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Determinants of Forest Based Livelihood Strategy Choice by Farm Households': The Case of Jello-Muktar Forest, Chiro District, West Hararghe, Ethiopia.

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Abstract
Forest resource provides home and livelihood for people living in and around them, and serves as vital safety nets for the rural poor. Thus, this study initiated to investigate 'Determinants of Forest Based Livelihood Strategy Choice by Farm Households' A Case of Jello-Muktar Forest, Chiro District; West Hararghe, Ethiopia. A total of 150 sampled households were selected randomly and used for an interview. Descriptive statistics and multinomial logit model were used for data analysis. Accordingly, 13.50%, 18.74%, 30.56%, and 37.10% of the households choose fuel wood sell, beekeeping, animal fattening, and multiple livelihoods respectively. A multinomial logit result showed that family size and on-farm income, negatively affecting the choice of beekeeping while frequency of honey production in a year, and number of beehives owned affecting positively. On the other hand, land covered by Catha edulis (khat), size of livestock, distance from the forest, and on-farm income negatively affecting the probability choice of fuel wood sell. Contrary to this, land covered by Catha edulis, number of livestock, access to extension services, number of tree on own land, and on-farm income positively affecting households' choice of animal fattening as livelihood. In general the study had identified the role of Jello-Muktar forest in livelihood diversification for adjacent farmers' which contribute to household food security and calls to empower the integration of rural livelihood to forest resource in reducing rural poverty.
Keywords: Forest, Household, Jello-Muktar, Livelihood, Multinomial logit

1. INTRODUCTION

1.1. Background and Justification

Ethiopia owns diverse vegetation resources that include high forests, woodlands, bush lands, plantations, and trees outside forests or farm forestry located at different corners of the country. For instance, Oromia National Regional State has identified 43 high natural forests as regional forest priority areas covering a total area of nearly 3 million hectare of which, three of them are found in eastern Hararghe (Jarso-Gursum, Gara-Mul'ata and Dhangago-Hawale) with area coverage of 112,937ha, and two of them (Jalo-Muktar and Dindin forest) are found in western Hararghe with area coverage of 40,340 ha (WHFE, 2013).

Forests in general have several socio-economic and ecological importance's. It provides home and livelihood for people living in and around them and serves as vital safety nets for the rural poor. A primary role of forest or tree resources in the lives of the rural poor is thus as a "safety net", as one of many strategies to avoid falling into destitution (Shimizu, 2006). Among others its contribution to the national economy is considerably high (Mulugeta, 2008). For instance in Ethiopia, fuel wood entrepreneurs receive an equivalent of USD 420 million per year, herbalists USD 216 million per year, wild coffee producers USD 130 million per year, honey and beeswax producers USD 86 million per year (Mulugeta, 2008). Various case studies (Turnbull, 1999; Jagger and Ponder, 2000; Zenebe *et al*., 20007) revealed that forest- based income is the second largest of non-agricultural income for rural households in the country.

Likewise, more than 90% of the energy used in Ethiopia originates from biomass, mostly forests (FAO, 2002 and 2005), and more than 480 species of wild trees, shrubs and herbs have been recorded as important traditional forest-food sources in Ethiopia (Zemede and Mesfin, 2001). Furthermore, about 80% of human and 90% of livestock populations in Ethiopia also depends on traditional herbal medicine obtained from the forest for primary health care (Yinger *et al*., 2007).

However, livelihood dependency of local community on forest could be differing based on socioeconomic and biophysical variability (Getachew *et al*., 2007). For instance factors like family size, age, sex, wealth status, level of education and household livelihood could affect the level of dependency of the local community on forest (Adhikari *et al.,* 2004). Thus, several studies have conducted related to forest based livelihood emphasis on outcome valuation like income. Here, in this study investigation was emphasized on livelihood strategy that particular household decide to choose given socio-economic characteristics. It focuses on output side of forest that used as immediate functioning as source of fuel wood, grass, and bee floras that helps to adjust household decision. Further, it stakes the literature via identifying the determinants of forest based livelihood strategy

which fortunate to manage prioritized forest. Therefore, the objectives of this study are to describe socio-economic characteristics of forest based livelihood and to determine factors affecting forest based livelihood strategy decision by households of the study area.

2. METHODOLOGY

2.1. Descriptions of the Study Area

The study was conducted in Chiro district which is located in west Hararghe Zone between map greed of 1,002,072 Northing and 695,703 Easting. It has a distance of 326 kms from the capital city; Addis Ababa and comprises 39 rural *kebeles* in which Chiro is the district and zonal capital. The total human population is 169,912 and 35,747 household units in which 87,003 are males and 82,909 are females (CSA, 2007).

Topographically it is hilly and mountainous with altitudinal variation of 970 to 1,410 meter above sea level. The agro-climatic condition of the district is high-land (*Dega*), middle-land (*Woina-dega*) and low-land (*Kolla*) types which cover 10%, 57% and 33%, respectively. The annual range of rainfall is from 650mm - 950mm and mean temperature ranges between 17.5^0c - 27^0c (CDAO, 2016) The total area of the district is 42,936 ha of which 31,659.01 ha is used for agricultural crop, 482 ha for grazing land, 1,576.164 ha covered by plantation forest, 2,958.812 ha covered by protected forest and 3,693.742 ha covered by open access woodland (CDAO, 2016).

The economic activity of the district is mixed form of farming i.e. crop production and animal rearing with dominance of mono crop. The major crops grown are sorghum, maize, barely, horse bean, field peas and *Chata edulis*. In addition, the total number of cattle population is 150,010, sheep, goat 65,494, donkey 20,048, camel 1,476, and poultry 154,408 (CDAO, 2016). Villages *(kebeles)* in high-land (*Dega*) and middle-land (*Woina-dega*) participating in crop production, bull fattening and *Catha edulis* production while the low-lands (kola) villages (kebele) are engaged in animal rearing and crop production (CDAO, 2016).

