

## Forests and Livelihood: A Study in Jungal Mahal

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### Abstract

*Household livelihood choices are determined by coping with economic and environmental shocks and are conducive to household well-being in the present and future. In this paper, we find the determinants that influence the choice of livelihood of the households toward sustainable livelihoods in the Jungal Mahal region in West Bengal, India. We have used primary data randomly collected from 244 households from 9 blocks in Jungal Mahal region and analyzed data using descriptive and inferential statistics along with a multinomial logistic model. It is found that the average shares of income earnings by the households from the forest, agriculture, wage earner, and non-firm livelihood activities are respectively 35%, 31.1%, 24.8%, and 9.1%. Also, the poorer income group is found to depend more on forest activities compared to the richer income group. Multinomial analysis revealed that the householder's age, land area, working eligible family members, educational status, size of livestock holding (TLU), distance to the nearest forest, poverty status, and forest type were the main determinants of household livelihood preferences.*

**Keywords:** Forest, Jungal Mahal, Livelihood choice, Multinomial Logit Model

### 1. Introduction

Forest is the lifeblood of all living beings on the planet. Forests provide a variety of products and services. Forests provide various natural products including wood, leaves, fuel, fruits, bark, fibers and many other plant products. Forest products are very important for human food, construction purposes, cultural-spiritual heritage and medicine, especially for rural households in the developing world (Babulo et al., 2009; Belcher et al., 2005; Chauhan et al., 2008; FAO, 1992; FAO, 1995). In forest fringe areas, forest resource generation is an important livelihood for most poor, rural and tribal households across the world (Anonymous, 2009; Areki and Cunningham, 2010; Asfaw et al., 2013) as it is a source of income and employment (Hussain et al., 2019; Lepcha et al., 2018). As assessed by the World Bank, about 1.6 billion people around the world heavily depend on forests and NTFPs for both sustenance and regular income (World Bank, 2004). In developing countries, forest-based activities provide about 30 million jobs in the informal sector, as well as up to one-third of all rural non-farm employment (CIFOR, 2016). At present, forest product and services for sustainable income generation of forest fringe people are being hampered due to reduction in farm size, low land productivity, deforestation, high levels of forest product collection and climate change (Hong and Saizen, 2019; Eguiguren et al., 2019; CIFOR Report, 2002). Also, increasing demand for non-timber forest products with growing population has worsened the problem of deforestation (Meyerson, 2004). According to FAO (1995), the total forest area of the world is more than 4 billion hectares and around 13 million hectares of forest are cleared every year due to development activities, agriculture purpose, forest filling and others activity. Side by side,

in India, agricultural land alone is unable to provide enough agricultural produce to lift most poor rural households out of poverty due to barren land and lack of irrigation (NABARD 2021, World Bank 2012,). In view of this, proper livelihood strategies is one of the ways for coming out of poverty trap for forest dwellers (Mudzielwana et al., 2022; Agarwalla and Saha, 2021) and achieve food self-sufficiency (Echebiri et al., 2017).

Livelihood strategies are the process by which family members create portfolios of different activities to improve their quality of life (Ellis, 1998). It is an important survival strategy for rural households that increases sustainable livelihoods, reduces vulnerability, and improves income and well-being (Gebru et al., 2018; Chaudhuri, 2018; Mulungu and Myeya, 2018). Livelihood strategies enables households to earn better incomes, increase food security and better cope with environmental stresses (Roy and Basu, 2020). Many rural households in West Bengal depend on non-timber forest products (NTFPs) for livelihood (Ahmed et al. 2016; Ahmed and Jana 2017; Jana et al. 2017; Jana et al. 2019)

