Zone has a total population of 792,999. The crude population density of the zone is 585 persons/km^2 (CSA, 2007).

2.2. Data types, methods of collection and sampling procedure

Primary and secondary data were collected for the study. A huge amount of farm level primary data was collected from the study area individual farmers through personal interview using a well defined- structured questionnaire with close ended questions. Secondary data were reviewed from academic online journals and research reviews, books and theses including FAO and World Bank reports. The sampling procedures employed were the purposive and stratified random sampling techniques to select the sample farmers. At the first stage, out of seven districts, Kachabira, Kadida Gamela and Hadero tunto Zuriya were selected for the study purposes. At the second stage, three villages were selected randomly from each district. Finally, at the third stage with in these three villages, 28 farm households from each village were selected randomly for interview by chance meeting with them at the time of field survey. Overall 84 respondents from each of three districts and totally 252 farmers were interviewed to collect the farm level primary data.

2.3. Methods of Data Analysis

To measure livelihood diversification, Composite Entropy Index (C.E.I.) was used. The Composite Entropy Index (CEI) is computed as follows:

C.E.I. = - $[\sum_{i=1}^{N} Pi\ Log_N Pi][1-(\frac{1}{N})]$ (1)

where, Pi = $\frac{Ai}{\sum Yi}$ Pi = Proportion of the income of i^{th} activity relative to all activities

Ai = Net income received from activity *i,* Yi = Net income from all livelihood activities

i =1, 2, ----N (N= number of different income sources)

2.3.1. Model specification for livelihood diversification: In order to examine the determinants of livelihood diversification, the index of livelihood diversification was estimated using OLS estimation. The OLS estimating equation is represented as follows:

LDI = $_{\beta 0}$ + $_{\beta 1}$ HHSIZE+ $_{\beta 2}HHEDU$ + β_3 AGE + β_4 EXPR + β_5 SEX + β_6 HRLABCO + β_7 FAMLABCO + β_8NFRACT + β_9LSTKNO + β_{10}MKTDIS + β_{11}CREDCOST + β_{12}COOP + β_{13}FRMSIZE + β_{14}DISTHAD + β_{15}DISTKACH+ μ (2)

where, β0= constant term U= Error term assumed to have normal distribution with zero mean, and constant

variance i.e.U~N (0σ2) and E (Ui, Uj) =0ij.

The definition of explanatory variables in linear regression model is presented in Table 1 below.

2.3.2. Two-Stage Least Square Model of Livelihood Diversification and total household Income

Following Barret (2001), David *et al.* (2001) and Negatu (2004), a two-stage methodology was adapted to analyze the effect of livelihood diversification index on the income of farm household. This is because livelihood diversification index and household income are jointly depended on similar household socioeconomic variables. Moreover, livelihood diversification index has been used previously as dependent variable in equation (2). The model is specified as follows:

Yi= $\beta_0 + \beta_1 CEI + \beta_2 x_2$ +, ---, βx + ε_i (3)

Where, y is the total income; β_0 is the constant term, β_1, β_2 and β are parameters to be estimated, CEI is Composite Entropy Index, x's are a set of independent variables and ε_i is the error term. The coefficient of β_1 is the main parameter of interest because it estimates the effect of livelihood diversification on household income. A positive and significant value of β_1 would suggest that livelihood diversification has a significant effect on household income.

A key determinant for the estimation of equation (3) is that all the right-hand side variables are truly exogenous. However, in reality, there might potentially be a reverse causality problem leading to endogeneity of livelihood diversification: diversification will lead to higher household income and households with large total income are more likely to diversify the livelihood strategies into non/off-farm activities. The effect is that the estimate of coefficient β_1 will be biased and inconsistent when OLS regression method is used directly to equation (3) (Apata T.G. 2010). In order to tackle this endogeneity bias, the study employed the simultaneous multiple linear regression model. The use of 2SLS has the advantage of estimating all parameters of the structural equation in the model simultaneously. Furthermore, the objective of using 2SLS is to facilitate the use of Ordinary Least Square (OLS) method to each equation of the structural model (Apata T.G. 2010). CEI is an endogenous explanatory variable in equation (2); hence its estimated value from equation (2) is used in equation (3) as an explanatory variable.