2.2. Sampling Design and Methods

For this study, a two-stage sampling techniques were used. First, out of 39 *kebeles* of the district, three *kebeles, namely, Chiro kella, Nejabas and Shek Adem* were selected purposively due to their proximity to *Jello-Muktar* forest. Then, 58, 48 and 44 sampled households were selected randomly from Chiro kella, Nejabas and Shiek Adem based on Probability Proportional to Sample size (PPS) respectively. For sample size decision 8% margin of error was applied in Yamane formula considering the cost of the study incurred i.e.

$n=\frac{N}{1+N(e^2)}$ Where: N- is the total number of households from the three sampled *kebeles*, e is margin of error (Yamane, 1967).

2.3. Data Collection Methods and Sources

In this study, both primary and secondary data were used. First, reconnaissance survey was conducted that helped us to design interview questionnaire. Primary data was obtained through, a semi-structured questionnaire using personnel interview method. The questionnaire was designed to capture information on household characteristics, wealth characteristics, forest resource based livelihood and institutional and infrastructure factors. Before data collection, the questionnaire was tested. To supplement primary data, personal observation and focus group discussions tools were used. Data was collected from household head and carried out during the dry season. In addition, secondary data was collected from Hararghe Forest Enterprise Chiro Branch (HFEC), District Agricultural Office (DAO).

2.4. Method of Data Analysis

2.4.1. Descriptive statistics

Descriptive statistics such as percentages, mean, standard deviation, minimum, maximum, pie chart and figure were used to describe the explanatory variables for each forest resource based livelihood. Moreover, F-test and χ2-test were employed to test whether there are significant differences between households decision to livelihoods in terms of continuous and categorical variables, respectively.

2.4.2. Econometric model

Household livelihood strategy has often been viewed by analyzing the utility maximizing model. To identify the determinants behind rural household decision to engage in various livelihood strategies the assumption is that in a given period at the disposal of its asset endowment, a rational household choose livelihood that offers the maximum utility.

Following Greene (Greene, 2003), suppose for the i^{th} respondent faced with j choices, we specify the utility choice j as:

$$U_{ij} = X_{ij}\beta + \mu_{ij} \quad (1)$$

Where:

- U_{ij} is the utility derived from the choice of j's livelihood strategy,
- X_{ij} is a vector of explanatory variables that affect the choice of livelihood strategy,
- μ_{ij} is the disturbance term
- β is the vector of parameter estimated

Then, individual chooses forest based livelihood on his preferences to maximize his utility. Hence, the statistical model is driven by the probability that choice *j* is made.

$$\Pr(U_{ij} > U_{ih}) \text{ for all other } h \# j \quad (2)$$

If the household maximizes its utility defined over income realizations, then the household's choice is simply an optimal allocation of its asset endowment to choose livelihood that maximizes its utility (Brown *et al*, 2006). Thus, the ith household's decision can, therefore, be modeled as maximizing the expected utility by choosing the jth livelihood strategy among J discrete livelihood strategies, i.e., the option with the highest utility is chosen.

$$Max_j = E(U_{ij}) = f_j(X_i) + \varepsilon_{ij}; j = 0....J \quad (3)$$

Therefore, for this analysis multinomial logistic regression is used to predict categorical placement or the probability of category membership on a dependent variable based on multiple independent variables. It is a simple extension of binary logistic regression that allows for more than two categories of the dependent or outcome variable. Like binary logistic regression, multinomial logistic regression uses maximum likelihood estimation to evaluate the probability of categorical membership (McFadden, 1974). Multinomial logistic regression is often considered an attractive analysis because; it does not assume normality, linearity, or homoscedasticity (Schwab, 2002). In discrete choice models where the dependent variable has more than two categories, multinomial logit models can be used to analyze factors that determine the choice of one outcome over the other (Maddala, 1997). Before estimation of the model the different tests was employed. The problem of multi-collinearity among the selected explanatory variables was tested using Variance Inflation Factor (VIF) and found no serious correlation in this analysis.

$$VIF(\hat{\beta}) = \frac{1}{1 - R_j^2} \quad (4)$$

Where, Rj^2 is the squared multiple correlation coefficient between X_i and the other explanatory variables. Thus, variance inflation factor (VIF) is necessary to check multicollinearity between continuous and dummy variables. As R^2 increase towards 1, it is a colinearity of explanatory variables. The larger the value of VIF, the more troublesome or collinear is the variable X_i. As a rule of thumb if the VIF greater than 10 (this will happen if R^2 is greater than 0.80) the variable is said to be highly collinear (Gujarati, 2003). After these tests, multinomial logit model was employed to estimate the coefficient of the explanatory variables using STATA 13. Then, the most serious assumption within the multinomial logit framework of the Independent of Irrelevant Alternatives (IIA) i.e. the deleting or removal of any dependent variables does not affect the estimation result was tested by Hausman-Mac Fadden. Finally, post-estimation was employed to obtain the marginal effects results of each explanatory variable on dependent variable and found insignificant. Let Y be the unordered categorical dependent variable that takes on a value of zero or one for each of the *J* forest based livelihood alternatives. The model for forest based livelihood can be given by:

$$\Pr = (Y_i = j) = \frac{\exp(\beta_j' X_i)}{\sum_{j=0}^{J} \exp(\beta_j' X_i)} \quad \text{for } j = 0, 1, 2, 3, \quad (5)$$

Where:

· Pr (Yi = j) is the probability of participating either in, animal fattening, bee farming, fuel wood sell, and multiple livelihood with multiple livelihood as the reference category,

· J is the number of livelihood in the alternative set,

· j = 0 is animal fattening livelihood, j= 1 is bee farming livelihood, a j = 2 is fuel wood sell livelihood, and j=3 is multiple livilihood

· Xi is a vector of explanatory factors conditioning the participation of the jth alternatives,

· β_j is a vector of the estimated parameter.