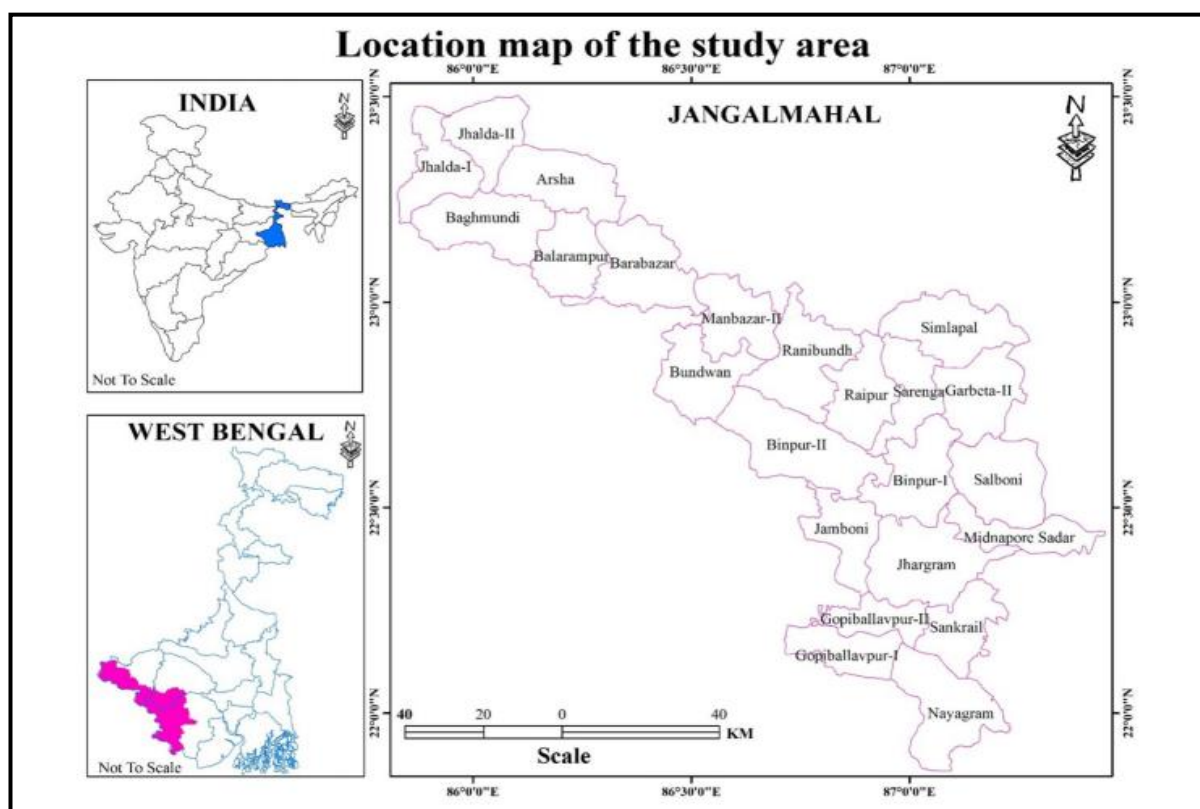
Jungal Mahal region is one of the dry regions of West Bengal. People in these areas maintain livelihood by extracting forest resources. In addition, forest product and productivity are facing challenges due to climate change, deforestation and population growth. This region is affected by climatic events (such as droughts and storms) which exacerbates the problem of income generation. Also, scarcity of cultivable land, low level of education, low level of social infrastructure and presence of disadvantaged social groups have compounded the problem of sustainable livelihood. A certain section of the population also depends on rain-fed agricultural production systems and livestock rearing. As the population increases, low income from forestry and agricultural activities has forced them to engage in various livelihood choices. Although a considerable number of households participate in various livelihood activities, there is limited number of studies explaining the determinants of livelihood choice adopted by the households in Jungal Mahal. In this context we have undertaken the present study to investigate the determinants of rural livelihood choice adopted by households in Jungal Mahal. We have selected Jungal Mahal region as there is a limited opportunity for alternative livelihood in these areas. The other point of interest in this region is the high degree of variation in the genetic, species, and forest resources. Also, this region is dominated by underprivileged social groups such as landless labourers, marginal and small farmers, and tribal groups.

The study aims to find the determinants that influence the livelihood choice of the household toward sustainable livelihoods. Also, the study attempts to investigate the economic contribution of forestry activities to the annual income of a rural household in Jungal Mahal' region of West Bengal in India.