Moreover, to cope with potential endogeneity issue of Composite Entropy index, choosing the plausible instrumental variables is critical. The instrumental variable used in this second method should meet two conditions: (i) instrumental variable are correlated (positively or negatively) with endogenous explanatory variable, (ii) instrumental variable are uncorrelated with the disturbance term. In this study, the number of non-farm activities is used as an instrumental variable.

The definition of explanatory variables in 2SLS regression model is presented in Table 1 below.

Livelihood Diversification Index = f(HHSIZE, HHEDU, AGE, EXPR, SEX, HRLABCO, FAMLABCO, NFRACT, LSTKNO, MKTDIS, CREDCOST, COOP(D), FRMSIZE, DISTHAD(D), DISTKACH(D) (4)

TOTINC= f(AGE, HHEDU, SEX, HHSIZE, LSTKNO, SEEDCOST, EXPR, FAMLAB, HRLAB, FRMSIZE, DAVISIT(D), DISTHAD(D), DISTKACH(D), CHEMCOST, MKTDIS, OXEN(D), CREDCOST, Livelihood Diversification Index*) Livelihood Diversification Index* - is endogenous variable (5)

LDI = β_0 + β_1 HHSIZE+ $\beta_2 HHEDU$ + β_3 AGE + β_4 EXPR + β_5 SEX + β_6 HRLABCO + β_7 FAMLABCO + β_8NFRACT + β_9LSTKNO + β_{10}MKTDIS + β_{11}CREDCOST + β_{12}COOP + β_{13}FRMSIZE + β_{14}DISTHAD + β_{15}DISTKACH+ μ (6)

TOTINC= β_0+ β_1LDI + β_2HHSIZE + β_3HHEDU + β_4AGE + β_5SEX + β_6EXPR + β_7LSTKNO + β_8SEEDCOST + β_9 CHEMCOST + β_{10} HRDLABCO + β_{11} FAMLABCO + β_{12} MKTDIS + β_{13} OXEN + β_{14} DAVISIT + β_{15}CREDCOST + β_{16}FRMSIZE + β_{17}DISTHAD + β_{18}DISTKACH + μ (7)

Definition of Variables:

Table 1 Definition of variables and their expected sign in linear regression and 2SLS Model

Variable name	Definition of variables	Expected sign	
		TOTINC	LDI
Dependent variable: TOTINC	is the total annual household income (ETB)		
Endogenous variable: LDI	LDI = 0 when specialization into agriculture whereas when the number of livelihood diversification increases, CEI approaches to 1)	(+)	
Explanatory variables:			
HHSIZE	Size of the family (in number)	-	+
HHEDU	Household head's education (in years)	+	+
AGE	Age of the household head (in years)	+	+
SEX	Sex of the household head ,Dummy (1= male, 0= female)	+	+
LSTKNO	Livestock holding (in number)	+	+
SEEDCOST	Expenses on improved seed (in ETB)	-	
NFRACT	Number of non-farm activities		+
EXPR	Farming experience (in years)	+	+
FRMSIZE	Farm size in hectares	+	-
EXPCHEM	Expenses on chemicals (in ETB)	-	
HRLABCO	Hired labor cost (in ETB)	+	+
FAMLABCO	Opportunity cost of own labor (in ETB)	+	+
MKTDIS	Market distance in (km)	+	+
DAVISIT	A dummy variable, 1 if DA visited farmers, otherwise 0	+	
CREDCOST	Cost of credit facilities (in ETB)	+	+
OXEN	A dummy variable, oxen ownership is yes=1, 0 otherwise	+	
COOP	A dummy variable, 1 if member of the coop, otherwise 0		+
DISTHAD	Location dummy, 1 if Hadero Tunto district, 0 otherwise	+(-)	+(-)
DISTKACH	Location dummy, 1 if Kachabira district, 0 otherwise	+(-)	+(-)

The selection of these variables is based on economic theory, previous or similar studies and peculiar characteristics of the variables in the area of study.