The estimated equations provide a set of probabilities for the *J* + 1 alternative restricted for a decision maker with characteristics. In order to remove an indeterminacy in the model, a convenient normalization that solves

the problem is β0 = 0. Therefore, one can define the general form of the probability that individual i[th] choose the alternative j[th] in the following way:

$$\Pr(Y_i = j / X_i) = \frac{\exp(\beta_j' X_i}{1 + \sum_{j=0}^{J} \exp(\beta_j' X_i)'} \quad \text{for} \quad j > 0 \qquad (6)$$

The MNL coefficients are difficult to interpret, and associating the *βj* with the *j* th outcome is tempting and misleading. To interpret the effects of explanatory variables on the probabilities, marginal effects are usually used and derived as (Greene, 2003):

$$\delta_j = \frac{\partial P_j}{\partial X_j} = P_j \left[\beta_j - \sum_{j=1}^{j} P_j \beta_j \right] = P_j \left[\beta_j - \bar{\beta} \right] \qquad (7)$$

The marginal effects measure the expected change in probability of a particular outcome being made with respect to a unit change in an explanatory variable (Greene, 2003)

Operational Definition of Dependent variables

Forest based Livelihood Choice: This is a categorical variable that takes a value of 0 if animal fattening livelihood, 1 if bee farming livelihood, and 2 if fuel wood sell, 3 if more than one livelihood (multiple livelihoods)

Animal fattening (AnimalF): It represents the fattening of animal such as of goats and cattle for income generation at zero grazing either kept in *Jello-Muktar* forest or using cut and carrying system of grass from the forest. The decision to choose animal fattening as a livelihood is depend on households fattening experience, wealth, physical factors, and institutional factors. .

Beekeeping (BeeKeP): It represents beekeeping by farm households in *Jello-Muktar* forest for honey production to generate income. It comprises both traditional and modern bee hives that kept in the forest. The decision to choose the activity is depend on the availability of bee flora, physical factors, farm experience, institutional factors, number of bee hives, and wealth of the household's.

Fuel wood Sell (FuelWSe)): It represents the collection and sell of dry fuel wood from *Jello-Muktar* forest as means of income generation. The decision to choose the activity is depend on households' wealth, institutional, physical and household specific factors.

Multiple Livelihoods (MultiLive): It refers when households' decide to choose more than specific livelihoods. That means, households' engaged in combined activities as animal fattening, beekeeping, and fuel wood sell. The decision is affected by the socio-economic characteristics of the household.

Table 1. Summary of Variables Definition and Hypothesized Expected Sign

S/N	Explanatory Variables			Categorical Dependent Variables = Forest based Livelihood			
	Description	Code	Types	Animal Fattening	Bee keeping	Multiple livelihood	Fuel wood sell
1	Sex of the Household Head (1= male; otherwise '0')	SEXHH	Dummy	+	+	+	-
2	Educational Status of the Household (=literate; otherwise '0')	EDUCA	Dummy	+	+	+	-
3	Total family size of the Household in number	FMSIZE	Discrete	+	+	+	+
4	Total Livestock Number in TLU	TLU	Continuous	+	-	_	-
5	Land Size Allocated for *Khat* Production	KHATSIZE	Continuous	-	-	_	-
6	Frequency of Honey Harvested in a Year	FHOprod	Continuous	-	+	_	-
7	Number of beehives owned	NoBEHIVE	Continuous	-	+	_	-
8	Number of tree planted on own land	TRELAND	Continuous	-	+	+	-
9	Participation in Community tree planting (1= yes; otherwise; '0')	PaTRPla	Dummy	-	-	+	-
10	Participation in on-farm income activities (1= yes; otherwise; '0')	OnFARMIN	Dummy	-	-	+	-
11	Distance from the forest in hours	Dforest	Continuous	-	-	-	-
12	Access to the nearest market place (1=yes; otherwise; '0')	ACMARKET	Dummy	+	+	+	+
13	Access to agricultural extension services (1=access; otherwise;'0')	AcEXTE	Dummy	+	+	+	-
14	Access to agricultural credit services (1= yes; otherwise; '0')	ACREDIT	Dummy	+	+	+	-

3. RESULTS AND DISCUSSION

3.1. Proportion of Households by Forest Based Livelihoods

It is apparent that forest resources have great role of contributions in rural livelihoods to fulfill households' daily food requirements. Accordingly, this study identified three alternative livelihoods or a combination of it. These are animal fattening, beekeeping, and fuel wood sell. Hence, about 37.10%.of the households in the study area

were engaged in multiple livelihood while the remaining 30.56%,18.74%, and 13.50% engaged in animal fattening, beekeeping and fuel wood sell respectively (Table 2).

Table 2. Percentages of Sampled Households by Livelihoods

Types of Livelihoods	Percentage (%)	Total
Multiple livelihood	37.10	57
Animal Fattening	30.56	46
Beekeeping	18.74	28
Fuel wood sell	13.50	20
Total	**100**	**150**

Source: Own survey data (2015/16)

3.2. Socio-Economic Characteristics of the Households

About, 40.74%, 33.33%, 22.22%, and 3.70% of male households decided to choose multiple livelihoods, animal fattening, beekeeping, and fuel wood sell respectively. While 37.1%, 29.84%, 17.74%, and 15.32% of female households engaged in multiple livelihoods, animal fattening, beekeeping, and fuel wood sell respectively. Female participation in multiple livelihoods is more or less similar to male participation though there is high percentage of females participated in fuel wood sell. In addition, female participation in animal fattening is less percentage as compared to male households' (Figure 1).