## **2. Materials and methods**

### **2.1 Site Selection and Sampling Procedure**

The study has been carried out in 'Jungal Mahal' region in West Bengal, India. This is one of the dry regions of West Bengal.

**Fig. 1: Location map of the study area**

in Table 1.

**Table 1: Name of the blocks in the Jungal Mahal**

Name of the Districts	Blocks (N)	Name of the blocks
1. Purulia	8	Jhalda I, Jhalda II, Arsha, Baghmundi, Balarampur, Barabazar, Manbaza II and Bandwan
2. Bankura	4	Ranibandh, Simlapal, Raipur and Sarenga
3. PaschimMedinipur	3	Salboni, MidnaporeSadar and Garbeta II
4. Jhargram	8	Gopiballavpur-I, Gopiballavpur-II, Nayagram, Jhargram, Sankrail, Binpur-I, Binpur-II and Jamboni

**Source: Annual Administrative Report, Government of West Bengal, 2017**

A three-stage sampling method has been employed to select households under FPC for the study. In the first stage, 9 blocks out of 23 blocks under the Jungal Mahal region were randomly selected. Basic information on forest bits has been gathered through key information interviews with staff of the District Forest Offices (DFO) of the districts. After the randomly selection of 9 blocks, we have purposively selected at least two FPC in each blocks in the second stage based on forest quality, species characteristics, and availability of NTFPs. Lastly, we have randomly selected at least 10 households every FPC. Selected blocks and number of the households in the FPC are shown in the Table 2. Primary data collection for the study has been conducted through a structured questionnaire. We conducted a structured household survey containing closed and open questions to collect reliable data about the demographic and socio-economic characteristic of the households; the existing livelihood strategies and factors that influence the diversification of livelihood choices in the area. Questionnaire testing and adjusting were conducted before the survey among some randomly selected households in Bhadulia FPC in Midnapore Sadar block.

**Table 2: Profile of the study area**

District	Block	FPC Name	No of HHs
Purulia	Bandwan	Shayamnagar	10
		Radhanagar	15
	Manbazar II	Bagrabad	10
		Kallabara	12
Bankura	Sarenga	Sarulia	10
		Telijantajungal	20
	Ranibandh	Pukuria	11
		Nachana	13
		Hetiapathar	12
PaschimMedinipur	Garbeta II	Daldali	10
		Phulbani	11
	MidnaporeSadar	Intilikachak	13
		Bhadulia	16
Jhargram	Jhargram	Dhadikavanga	15
		Basantapur	10
	Binpur 1	Kamrangi	12
		Bandi	20
	Jamboni	Susni	12
		Baghuadam	12
Total	9 blocks	19 FPCs	244

**Source: Primary data**

## 2.2 Methods of data analysis

Data generated through questionnaires were analyzed using descriptive and inferential statistics along with Multinomial Logit Model. Quantitative categorical types of data were analyzed using percentages, frequency distributions, cross-tabulation and chi-square tests; while quantitative continuous data were analyzed using means, standard deviations and one-way ANOVA. Chi-square test ( $\chi^2$ ) and *F*-test were used to see whether there were significant differences among different livelihood strategies in relation to dummy/categorical and continuous variables, respectively. Multinomial logistic regression model was employed to investigate the determinants of livelihood choice of the households' and data analysis has been conducted using SPSS software.

### Multinomial logit model specification

Multinomial logistic (MNL) regression is a popular and widely used model for nominal outcomes that is often used when the dependent variable has more than two choices. We have used this model to identify the determinants of livelihood choice of rural households. The assumption is that within a given period of available resource endowment, a rational household chooses among different income sources that offer the highest income. That choice will have the highest probability of being chosen. Let

$Y_{ij} = 1$ , if the individual *i* chooses alternative livelihood choice of *j* ( $j = 1, 2, 3$  and  $4$ )

$= 0$ , otherwise

Further, let

$$\pi_{ij} = P_r (Y_{ij} = 1)$$

Where, Pr stands for probability.