Elasticities were computed for significant variables in both the total income and LDI. Following Herath and Takeya (2003), elasticities were calculated as:

$$\text{Elasticity} = \frac{dy}{dx_i} \cdot \frac{\bar{x}}{\bar{y}} \qquad (8)$$

$\eta = b\frac{\bar{x}}{\bar{y}}$ where, η = Elasticity estimate, b =parameter estimate (marginal effect associated with each independent variable), $\bar{x}$ = Mean of independent variable, $\bar{y}$ = Mean of dependent variable

3. Result and discussion

3.1. Descriptive results

Table 2 presents the description and summary statistics of selected socioeconomic characteristics derived from the sampled households, which were later used as dependent and independent variables in the econometric estimation. In order to analyze the effects of livelihood diversification on household income, I employed the livelihood diversification measure (CEI) as explanatory variable. The average age of the respondent farmers in the sample was 45 years and 91.3% of the sample household heads were male. Overall, there are on average 5.7 members in farm households. Education is believed to be an important feature that determines the readiness of household heads to diversify their livelihood. On average, they have approximately seven years of schooling. The average farming experience of household head is almost 20 years. About 53% of the households are members of a cooperative and the distance to the nearest market place is 6.5 km on average.

Table 2. Summary statistics and description of variables used in the analysis

Variables	Variables description	Mean	Std. Dev	Min	Max
CEI	Livelihood diversification index	0.2601	0.2436	0	0.6707
HHSIZE	Family size in the HH (number)	5.70	1.50	3	11
AGE	Age of household head (years)	44.87	8.84	31	91
SEX	Gender of HHH (1= male, 0= female)	0.91	0.28	0	1
HHEDU	Education of HHH (rears)	6.45	2.95	0	12
FARMEXP	Farming experience of HHH (years)	19.43	9.61	5	61
COOP	Dummy for cooperative membership (yes=1, no=0)	0.53	0.50	0	1
HIRLABCO	Expenditure on hired labor (Birr)	146.19	141.72	0	840
FAMLABCO	Family labor cost (Birr)	201.51	62.76	40	480
NFRACT	Non-farm rural activities in number (instrumental variable)	1.76	0.85	0	4
MKTDIST	Market distance from home (km)	6.54	4.45	0.75	17.5
LSTKNO	Livestock holding of the HH (number)	5.33	3.35	1	44
CREDCOST	Cost of credit (Birr)	1873.71	1923.79	0	6000
FRMSIZE	Land area cultivated by the HH (ha)	0.98	0.51	0.25	2.5
TOTINC	Average total household income per year (Birr)	70861.51	69423.79	4065.4	420310
FARMINC	Average total household farm income per year (Birr)	33246.11	25056.31	1965.4	155139
NONFRMINC	Average total household off/non-farm income per year (Birr)	37615.4	54209.72	0	326050
SEEDCOST	Expenditure on improved seed (Birr)	569.28	367.76	18	1973
CHEMCOST	Expenditure on pesticide (Birr)	210.62	108.98	0	590
DAVISIT	Dummy for development agents farmers visit (yes=1, no=0)	0.65	0.48	0	1
OXEN	Dummy for oxen ownership (1=own, 2=borrowed)	0.88	0.33	0	1
DISTHAD	Location dummy, 1 if Hadero Tunto district, 0 otherwise	0.33	0	0	1
DISTKACH	Location dummy, 1 if Kachabira district, 0 otherwise	0.33	0	0	1