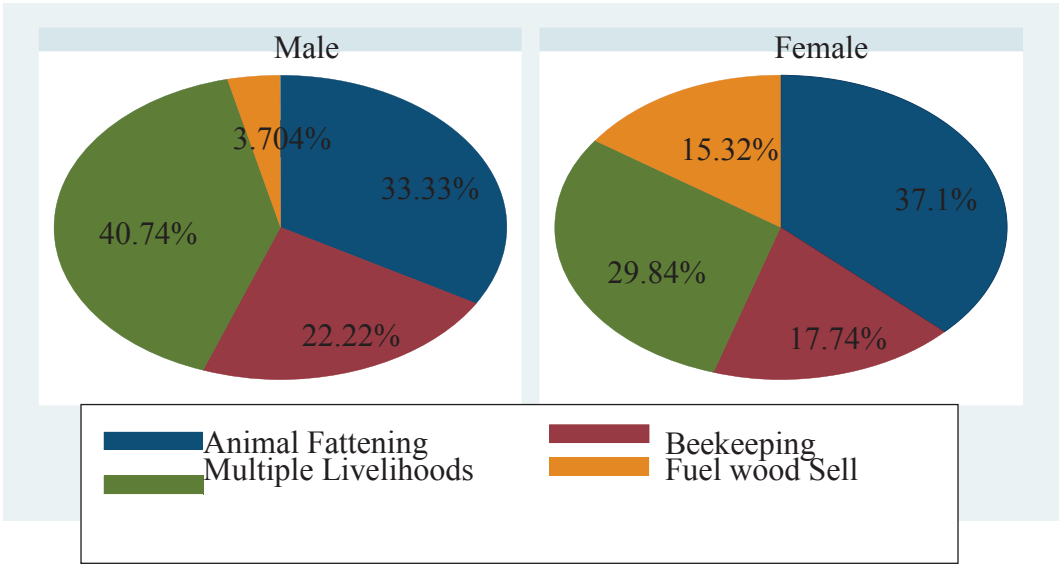

Figure 1. Proportion of Sex of the Households by Livelihood

Source: Own Survey data (2015/16)

As described on table 3 below, the educational level of the households showed that among the literate: 36.05%, 35.32%, 20.4% and 9.6% were engaged in multiple livelihoods, animal fattening, beekeeping, and fuel wood sell respectively. On the other hand, 25% of illiterate participated in multiple livelihoods while 15.15% decided to choose fuel wood sell. This indicated that education is correlated with wealth accumulation that helps for decision.

Table 3 Educational Level of the Households by Livelihoods

	Types of Livelihoods							
	Animal Fattening		Beekeeping		Fuel wood sell		Multiple livelihoods	
Educational level	N	Percent (%)	N	Percent (%)	N	Percent (%)	N	Percent (%)
Illiterate	14	28.46	13	23.92	15	15.15	20	25
Literate	32	35.32	15	20.4	5	9.6	34	36.05

Source: Own Survey data (2015/16)

On the other hand, below bar graph show that the mean of family size is higher for multiple livelihoods and lower for fuel wood sell while relatively similar for animal fattening and beekeeping. This is an indication of large family size calls for allocating more family labor for diversifying livelihoods as compared to other livelihoods option.

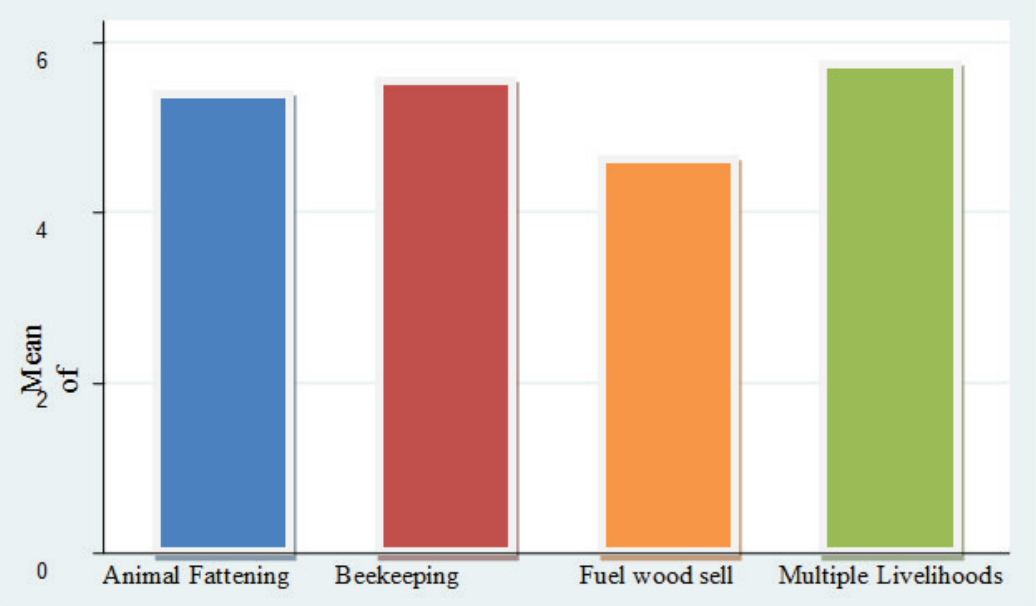

Figure 2. Bar Chart of Mean of Family Size by Livelihoods from Own Survey Data (2015/16)

Land holding in the study area is very small that mainly used for mixed crop production. As indicated below (Table 4) households who have land size less than 0.5 hectare were engaged in multiple livelihoods. This showed that the insufficiency of crop production for family food security which induced to diversify their livelihoods. Correspondingly those who have relatively big land size would also engage in animal fattening, beekeeping, and fuel wood sell.

Tabel.4. Category of Land Size in Hectare by Types of Livelihood

	Category of land size in hectare		
	≤ 0.5 ha	**0.625 – 0.99 ha**	**≥ 1 ha**
Types of Livelihoods	Frequency	Frequency	Frequency
Multiple Livelihoods	33	17	39
Animal Fattening	27	8	33
Beekeeping	23	2	10
Fuel wood sell	19	2	1
Total	**102**	**47**	**83**

Source: Own Survey data (2015/16)

Regarding income generated from each livelihood; many of the respondents' generated income less than 20,000 Ethiopian Birr per annum though there was a variation in income generated between livelihoods. Animal fattening is the dominant livelihoods that generate higher income may be because of farmers experience in animal fattening in the study area and trap higher price in local market. Nevertheless, fuel wood sell, beekeeping, and multiple livelihoods generate income below 20,000 Ethiopian Birr.