Therefore,  $\pi_{i1}, \pi_{i2}, \pi_{i3}$  and  $\pi_{i4}$  represent the probabilities that individual i choice alternative 1, 2, 3 and 4 respectively. Alternative livelihood choice is forest activities, agricultural activities, wage earning activities and non-farm activities. If these are the only alternatives an individual faces, then we get

$$\pi_{i1} + \pi_{i2} + \pi_{i3} + \pi_{i4} = 1 \quad (i)$$

This is because the sum of the probability of mutually exclusive and exhaustive events must be 1,

Now,  $X_i$  is independent variables that determine the probability of choosing a particular livelihood choice. Also, some random factors (error term) that will be affect the livelihood choice.

Generalizing the bivariate logit model and we can write the multinomial logit model (MLM) as:

$$\pi_{ij} = \frac{e^{\alpha_j + \beta_j x_i}}{\sum_{j=1}^4 e^{\alpha_j + \beta_j x_i}} \quad (ii)$$

The dependent variable in this study was the choice of livelihood by the households. Hence, the dependent variable was hypothesized to have the following values:  $Y = 1$ , if the choice lies in forest activities which are considered as base/reference category;  $Y = 2$ , if the choice lies in agriculture activity;  $Y = 3$ , if the choice lies in wage earning activity and  $Y = 4$ , if the choice lies in the non-farm activities. In this study, critical explanatory variables (socio-economic, demographic and forest related factors) hypothesized to influence household choice of livelihood. Accordingly, age of the household head, working eligible members, land holding size, livestock value, distance between forest and house, forest type, poverty status and education are assumed to affect the choice of livelihood by the households. The description of independent variables and their hypothesis are presented in table 3. Positive expected sign means, if increase in value, household's choice to the non-base categories (agriculture, wage earner, and non-firm livelihood activities) over the base category (forest activities) and vice-versa.

**Table 3: Independent variables in multinomial logit model**

Explanatory variables	Description of explanatory variables	Nature	Expected sign (non-base categories)
AGEHEAD	Age of the household head in years	Continuous	—
WORKMEN	Working eligible members of the household	Continuous	+
LAND	Land holding size of the household in hectare	Continuous	+
TLU	Total livestock owned by the household in TLU	Continuous	—
DISTANCE	Distance between forest and house in km.	Continuous	+
FOREST	Forest type (Native forest=1, Non-native forest =0)	Dummy	—
POV	Poverty status of the household (Poor=1, Non-poor =0)	Dummy	—

EDU	Average Educational year of the household in eligible members	Continuous	+
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Source: Own classification

### 3. Results and discussions

#### 3.1 Income composition of the livelihood strategies

In order to compare income groups, we split the sample into two income categories based on National Council for Applied Economic Research (NCAER) criteria. NCAER concluded a study; titled India Human Development Survey (IHDS) (published in 2015) based on data for the year 2011-12 and has come up with three broad household classifications on the basis of the annual income of the households. Two income categories household is poor and non-poor households. We have presented income criteria and household category-wise sample household in Table 3.

**Table 3: Income criteria and categories-wise number of households**

		Households	
Category of the households	NCAER Criteria	N	%
Poor	Less than Rs. 88,800	115	47.1
Non-poor	Above Rs. 88,801	72	52.9

Source: Primary data

**Table 4: Percentage of income composition of the households**

Income Sources (%)	Poor (N=115)	Non-poor (N=129)	Total (N=244)	F value	P value
NTFP	39.5	28.2	33.5	12.71***	0.000
Forest Felling	2.2	0.9	1.5	19.73***	0.000
<b>Forest Subtotal</b>	<b>41.7</b>	<b>29.1</b>	<b>35.0</b>	<b>15.79***</b>	<b>0.000</b>
Crop	19.1	22.5	20.9	1.39	0.239
Livestock	11.5	9.2	10.2	1.39	0.240
<b>Agriculture Subtotal</b>	<b>30.6</b>	<b>31.6</b>	<b>31.1</b>	<b>0.12</b>	<b>0.732</b>
Daily Wage	23.2	24.0	23.6	0.07	0.786
Public Works	1.3	1.0	1.2	1.07	0.301
<b>Wage Earner Subtotal</b>	<b>24.5</b>	<b>25.0</b>	<b>24.8</b>	<b>0.02</b>	<b>0.879</b>
Services (Govt.)	0.6	7.0	4.0	8.03***	0.005
Services (Non-Govt.)	0.3	2.8	1.6	4.74**	0.031
Petty trade	2.3	4.5	3.5	1.48	0.226
<b>Non-farm Subtotal</b>	<b>3.2</b>	<b>14.3</b>	<b>9.1</b>	<b>14.36***</b>	<b>0.000</b>