Source: Computed from author's survey data 2014/15. HH = household, HHH = household head

The average land area cultivated by the farm household is less than one hectare and livestock kept per hectare in the study area is almost 5.3 on average. The credit cost of those households accessible to formal and informal credit facility is approximately 1875 Birr on average. The average number of non and off-farm activities in the study are is 1.76. Mean value of family labor used by the sample households was 201.5 man days where as hired labor used was 146 man days. Total annual household income is about 70860 Birr per year from all income sources. Farming accounts for 47% of this total; the other 53% is off and non-farm income. This share of off-farm income fits reasonably well into the available literature for Sub-Saharan Africa (Davis *et al*., 2007; Haggblade *et al*, 2007; Haggblade *et al*, 2010; Woldehanna and Oskam, 2001), although the definition of what exactly constitutes off-farm income slightly varies across studies. The average expenditure on improved seed and chemicals is 569 and 211 ETB respectively.

3.2. Regression results and discussion

To analyze the effect of livelihood diversification on total income, equation 3 was estimated where the average value of total household income in ETB is regressed against the predicted value of CEI and several other independent variables. The livelihood diversification index (CEI) has been used as a dependent variable in equation 2 and its predicted value was used as an endogenous explanatory variable in equation 3. Moreover, CEI and household income are simultaneously depended on similar household socio-economic variables and this justifies the use of two-stage least squares (2SLS) regression technique.

To start with, the results of the first-stage estimation of livelihood diversification index (CEI) were presented in Table 3 to demonstrate the effects of number of non-farm activities and some other variables on livelihood diversification index.

Table 3. First-stage OLS regression results of LDI
Dependent variable: Livelihood Diversification Index
R^2= 77.9% F= 64.655*** Mean VIF= 2.163

Variable	Coefficients	Std. error	T value
(Constant)	-0.120	0.063	-1.899*
Family size	0.0034	0.007	0.478
Age	-6.347E-3	3.117E-3	-2.036**
Sex (D)	0.028	0.029	0.955
Education of the Head	.051	.021	2.480**
Farming experience	-7.29E4	0.001	-0.625
Cooperative (D)	-0.023	0.015	-1.563
Hired labor cost	-0.199	0.233	-0.855
Family labor cost	-2.07E4	1.555E4	-1.334
Number of non-farm activities	0.322	0.0127	25.276***
Market distance (km)	.052	.019	2.761**
Number of livestock	-.103	.041	-2.478**
Credit cost	1.171E-5	5.867E-6	2.401**
Farm size (ha)	-.279	.080	-3.498***
Haderotunto district (D)	.039	.035	1.094
Kachabira district (D)	.074	.037	1.970**

**Significant at 5% level, ***Significant at 1% level Source: Based on Author's survey data 2015.

Age of the household head negatively affected the level of livelihood diversification at 5% significance level. A one percent increase in age of the household head caused decrease in the level of diversification by 0.006347 percent. This result also concurs with Apata (2010) and Kassiye (2013) finding that the age of a household head negatively affected livelihood diversification in Nigeria and Ethiopia respectively. As expected, the educational level was found to affect positively the livelihood diversification of the households at 5% significance level. The result indicated that improvement in the education level increase the possibility of engagement in non/off-farm activities. This result agrees with studies done by Dilruba and Roy (2012) and Eneyew (2012). As expected, the numbers of non/off-farm activities have a positive and significant influence on the livelihood diversification at less than 1% level of significance. The positive coefficient indicates that the level of livelihood diversification of households who have been engaged in large number of non/off-farm activities increased by 0.32 percent. This makes sense, since farm households often engaged in diversified livelihood when they often have access to higher number of off and non-farm activities. This finding concurs with that of Apata (2010) in that households with increased number of non/off-farm activities can make more money from non/off-farm sources.