Tabel. 5. Income Category by Livelihoods

	Types of Livelihoods				
	Animal Fattening	Beekeeping	Fuel wood sell	Multiple Livelihoods	
Income Category	Frequency	Frequency	Frequency	Frequency	**Total**
0-20,000 Birr	42(31.81%)	28(21.21%)	32(24.24%)	30(22.72%)	**132**
20,001-40,000 Birr	10(66.67%)	0	0	5(33.33%)	**15**
Above 40,000 Birr	3(100%)	0	0	0	**3**

Source: Own survey data (2015/16); current Currency Exchange Rate is 1$ = ETB 23.18

In addition, secondary data obtained from HFEO (Hararghe Forest Enterprise Office) argued that *Jello-Muktar* forest has served for different income sources. Among this Non-Timber Forest Product (NTFP's) is one of the primary sources of income in addition to other forest income sources. Moreover, sell of grass, honey, poaching, animal fattening, punishment collected from PFM member and tree seed are the main income sources.

Table.6 Sources of Income from Jello-Muktar forest During 2013-2016 E.C

Sources of income 2013- 2016							
Income from NTFP (in Birr)			**Income from other Activity (in Ethiopian Birr)**				
Sell of Grass	Honey	Total	Poach (60% of the total payment)	Punishment Collected from members	Animal Fattening	Tree Seed sell	Total
485,700	14,800	**500,500**	377,586.47	27,811	81,086	136,935.29	**623,418.76**

Source: Hararghe Forest Enterprise Office, (2015/16); Current Currency Exchange Rate is 1$ = ETB 23.17

3.4. Descriptive and Inferential Statistics Results

3.3.1. Mean and proportional difference comparison across livelihoods

As illustrated on Table 7, there was a significance mean difference between each livelihood in-terms of number of animal fattened at 1% probability level. Thus, the mean in number of animal fattened is 1.9, 0.5, 0.6 and 0.85 for animal fattening, beekeeping, fuel wood sell and multiple livelihoods respectively. Number of animal fattened entails basic asset to engage in a given alternative livelihoods. Moreover, the total number of livestock in TLU also showed variation and significant at 5% probability level. Thus, the mean in TLU was 2.7, 1.7, 1.8 and 3.73 for animal fattening, beekeeping, fuel wood sell and multiple livelihoods respectively. It indicates livestock size had important asset to decide choice of livelihoods.

On the other hand, the number of beehives owned by the farmers marked differences among the alternative livelihoods. Thus, the mean in number of owned beehives is 1.14, 7.50, 1.03 and 2.90 for animal fattening, beekeeping, fuel wood sell and multiple livelihoods respectively and significant at 1% probability level. It showed that the number of beehives is fortunate for farmers to engage in beekeeping livelihood. On top of this, area of land covered by *Chata edulis* (khat) showed mean differences between livelihoods. Therefore, allocating the available land for *Chata edulis(khat)* production is different among alternative livelihoods at 5% probability level. Generally, distance from the forest, on-farm income and access to market significantly showed variation among the given alternatives livelihoods.

Tabe 7. Disaggregated Descriptive Statistics by Types of Livelihoods

	Types of Livelihoods											
(N= 150)	**Animal Fattening (n= 46)**		**Beekeeping (n=28)**		**Fuel wood Sell (n=20)**		**Multiple Livelihoods (n=57)**					**Sig. test**
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Total**	**Min**	**Max**	
Continuous												**F- value**
Age of the respondent	36.58	8.15	34.74	7.90	38.87	10.75	37.45	7.65	36.61	18	70	1.96
Family size	5.59	1.96	5.08	2.01	5	1.92	5.75	2.15	5.33	1	12	1.45
Number of animal fattened	1.95	1.49	0.5	0.72	0.67	0.63	0.85	0.81	1.32	0	8	24.36***
TLU	2.71	1.36	2.56	1.79	1.82	1.45	3.73	1.59	2.48	0	7.3	4.04**
Number of bee hives	1.14	2.84	7.5	10.25	1.03	2.11	2.90	4.13	2.73	0	17	18.28***
Land use for mixed crop (ha[1])	0.26	0.28	0.31	0.41	0.36	0.33	0.38	0.23	0.29	0	2.5	2.07
Land use for *Chata edulis* (ha)	0.20	0.22	0.14	0.18	0.09	0.15	0.07	0.10	0.16	0	1	3.46**
Average two-way distance in hour	0.62	0.49	0.59	0.47	0.85	0.58	0.61	0.49	0.66	0	2.3	2.76*
Dummy												**χ^2- value**
Sex of the respondent	0.82	0.38	0.84	0.37	0.78	0.42	0.95	0.22	0.82	0	1	0.46
Educational level	0.70	0.46	0.66	0.48	0.56	0.50	0.75	2.15	0.66	0	1	1.93
Access to market	0.61	0.49	0.53	0.51	0.41	0.56	0.93	0.24	0.55	0	1	9.61**
Access to Extension service	0.91	0.28	0.84	0.37	0.87	0.34	0.95	0.25	0.88	0	1	1.32
Access to credit services	0.34	0.47	0.42	0.50	0.44	0.50	0.10	0.31	0.38	0	1	1.33
Use of on-farm income	0.74	0.44	0.53	0.51	0.26	0.52	0.40	0.50	0.63	0	1	6.28**
Use of non-farm income	0.64	0.49	0.5	0.56	0.68	0.47	0.54	0.50	0.54	0	1	3.56

Source: Own computation using STATA Ver. 13; F-test for continuous variables and χ^2-test for dummy variables. Hint: (***) 1%, (**) 5% and (*) 10% significant level.