Source: Own estimation

Note: \*\*\* and \*\* means the coefficient is statistically significant at 1% and 5% probability levels

Livelihood choice is an activity that people undertake to survive and fulfill their livelihood requirements. In their day-to-day struggle, rural people pursue a number of strategies to attain their livelihood goals. We have divided the income sources of the households into nine categories in four livelihood choice categories- forest, agriculture, wage earner and non-farm. The average annual income per household for the whole sample is Rs. 1,17,788. The major income earning activities is NTFP for which share is 33.5%. Daily wage earning activities

(23.6%) is the second greatest and crop (20.9%) is the third greatest out of nine categories. Remaining six categories hold 22.70% of total income.

As we see in the Table 4, the income share of forest in the total income for poor household is 41.7% which is higher than non-poor categories (29.1%). Both poor and non-poor households earn about the same percentage of income from agriculture and wage activities. The non-poor households derive higher share of income from agriculture which is 31.6%. So, the poorer income group depend more on forest compared to richer income group.

An ANOVA was run to explore different type's income sources across different household categories of poverty situations. The Table 4 reveals statistically significant mean income differences across households for incomes from NTFP, forest felling, and services. Therefore, non-farm and forestry activities are the main factors that make a family poor and rich.

**Table 5: Characteristic of the households by choice of the livelihood**

Characteristic	Forest (N=85)	Agriculture (N=65)	Wage Earner (N=63)	Non-farm (N=31)	Total (244)	Statistics value
Average TLU	4.12	5.31	4.70	3.22	4.47	F value : 2.24*
Average farm size (he)	0.137	0.330	0.152	0.269	0.213	F value:21.06***
Tribal household (%)	81.2	38.5	65.1	32.3	59.4	$\chi^2$ value: 38.85***
Kuccha house (%)	84.7	64.6	84.1	58.1	75.8	$\chi^2$ value:15.81***
Household used LPG as cooking fuel (%)	48.2	67.7	52.4	67.7	57.0	$\chi^2$ value: 7.70*
Household used safe drinking water (%)	77.6	93.8	93.7	87.1	87.3	$\chi^2$ value: 11.94***

**Source: Own estimation**

Note: \*\*\*, \*\*and \*means the coefficient is statistically significant at 1%, 5% and 10% probability levels

Table 5 shows some characteristics of the households under study by livelihood choice of the households. Almost all the households rear livestock with average number TLU (cows, buffalos, pigs, goats and poultry are major) per household being 4.47. The highest TLU value (5.31) has been observed in agriculture livelihood choice households compared to the other three groups. Most of the households (75.8%) live in *kacha* houses. Average farm size per household is calculated as 0.213 hectare. Agriculture livelihood choice households are found to have more land (0.33 hectare) in this study area. The sample consists of 59.4% tribal households (santal, sabar, munda and lodha are major). Most of the households (87.3%) use safe drinking water. Mainly community water tap (government sponsored) is the source of drinking water. LPG as cooking fuel is not frequently used by the household, only 57% overall households used LPG. In the case of agriculture and non-farm livelihood choice households, 67.7% of households are used LPG as cooking fuel.

An ANOVA (Table 5) has been run to explore the differences in some household characteristics by livelihood choice of the households. There have a statistically significant mean difference in land holding size and TLU between household groups at a 1% and 10% level, respectively. A chi-square test has been run to explore the discrete variables (tribal households, kuccha house, household used LPG as cooking fuel and households used safe drinking water) on the household's category as a choice of livelihood. The chi-square test results reveals that the variables as a household used safe drinking water, percentage of kachha house and percentage of tribal household of significant differences among the household

groups at 1% level, another variable as a household used LPG as cooking fuel has been significant differences among the household groups at 10% level.