Contrary to the expectation, livestock holding affected the level of livelihood diversification significantly and negatively at 5% level of significance. As the livestock number increases by one unit, the probability of engagement in livelihood diversification decreases by 0.10 percent. The possible reason could be households who obtained the required amount of cash from livestock may not need to involve in non/off-farm activities for additional income. This finding is similar with the findings of Yisehak *et al.* (2014) and Yenesew *et al.* (2015). The walking distance to the nearest market yielded positive and significant influence on the level of livelihood diversification at 5 percent level of significance. As the market distance increases by 1 km the level of livelihood diversification of the household increases by 0.052 percent which is consistent with findings of Amare and Belayneh (2013) in Ethiopia. As expected, access to formal credit was found to have a positive effect on the level of livelihood diversification at 1 percent level of significance. The positive coefficient indicates that as farm households access to credit facilities increases, the possibility of farming rural households' engagement into non/off-farm livelihood diversification strategies increases by 0.00001171%. This result concurs with the finding of Dilruba and Roy (2012) in West Bengal.

The farm size is significantly and negatively related to livelihood diversification at 1% significance level. The negative coefficient indicated that the households with large farm size are less diversified and rely more on agriculture livelihood strategy. The livelihood diversification of large farm households into non/off-farm activities other than agriculture decreases by 0.28% as the farm size increases by one hectare. This finding is in agreement with that of Fikru (2008) and Yenesew, *et al.* (2015). The households in Kachabira district were more diversified than other districts households in the study area. A household in Kachabira district increased his/her level of livelihood diversification by 0.07 percent. The possible justification may be the resource endowments differences between the districts that create variations in diversification activities among districts.

The second-stage OLS regression results of total income are presented in Table 4 to demonstrate a positive significance of livelihood diversification on total household income which is consistent with findings of

previous studies that have highlighted the important and complementary role of livelihood diversification on farm household income. To maintain the degree of freedom, given the small sample size, 18 independent variables including location dummy were used. The R^2 of 53.43% and the standard error of the estimate 48448.5096 indicated a good fit for the estimated linear equation. The existence of multicollinearity between explanatory variables was checked through variance of inflated factors (VIF) and the VIF of each coefficient of parameter is less than 10 and the mean VIF of the coefficients is 2.798.

Table 4. Second-stage OLS regression estimates of total income

Dependent variable: Total household income

R^2 = 55.8% F = 16.372*** Mean VIF = 2.798

Variables	Coefficients	Std. error	t- value
(Constant)	-67805.958	32227	-2.104**
Livelihood Diversification Index	106754.316	16437.589	6.495***
Age of the household head	884.558	552.166	1.602
Sex of the household head	-1016.509	12080.063	-0.084
Household size	7347.402	2999.277	2.449**
Education of head	-1774.424	1169.169	-1.518
Farming experience	671.622	507.246	1.324
No of livestock	5664.492	1040.693	5.443***
Farm size	37043.975	15754.516	2.351**
Seed cost	24.991	14.658	1.705*
Chemical cost	11.365	37.263	0.305
Hired labor cost	-4.143	47.066	-0.088
Family labor cost	176.973	64.595	2.739**
Credit cost	11.747	16.520	0.711
Market distance (km)	-976.862	867.283	-1.126
DA's farm visit (D)	5613.222	6548.62	0.857
Oxen ownership (D)	-5203.795	7660.887	-0.679
Hadero tunto district (D)	-.013	.089	-.148
Kacha bira district (D)	.223	.088	2.544**

*Significant at 10% level, **Significant at 5% level, ***Significant at 1% level Source: Based on Author's survey data 2014/15.