3.5. Determinants of forest based livelihood choice

In the next econometric analysis, multinomial logit model (MNL) was employed to estimate the determinants of forest based livelihoods choice by households. We have four options of livelihoods each explained by 14 independent variables. During the procedural estimation multiple livelihoods was tailored to the reference category based on highest rate of respondents' choice. Firstly coefficient for each explanatory variable was estimated by suppressing the constant from the model and next model was run to estimate at mean for each variables using marginal effect. The goodness fit of the model is 0.0000 which is significant at 1%. Likewise, to check the effect of heteroskedasticity the model was set at robust standard error and multicollinearity was tested using Variance Inflation Factors (VIF) and found less than 10% showed no serious multicollinearity.

Family size: The number of family members in a given household's had significant effect on choice of

[1] Ha(hectare)

beekeeping as a livelihood. Thus, a one unit reduced in family size reduces the probability choice of beekeeping as livelihood by 4.7% at 5 percent probability level. That means small family size lacks enough labour to supply for beekeeping activities. This result is consistent with Babulo *et al*, 2008 in analysis of forest dependency income in North Ethiopia.

Land Size Allocated for *Chata edulis (Khat)* Production: Land is the most important productive assets for farmers. Accordingly, a one unit reduced in hectare of land allocation for *Chata edulis (Khat)* production increases the probability choice of fuel wood sell by 54.6% at 5 percent probability level. On the other hand, an increase in *Chata edulis* (khat) production increases the probability choice of animal fattening by 302.5 percent at 5 probability level. Those who are land-poor, do not have *Chata edulis (Khat)* crop from their own farm to generate income, and decide to sell fuel wood as a means of income generation. On the other hand, *Chata edulis* is used commonly as animal feed for small ruminants specially goats in the study area. Here the result consisitent to (Julian, 2006; winters *et al*, 2009: and Andersson, 2012) where large land size associated to involvement in agricultural activities.

Number of Livestock in TLU: A one unit reduced in number of tropical livestock unit increases the probability choice of fuel wood sell by 5.3% at 5 percent probability level. While a unit increase in TLU increases the probability choice of animal fattening by 58.2% at 5 percent probability level. This argued that the number of livestock owned by households provides livelihoods option to base on it. The sign in this finding confirmed with (Ellis, 2000; and Dagim *et al*, 2016) showed positive correlation between livestock asset diversifying livelihoods.

Frequency of Honey Production in a Year: During survey time question was asked how often farmers harvest money from their beehives in a year. A unit increase in frequency of honey extraction increases the probability choice of beekeeping as a livelihood by 19.7% and significant at 1 percent probability level. This may be due to the availability of bee flora, and knowing the season of harvesting. Moreover, may be the training given by Haramaya University and other NGO's like CISP support households in sharing experience and knowledge in bee farming. This finding is consistent with Yirga and Teferi 2010 found that amount of honey production directly linked to engagement in beekeeping as livelihood.

Distance from the Forest: This is a physical factor that affects the probability choice of livelihoods. Thus, a one minute decrease in distance from the forest increases the probability to choose fuel wood sell by 7.6% at 10 percent probability level. Possibly it can demonstrate that the households' access to the forest, collect fuel wood from the forest. This result is consistent with Jumbe and Angelson (2006) in which they found negative correlation between fuel wood source choice and distance from the forest.

Number of Bee-hives owned: A one unit increase in number of beehives increases the probability choice of beekeeping by 2.7% at 5 percent probability level. It is evidenced that the more the number of beehives farmers owned encourage them to engage in beekeeping activity. This result is similar to Mujuni *et al*, 2012 where households with more beehives initiated to keep their hives in forest than homestead areas the case of Uganda.

Participation in On-Farm Income Activities: This is dummy explanatory variables affecting significantly the likelihood of household's decision. Thus, use of on-farm income reduces the probability choice of beekeeping and fuel wood sell by 25.5%, 14% at 5 percent and 10 percent probability level respectively. This may be because of farmers' use cash crop such as khat to generate income. While on-farm income increases the probability choice of animal fattening by 53.8% at 1 percent probability level. This indicates that farmers in the study area use animal fattening as source of income.

Access to the Nearest Market: Access to the nearest market is important factor affecting decision to choose livelihoods. Hence access to the nearest market increases the probability choice of animal fattening by 29.6 percent at 10 % probability level. It shows that as far as market is available for animal sell the tendency to participate in animal fattening would increases. The result is consistent with previous studies whereby distance to the specific market destination was one of the elements that condition prices observed at that location (Isabella and Steve, 2007). Long distances increase transaction costs which in effect reduce the prices offered for a given class of animal. While it is contrary to Godfrey, 2010 where distance to the nearest livestock market positively and significantly influenced the sales rate.

Access to Agricultural Extension Services: Again this is the most important factor for household's decision. Access to agricultural extension services increases the probability choice of animal fattening by 83.7 percent at 1% probability level. It indicates that as farmers access to better animal breed selection through adoption of better fattening technology and other management practices, the tendency to participate in animal fattening will increase because of better use of technology. This findings consistent with (Zelalem, 2007) in which he found is the existence of positive correlation between access of extension services and adoption of cattle fattening in west Hararghe.

Number of tree planted on own land: This is significant variable affecting the decision to participate in animal fattening. As forest degradation increases the consequence to reduce open grazing getting high. Thus, as if there would be insufficiency of grazing land, farmers try to adopt planting fodder trees on their own land. Here in the study area we have observed *sesbania sesban*, and elephant grasses planted on own land that used to feed their

animals during dry season. Therefore, as number of tree planted on farm increases, the probability to participate in animal fattening will increases by 86.4 percent at 1% probability level. The result in this finding is similar to Mekoya et al., 2008 in which they found that *Sesbania sesban* (further referred to as Sesbania) is one of the exotic multipurpose fodder tree (EMPFT) species that have been introduced in the Ethiopian highlands to alleviate feed shortages and to maintain or improve soil fertility.