**Table 6: Livelihood choice-wise number of households**

	Forest (N=85)	Agriculture (N=65)	Wage Earner (N=63)	Non-farm (N= 31)	Total	%
Poor	54	30	27	4	115	47.1
Non-poor	31	35	36	27	129	52.9
X <sup>2</sup> (Pearson)						24.235***
Likelihood Ratio						26.307***

**Source: Primary data**

Note: \*\*\* means the coefficient is statistically significant at 1% probability levels

**Fig 2: Livelihood choice-wise percentage of households**



**Source: primary data**

Understanding the local context of household livelihood choice is crucial to pinpoint appropriate development intervention strategies. In the forest livelihood choice household category, large proportions of the sample households (63.5%) are poor; whereas 36.5% belong in non-poor categories (Fig 2). But if we look at the non-farm household category as a choice of livelihood, the picture has entirely changed. Large proportions of the sample households (87.1%) belong to the non-poor category, remaining 12.9% households belonging to poor categories. Fig 2 shows that, 46.2% of agriculture choice livelihood households belong to poor categories, whereas 53.8% households belong to non-poor categories. As well as the same picture reflects in the wage earner group as a choice of livelihood but the percentage of non-poor households is marginally higher than agriculture livelihood choice households. Among the surveyed households, 63.5 of poorer households belong to forest livelihood choice of households, whereas 46.2%, 42.9%, and 12.9% belong in agriculture, wage earner, and non-farm livelihood choice of households. This implies that poorer households are more likely to follow forest activities than the other income categories.



### 3.2 Determinants of livelihood diversification strategies: the econometric model results

A multinomial logistic regression model (given in section 2.2) has been estimated to find the relationship between predictors and the choice of livelihood of the households with forest livelihood choice as a reference category in the study area. We have tried to present in this section the main findings of the factors influencing the choice of households. The results of the multinomial logit model have been presented in Table 7. The results indicate that among the hypothesized variables, age of the household head (AGEHEAD), land holding size (LAND), the distance between house and forest (DISTANCE), forest quality (FOREST), poor household (POV), average years of education of the family (EDU) and Total livestock units (TLU) were the major determinants of livelihood diversification strategies (Table 7).

**Table 7: Multinomial logit model (MLM) estimation result**

Variables	Agriculture		Wage Earner		Non-farm	
	Coefficient	Std.Error	Coefficient	Std.Error	Coefficient	Std.Error
Intercept	-2.340	1.302	-0.722	1.237	-1.171	1.531
AGEHEAD	-0.020	0.019	-0.004*	0.018	-0.002*	0.024
WORKMEN	-0.110	0.185	0.315**	0.174	-0.138	0.234
LAND	6.891***	1.584	-1.069	1.628	3.422**	1.782
TLU	-0.006	0.053	-0.031	0.055	-0.231**	0.094
DISTANCE	2.634***	0.530	2.178***	0.522	2.618***	0.640
FOREST	0.445	0.673	-0.964**	0.601	-1.004**	0.782
POV	-0.443	0.472	-1.288***	0.449	-3.348***	0.747
EDU	0.058	0.064	0.019	0.068	0.218***	0.077
Reference Category: Forest						
Dependent Variable: Livelihood Diversification Strategy						
Number of Observations: 244						
- 2 Log likelihood model: Intercept only _649.755, Final _474.051						
X <sup>2</sup> value: 175.704, Degrees of freedom:24, Significance: 0.000***						
Pseudo R-square: Cox and Snell_0.513, Nagelkerke_0.552, McFadden_0.270						

**Source: Own estimation**

Note: \*\*\*, \*\*and \*means the coefficient is statistically significant at 1%, 5% and 10% probability levels

In multiple regressions we use  $R^2$  as measure of goodness of fit of the chosen model. But the  $R^2$  does not work well for MLM because this is nonlinear regression model. However, a pseudo  $R^2$  measure the goodness of fit of the model. McFadden version Pseudo  $R^2$  is about is 0.270. Instead of the pseudo  $R^2$  we can use likelihood Ratio (LR) test. Under the null hypothesis that none of slope coefficients are statistically significant, the computed LR highly statistically significant as its p value is zero. This suggests that the model we have chosen has a good fit. Here we have taken the base category 1 as the forest-based livelihood choice.