As a complementary analysis, I also carry out a 2SLS or the IV estimation which solves the endogenous problem of the Composite Entropy Index (CEI) regressor in the farm household total income model (Table 5). Because there might be some unobservable factors that could be correlated with the LDI that are not properly captured by the first 2SLS method, I run this IV regression. In this regression, one instrument was used to control for the endogeneity of livelihood diversification index. This is number of non-farm rural activities. The estimates produced by the direct 2SLS/IV option remain largely the same with the first method 2SLS parameter estimates. I therefore conclude that since the consistent estimates and accurate standard errors produced by the single IV expression proved the two OLS regression results being not biased and so stick to the first method 2SLS regression results in Table 4. The analysis of the data was carried out through a direct 2SLS/IV estimation option available in the SPSS statistical software package.

Two Stage Least Square provides a number of useful tests that can help in deciding whether IV estimation is necessary, and whether the instruments chosen are valid. The assertion for endogeneity test and instrument relevance test is as follows. Always test for instrument relevance first: are the instruments sufficiently strongly correlated with the potentially endogenous variable? Then deal with endogeneity concerns by ensuring that the instrument only influences the dependent variable through the potentially endogenous independent variable. In the case of just one endogenous regressor, there are no over identifying restrictions and we cannot use this test, Hausman Specification Test and Hansen J test to assess the extent to which endogenity is really a problem rather present the First Stage F-statistics to reject weak identification of endogenous variable. In addition, always test the "strength" of your instrument by reporting the F-test on the instrument in the First Stage regression. Following Staiger and Stock (1997), a rule of thumb to identify the strength of instruments is suggested that the F-statistics of instrumental variables should be larger than 10 to ensure that the maximum bias in IV estimators to be less than 10%. If you are willing to accept the maximum bias in IV estimators to be less than 20%, the threshold is F-statistics being larger than 5. If the number of instrumental variable is one, the F-statistics should be replaced by the t-statistics.

Since this study has just one endogenous regressor and a single instrument, the model is exactly identified. Test of validity of one instrument was conducted using the First Stage regression t-statistics test. As can be seen on the results of the first stage OLS regression of the first method in Table 3, the t- value of 25.276 reveals the

relevance and strength, thus establishing the validity of the instrument. Indeed, the instrument is very relevant because it is statistically positively significant. Similarly, the First Stage regression F-test of 64.655 confirms that CEI is indeed endogenous, so that the IV approach is appropriate. Moreover, the statistically significant greater than 6 t-value, F-test of 16.372 and 36.956 in Second stage OLS regression and IV/2SLS estimation respectively implies that there is simultaneity between CEI and household income.

Table 5. 2SLS Analysis for the effect of livelihood diversification on household income
Dependent variable: total income
Predictor: Unstandardized predicted value of CEI
Instrumental variable: number of non-farm activities

variable	coefficient	Std.error	t-statistic	sig
(constant)	39817.2138	6589.920185	6.042139	5.49E-09
CEI	119350.296	19632.77108	6.079137	4.49E-09

Multiple R = 0.35886766 Mean dependent variable = 70861.50774
R-squared = 0.12878599 S.D. dependent variable = 50747 1377
Adjusted R^2 = 0.12530114 Sum squared residual = 1.093E+12
S.E. of regression = 66120.1703 F-statistic = 36.9559
Sig (F-statistic) = 4.49E-09

Note: Calculated by author basing survey data 2014/15.

Livelihood diversification index (LDI): The endogenous variable, livelihood diversification that is measured in CEI likely has statistically strong and significant positive effect on the farm household's total income in the study area at 1 percent level of significance. As farm households' measure of livelihood diversification, CEI increased by one unit, the value of total income will be increased by 106754.3 percentage units.

There are at least three possible explanations for the reliability of this result in the study area. First, farming as a primary source of income has failed to guarantee sufficient livelihood for most farm households in the study area, their personal income likely be maximized as they diversify their livelihood activities. Second, the income from livelihood diversification will motivate farmers to purchase fertilizer and improved seed and relieves credit constraints to agricultural intensification among small farm size holders. Third, as farm households allocate the labor of the family members to livelihood diversification activities, it will help to smooth their annual consumption expenditure. These non/off-farm income sources may help to create job opportunity for large family size of the households in the study area. This finding is consistent with the findings of Tran Nguyen (2010), Apata (2010) and Babatunde R.O. and Matin Q.(2009).