Table 8.Marginal Effect Estimates at Mean from Multinomial logit Model

Forest Based Livelihoods (Multiple Livelihoods = Reference category)									
	Animal Fattening			Beekeeping			Fuel wood sell		
Variables	dy/dx	Robust Std.Err	P>|Z|	dy/dx	Robust Std.Err	P>|Z|	dy/dx	Robust Std.Err	P>|Z|
Sexhh[d]	1.817	2.19	0.620	0.071	0.086	0.414	0.014	0.082	0.866
Famsize	0.913	0.170	0.628	-0.047**	0.023	0.039	-0.021	0.016	0.186
Edu[d]	0.309	0.317	0.253	0.025	0.076	0.737	-0.012	0.073	0.859
KhatLSize	3.025	0.420	0.034**	-0.325	0.253	0.198	-0.546**	0.260	0.036
TLU	0.582	0.135	0.020**	-0.004	0.029	0.889	-0.053**	0.025	0.036
AccMarket[d]	0.296	0.199	0.071*	0.055	0.087	0.531	-0.067	0.087	0.384
AccExt[d]	0.837	0.286	0.000***	-0.020	0.118	0.865	0.085	0.077	0.272
AccCredit[d]	2.470	2.138	0.296	-0.004	0.089	0.963	0.120	0.075	0.111
FHoProd	0.533	0.279	0.230	0.197***	0.049	0.000	0.077	0.072	0.167
Dforest	0.432	0.315	0.250	-0.017	0.103	0.863	-0.146*	0.076	0.057
Nbehive	0.997	0.120	0.986	0.027**	0.012	0.025	-0.027	0.017	0.128
Treland[d]	0.864	0.193	0.000***	0.113	0.126	0.368	-0.006	0.093	0.948
Partrpla[d]	2.408	1.486	0.637	0.009	0.086	0.911	-0.132	0.136	0.332
OnFarmIN[d]	0.538	0.819	0.003***	-0.255**	0.091	0.005	-0.140*	0.081	0.065
Log pseudo likelihood = -129.98									
No. of Obs. = 150									
Wald Chi2 = 1747.85									
Prob > Chi2 = 0.0000									
Pseudo R2 = 1747.85									

Source: Own calculation from multinomial logit regression model.

([d]) dy/dx for discrete change of dummy variable from 0 to 1

(*) significance levels of 10% (**) significance levels of 5% (***) significance levels of 1%

4. Conclusion and Recommendations

4.1. Conclusion

In this study, area households choose animal fattening, beekeeping, and fuel wood sell or a combination of the activities. And Jello-Muktar forest provides significant advantages for adjacent villages to diversify their livelihood. Farm households' decision to choose livelihood is affected by family size, and other wealth factors such as Chata *edulis (Khat) cash crops* owned on his/her farm land. On top of this, number of livestock, beekeeping experience, on-farm income sources, proximity to market, access to agricultural extension services, and distance from the forest affects the decision of households. Generally, the study identified the importance of integrated forest management through livelihood strategy that can surpass the sustainability of the existing forest resources in the study area.

4.2. Recommendations

- The more land allocated for *Catha edulis (khat)* production as source of income, the less households choose to sell fuel wood to generate income. Therefore, using available land, and farm experience water they can grow cash-crop to earn income.
- The more households possess livestock the less they participate in fuel wood sell and the more they choose animal fattening as a livelihood. Therefore, increasing livestock productivity via adoption breed selection and use of artificial insemination for improvement paves for specialization.
- In the study area farmers on average harvest honey three times. Thus, the existing training given by Haramaya University and other NGO's on beehive handling, and management of beehives must be supported. Moreover, the existing bee flora should be managed well in the forest for sustainable harvest of honey products.
- On the other hand, the number of beehives owned by the households positively affects the probability engagement in beekeeping. Therefore, access to credit should be facilitated for farmers based on the preference and affordability of the hives.
- The more households generate on-farm income the less they engaged in beekeeping and fuel wood sell and contrarily the more they decide to choose animal fattening. Therefore, maximization on-farm income through adoption of improved agricultural technologies that helps to increase farm productivity.
- Distance from forest is important factor that possibly calls for households induced to engage in other income source activity reminding that the more time they spent in collecting and selling fuel wood is

high. Therefore, it is advisable to optimize other income source activities like informal trade or petty-cash trade to generate income for their domestic use.

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6. REFERENCES

Adhikari, B., Di Falco, S., Lovett, J.C. (2004). "Household Characteristics and Forest Dependency: Evidence from Common Property Forest Management in Nepal." *Journal of Ecological Economics* 48(2): 245-257.

Andersson, D.A. (2012). Seasonality and farm/non-farm interactions in Western Kenya, *Journal of Modern African Studies*, 50(1):1-23.

Babulo, B., B. Muys, F. Nega, E.Tollens, J. Nyssen, J. Deckers, and E. Mathijs. (2008). Household Livelihood and Forest Dependency in the Highland of Tigray, Northern Ethiopia. Agricultural Systems 98(2008) 147-155.

Brown, T. C., Bergstrom, J. C., and Loomis, J. B. (2006).Ecosystem Goods and Services: Definition, Valuation and Provision. Fort Collins, CO: Rocky Mountain Research Station.

CSA (Central Statistical Authority), (2007). Summary and Statistical Report of 2007 Population and Housing Census. Federal Democratic Republic of Ethiopia Population and Census Commission.

CDAO (Chiro District Agricultural Office), (2016). District Agricultural Annual Report Document, 2016.

Dagim, F. T. Wubalem, and G. Abdella, (2016). Economic Contribution to Local Livilihood and Household Dependency on Dry Land Forest Products in Hammer District, South Western, Ethiopia. *International Journal of Forest Resource*, volume 2016(2016) Article ID 5474680 11 pages.

Ellis, F. (2000). The Determinants of Rural Livelihood Diversification in Developing Countries. Oxford University Press, Oxford, UK. *Journal of Agricultural Economics*.

FAO (Food and Agricultural Organization), (2002). *FAOSTAT* on-line statistical service. http://apps. fao.org, accessed on April 2, 2016.

FAO (Food and Agricultural Organization), (2005). Global Forest Resources Assessment: Progress Towards Sustainable Forest Management, Rome, 2005. PP 107-109.