A positive coefficient of a regressor suggests increased odd for choice  $j$  ( $j=2, 3, 4$ ) over choice 1 (base category), holding all other regressors constant. Likewise, a negative coefficient of regressor implies that the odds in favour choice 1 (base category) over the choice  $j$  ( $j = 2, 3, 4$ ). In the first part of Table 7 we observe that if land size and distance between forest and house increases, the odds of going to agriculture activities increase compared to the forest activities. In the second part, we observe that if working members of the family and distance increase, the odds in favour of wage-earning activities increase compared to the forest activities; and if

the age of the head of the household, the poverty level of the household, and the natural forest increase, the odds of going to forest activities increase compared to the wage-earning activities. In the third part, we observe that if land size, the distance between the forest and house, and the education year of the family increase, the odds in favour of non-farm activities increase compare to the forest activities; and if the age of the head of the household, poverty level of the household, total livestock unit (TLU) and natural forest increase, the odds in favour of forest activities increase compare to the non-farm activities.

The positive coefficient value of distance in three non base category indicate that households closer to the forest participate more in forest livelihood activities. The possible explanation for this could be attributed to the fact that households far from forest find it difficult to go to forest access NTFP. That's why households choose other livelihood activities. Quality of forest has been found to have negative influence on the choice of the households' participation in wage earning and non-firm activities at 5% significance levels. Native forest provides high forest resource compared to the non-native forest. Hence rural households are more dependent on natural forests for their livelihood due to the high possibility of forest resource earning. For many of them, the forest resources provide economic sustenance, and forests are also a way of life socially and culturally. It fulfils basic needs like food, firewood, wood, and fodder. The coefficient values of poverty level indicate that poor households are more likely forest activities compare to the wage earning and non-farm livelihood activities. Positive coefficient of land size in agriculture livelihood choice implies that households with large land holding size are less likely to choose forest livelihood activities compared to those who have small land holding size. The possible reason can be large land holding enables the farm households to take agriculture as the occupation with possibility of higher farm income. Educational status has been found to have a positive and significant effect on no-farm livelihood choice of the households at the 1% significance level. The positive coefficient indicates that more educated households are more likely to non-farm livelihood activities compared to the less educated households. In other words, households with lower levels of average education are more likely to be engaged in forest activities. The age of the household head negatively and significantly influences the choice of wage earner and non-firm livelihood strategies at a 10% probability level. This implies that older people are more likely to take the forest as a livelihood. In other words, younger people are relatively less likely in forest activities or more likely to choose wage earning and non-farm activities. In the study region forest activities is the traditional livelihood activity and that's why older people are not interested in other activities. May be younger head of households cannot get enough income from forest activities for their maintain livelihood that's why younger people move to wage earning and non-farm activities compared to older head of households.

#### **4. Conclusions**

The study analyzes the rural livelihood choice adopted by households and the major determinants that influence livelihood choices. It has been found that forest activities are the main economic livelihood activity for rural households in the study area. Also, we find that poor households depend more on forest activities than non-poor households. Forest activities are mainly traditional livelihoods. High population growth coupled with a small land area, and low return on non-timber forest products have forced households to pursue different income-generating activities for their survival. The results of multinomial logit model reveal that among the hypothesized variables, age of the household head, land holding size, working eligible members of the household, educational status, size of livestock holding, distance to the nearest forest, poverty status, and forest type were the major determinants of livelihood choice.

Forest activities alone cannot be relied upon as the core activity for rural households and as a means of reducing poverty, achieving food security and improving livelihoods towards sustainable livelihood income in the study area.

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