The other significant variables in the total household income equation are household size, number of livestock, farm size, family labor cost, seed cost and Kachabira district.

Farm household size (HHSIZE): Contrary to the expectation, the number of household members positively affected the total household income at 5% significance level. The result indicated that when family size increases by 1 unit, total income increases by 7347 unit. The possible reason may be as part of the family members engaged in other diversified activities, the income from diversification activities help improve the total household income. This result is in tandem with findings by Babatunde R.O (2013) in that household size is positively related to family labor use and hence larger households are more likely to use family labor than smaller households and use less hired labor, other things being equal.

Livestock number (LSTKNO): As hypothesized, the total household income was significantly and positively affected by the number of livestock owned at 1% significance level. This suggests that the households' livestock holdings are often considered as a proxy for wealth or livestock played the role of cash deposit for the farming community of area at the time of dire need for money to balance the vulnerability/variability of crop income due to severe weather conditions. In other words the households may invest resources in livestock activities as a risk coping mechanism. Similarly, other studies found that livestock ownership was positively related to total household income (Qasim, 2012; Apata, 2010).

Farm size: The expectation was that large farm size would lead to higher income. Large farm size significantly and positively influenced the farm output at 5% significance level. The study indicated that an addition of one hectare of land cultivated leads to an increase in the value of farm output by 37044 ETB. This implies that large farm may enable households to allot their land to multiple crops than small holders to minimize income risk. This is consistent with the findings of Babatunde R.O (2013) and Matin Q. and Babatunde R.O (2009) that farm size has a positive and significant effect. This suggests that, while off-farm activities can increase income, farming still remains important for household livelihoods in rural Ethiopia.

Family labor cost (FAMLABCO): As expected, the opportunity cost of own labor positively affected the total household income at 5% significance level. The result indicated that when family labor cost increases by 1 percent, total income increases by 177 percent. This implies that when large family labor hours are involved in farming and livestock keeping activities, the cost incurred for hired labor decreases. This indicates the effect of substitution ability of family labor and hired labor. For instance, it is often assumed that households that use more family labor

will use less hired labor, other things being equal. Besides, family labor is not imputed into the purchased input variable (Pfeiffer *et al*., 2009).

SEEDCOST: Contrary to the expectation, expenditure on improved and local seed has positive relationship with farm household total income. It is significant at 10 percent level of significance with the coefficient of 24.991. This suggests that when a farmer purchased a seed with 100 ETB, he/she will earn 2499 ETB market value of the farm output. This result agrees with the finding of Nasir and Hunde (2014) in Ethiopia that expenditure on improved and local seed positively affected farm output. This could imply that when farm household expenditure on farming inputs increases, farm output increases by the same unit. However, a study conducted by Apata (2010) in Nigeria suggests that cost of farming inputs is found to have a negative impact on total household income.

Location dummy (KACHADIST): The district difference effect was positive and significant on farm household total income. The farmers in Kachabira district have considerably higher per hectare farm income as compared to Kadida gamela and Hadero tunto districts. Kachabira district has relatively more percentage of large farms and less crop diverse farmers. In addition, this district has relatively more cropping intensity and more area under irrigation as compared to the other two districts. Furthermore, the households in Kachabira district were more diversified than that of the rest sampled districts. Due to these reasons this district has higher total household income in relative to other two districts.

3.3. Elasticity of Total Income

Elasticities were computed for only seven continuous variables in the total income model. These included age, household size, number of non-farm activities, farm size, education of head, family labor cost and number of livestock. Table 6 reveals that only number of non-farm activities was elastic for both income and LDI models out of other variables whose elasticities were computed. The most important factors that significantly increase total income in order of importance are CEI (number of non-farm activities), household size, age, farm size, family labor cost and number of livestock. While for CEI model, in order of importance are number of non-farm activities, education and farm size.