Getachew, M. E.Sjaastad, and Veldeld, P., 2007. Economic Dependence on Forest Resources: A Case Study from Dendi District, Ethiopia. *Journal of Policy and Economics* volume 9(2007) pp.916-927.

Gujarati, D.N. (2003). Basic Econometrics 4th edition. New York. The McGraw-Hill Companies. PP 623-624.

Greene, W.H., (2003). Econometric Analysis, 4th ed., Prentice Hall, pp.640 – 642.

Godfrey K.R.(2010). Factors Affecting the Level of Commercialization Among Cattle Keepers in the Pastoral Areas of Uganda. A Thesis Submitted to The School of Graduate Studies in Partial Fulfillment of The Award of The Degree of Master of Science in Agriculture and Applied Economics of Makerere University, Unpublished Paper.

Isabbella, B., Steve, S., 2007. Beyond One -Size Fits-All: Differentiating Market Access Measures for Commodity Systems in the Kenyan Highlands. Journal of Agricultural Economics, 58(3): 536-548.

Jagger, P. and Ponder, J., (2000). The Role of Trees for Sustainable Management of less Favored lands: the case of Eucalyptus in Ethiopia. *EPTD Discussion paper No. 65*. International Food Policy Research Institute, Washington, DC.

Jumbe, C.B.L. and A. Angelson, 2006. Household's Choice of Fuel Wood Source in Malawi: A Multinomial Probit Analysis. A Paper Prepared for Presentation at the International Association of Agricultural Economics Conference, Gold Coast, August 12-18, 2006, Australia.

Julian, Q. (2006). Land Access in the 21st Century: Issues, Trends, Linkages and Policy Options. LSP Working Paper 24.

Maddala, G.S., 1997. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University press, Cambridge. pp. 175-181.

Mekoya, A, Oosting ,S.J. , Fernandez-Rivera ,S. , and van der Zijpp ,A.J. , (2008). Farmers' Perceptions about Exotic Multipurpose Fodder Trees and Constraints to their Adoption. *Journal of Agroforest. Syst.,* 73 (2008), pp. 141-153

McFadden, D. (1974). The Measurement of Urban Travel Demand. *Journal of Public Economics,* 3: 303-328.

Mulugeta Lemenih, (2008). Current and Prospective Economic Contributions of the Forestry Sector in Ethiopia, pp. 59–82. Proceeding of a workshop on Ethiopian Forestry at Crossroads: on the need for strong institutions. Addis Ababa, Ethiopia.

Mujuni, A. Naatukunda, K. and Kugonza,D.R. (2012). Factors Affecting the Adoption of Beekeeping and Associated Technologies in Bushjenyi District, Western Uganda. *Journal Livestock Research for Rural Development* 24(8) 2012.

Schwab, J. A., (2002). Multinomial Logistic Regression: Basic Relationships and Complete Problems. http://www.utexas.edu/courses/schwab/sw388r7/SolvingProblems/accessed on May 28, 2017.

Shimizu, T. (2006). Assessing the Access to Forest Resources for Improving Livelihoods in West and Central Asia countries. Livelihoods Support Programme. LSP Working Paper 33. Food and Agriculture Organization of the United Nations, FAO, Rome. Pp. 42.

Turnbull, J.W. (1999). Eucalypt Plantations. *New Forests* 17: 37–52.

Winters, P., B. Davis, G. Carletto, K. Covarrubias, E. J. Quinones, A. Zezza, C. Azzarri and K. Stamoulis. (2009). Assets, Activities and Rural Income Generation: Evidence from a Multi-country Analysis. World Development, 37(9): 1435-1452.

Yamane, T. (1967). Statistics: An Introductory Analysis, 2nd Ed. New York: Harper and Row.

Yinger, H., Kelbessa, E., Bekele, T. and Ermias, L., (2007). Ethno-Veterinary Medicinal Plantsat Bale Mountains National Park. Ethiopia. *Journal of Ethno pharmacology* **112**: 55-70.

Yirga G. and Teferi, M. (2010). Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, Northern Ethiopia. *Ethiopian Journal of Science*, 2(1):76-92.

WHFE (West Hararghe Forest Enterprise), 2013. Annual Report Document, 2013.

Zelalem Tamirat, (2007). Adoption of Small Ruminants' Fattening Package in Agro-pastoral Areas, Meiso Wereda, Eastern Oromia. A Msc Thesis Submitted to in Partial Fulfillment of The Requirements for The Degree of Master of Science in Agriculture (Rural Development and Agricultural Extension), Haramaya University.

Zemede Asfaw and Mesfin Tadesse (2001). Prospects for Sustainable Use and Development of Wild Food Plants in Ethiopia. *Journal of Economic Botany* 2001(55): 47–62.

Zenebe Mekonnen, Habtemariam Kassa, Mulugeta Lemenih & B. Campbell, 2007. The role and management of Eucalyptus in Lode Hetosa District, Central Ethiopia. *Forests, Trees and Livelihoods* 17: 309–323.

APPENDIX

Appendix Table 1. Some tree and shrubs species used for fuelwood & bee flora in the study area

Ser.No	Local name	Scientific name	Frequency
1	Agamsa	*Carissa edulis*	3
2	Bakkanniisa	*Croton macrostachyus*	52
3	Ceekaa	*Calpurinia aurea*	15
4	Daboobessaa	*Rhus natalensis*	24
5	Dhaddacha	*Acacia sieberiana*	7
6	Doddootii	*Buddleja polystachya*	11
7	Eebicha	*Vernonia amygdalina*	67
8	Ejersa	*Olea eurpeana*	80
9	Gaattiraa naannoo	*Juniperus procera*	55
10	Harooressaa	*Grewia bicolor*	34
11	Ittachaa	*Dodonaea angustifoila*	29
12	Laaftoo	*Acacia lahai*	16
13	Mi'eessa	*Euclea schimperi*	33

Source: Own data survey (2015/16) and for scientific name Azene Bekele (2007)

Appendix Table 2. Some of the livelihoods in *Jello-Muktar* Forest