Table 6. Elasticity coefficients from the Total Income and Livelihood Diversification Index models

Variables	Total income Elasticity ($\bar{y}$ = 70861.51)		Composite Entropy Index Elasticity ($\bar{y}$ = 0.2601)	
	Regression coefficients	Elasticity coefficients	Regression coefficients	Elasticity coefficients
Age ($\bar{x}$ = 44.87)	884.558	0.5601	-6.347E-3	-1.0949
Education ($\bar{x}$ = 6.45)	-1774.424	-0.1615	0.051	1.2651
Household size ($\bar{x}$ = 5.70)	7486.774	0.6022	0.0034	0.0745
Family labor cost ($\bar{x}$ = 201.51)	176.973	0.5033	-2.07E-4	-0.1604
No of non-farm activities ($\bar{x}$ = 1.76)	106754.316	2.651*	0.322	2.178*
Number of livestock ($\bar{x}$ = 5.33)	5664.492	0.4260	-0.005	-0.1025
Farm size ($\bar{x}$ = 0.98)	37043.975	0.5123	-0.279	-1.052

Source: Computed from multiple regression analysis print out. (2015) * = elastic variable

The elasticity of total income as a result of the number of non-farm activities was 2.651 where as it is 2.178 for CEI. This means that for every 10 percent increase in number of non-farm activities the total income of farm household and CEI increased by 26.5 and 22 percent respectively. The coefficient of elasticity of total income and CEI as a result of increase in opportunity cost of own labor was 0.5033 and -0.1604 respectively. This shows that 10 percent increase in family labor cost will increase the total income by 5 percent and decreases the CEI by 2 percent. Similarly, an increase of the same magnitude in the numbers of livestock and farm size would lead to 4% and 5% increase in total income and 1% and 10% decrease in CEI respectively. Furthermore, the coefficient of elasticity of total income as a result of age and education was 0.5601 and -0.1615. This shows that 10% increase in age and education would lead to 6% increase and 2% decrease in total income respectively. On the other hand, the same magnitude would lead to 11% decrease and 13% increase in CEI. The elasticity of total income as a result of household size was 0.6022 where as it is 0.0745 for CEI. This means that for every 10 percent increase in household size the total income of farm household and CEI increased by 6 and 0.7 percent respectively.

4. Conclusion and policy implication

Studying the effect of livelihood diversification on household total income is important since income diversification through enterprise diversification reduces the need for liquidity in a household. Livelihood diversification strategies have been meeting the gap of farming source of income by directly increasing households' income. The off-farm and non-farm livelihood diversification strategies will help farm households to employ their labor hour throughout the year particularly during the slack periods of agricultural activities. There must be no wasted idle labor hour. This will help farm households to develop the opportunity in substituting the rural financial

market failure. As a result, farm households can afford to buy new farm technologies that will in turn help to boost the agricultural productivity, indicating that increased household income.

The results of this study show some important findings about the effect of livelihood diversification on rural household income. Livelihood diversification has statistically strong and significant positive effect on the total household income at less than 1% level of significance. A 1.0% increase in livelihood diversification will lead to 3.9% increase in income signifying an elastic relationship. Owning higher number of livestock and larger size of farm land with better access to improved seed helps rural households significantly improve their farm income in particular and household total income in general. Rural households with higher household size and more diversification ability tend to diversify income sources. Absence of farm mechanization has increased the importance of farm family labor. This result in the higher family labor productivity in the area and has significant positive affect on farm household income. Thus, households can increase their income by diversifying their farm and non-farm activities.

The findings lead to policy implications that there is a need to develop a number of strategies to facilitate successful livelihood diversification and increase household income via the development of rural infrastructure in terms of road connectivity and market access. Policy that eases accessibility to credit and input supply with provision of fair educational services is promising to increase livelihood diversification and income of rural household.

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