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Household livelihood strategies choice and the impact of livestock rearing on the sustainable rural livelihoods of indigenous people in three selective districts of Bangladesh

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Abstract

This study adopts an asset-based approach to conceptualize the livelihood strategies pursued by indigenous people in rural Bangladesh in particular, Rangamati, Khagrachri and Dinajpur districts. To describe livelihood strategies in the context of livestock based on-farm management, primary data was collected from 300 sample Adivasi households in the survey areas. Asset-based socio-economic as well as demographic factors were characterized through descriptive statistics. Wealth ranking exercise showed that from the total sample households (HHs) 10%, 46.7% and 43.3% were better off, medium and poor respectively, clustered into four livelihood strategies with different outcomes and levels of livelihood diversification. In terms of income, the study result(s) indicated that, farm-alone livelihood strategy has/have better outcomes. However, some households were found to be depended on non-farm and off-farm strategies rather than farm-alone. In addition, the multinomial logit model reveals that households' livelihood strategies choice were influenced by sex, age of households' head, educational level of households' head, farm size, ownership of livestock, involvement in local leadership, annual cash income, access to credit, input use, and training. Our study suggests that livelihood strategy choice of an indigenous person household was mostly influenced by socio-economic and demographic factors. Poor households might be engaged in more income generating activities.

Keywords: Bangladesh, Livelihood strategies, Livelihood assets, Indigenous people's households, Multinomial logit model.

Introduction

Indigenous are called first peoples, tribal peoples, aboriginal peoples, autochthons. According to the International Labour Organization (ILO) convention, indigenous people are descent from the population which is inhabited the country[1]. About 370 million indigenous peoples live in more than 90 countries of the world[2]. In Bangladesh, about 2% indigenous peoples, generally called as '*Adivasi*' in Bengali, are living with the mainstream Bengali nationals, along with their distinctive way of life, religions and culture for a long time[3]. The socio-economic profile of *Adivasis* is also very low in terms of education, livelihood, as well as economic and human rights[4].

Livelihood strategy refers the progression of selected events and resources investment for strengthen livelihoods. After computing households' possessions, actions and outcomes; households choose their livelihood strategy and design the interventions focusing on the framework in which households activate and create a favorable situation for their livelihood[5]. Agriculture are seems to be the main source of income for rural household livelihood. However, from the last three decades some non/off-farm activities are also taking place as a livelihood strategy especially for the poor household[6-8]. Households may generate not only total cash income but also fulfill their nutritional requirement through Livestock and poultry production. In Bangladesh livestock is contributing at national level; the share of livestock to the agricultural GDP has been rising steadily which is at present 11% of agricultural GDP[9]. In the developing world small-scale livestock systems has a great opportunity to improve the productivity as well as economic growth[10,11]. Livestock products (such as eggs and milk) are only the farm products which can harvest throughout the year, it also provides flexible reserve during economic stress and serves as a buffer against crop failure, earns foreign exchange through exports of by-products and improves trade balance, and thereby enhances the sustainability of rural livelihood[12].

Indigenous community's rural households depend on various types of livelihood activities. Most of the households depend on one or a few strategies, while some expand their livelihood strategies. The livelihoods of indigenous people are closely connected with livestock rearing activities and they have distinct technique / knowledge for raising livestock. However, different asset based socio-economic and demographic characteristics and some exogenous factors such as market, price and technology that influence a household's dependency on economic activities, particularly on livestock rearing. Therefore, it is essential to understand the specific factors that influence a household's

livelihood strategy choice and its reliance on livestock rearing for socio-economic development of the indigenous people of Bangladesh.

A good number of research works related to various income generating activities have been done but literature show that studies on livestock raising among indigenous community have not yet gained much importance among the researchers particularly to the aspect of their livelihood sustainability. The objectives of this survey are to identify the role of livestock rearing on household's cash income and the livelihood strategy choice determining factors. Different types of livelihood activities as stated in livelihood framework and household's cash income mainly depends on assets endowment and its disposal[13,14]. Therefore, it may be hypothesized that households with less livelihood assets are mostly depends on income generating activities. In the socio-economic point of view of the indigenous community of Bangladesh, this is rational that household choice depends on maximum utility of asset endowment and thereby maximizes livelihood outcomes. According to Brown et al[14], a household generate its income by distributing its asset through different livelihood activities such as farming (agriculture and livestock rearing) or farm + non/off-farm activities. Therefore, it may be assumed that household's choice on farm-alone or a combination of farm + non/off-farm activities mainly depends on the household's capabilities and assets endowment.

This hypothesis was tested through an econometric model (multinomial logit model) analysis using 300 random sample data of indigenous people's households of Bangladesh and based on the identified asset-based independent variables which are the main determining factors of household's livelihood strategy choice. Application of econometric model analysis to the livelihoods framework allows assessing the quantitative importance of asset-based factors and the constraints of the whole study. Finally, our analyses indicate that asset-based socio-economic and demographic characteristics as well as differential access to, or endowment of, resources are the main determining factors of livelihood strategies choice.

Conceptual framework and livelihood assets for livelihood strategy analysis: In this study, the 'sustainable livelihood approach' as a framework of analysis was applied to obtain the widespread notion of the rural household's livelihood strategy choice, and the asset-based socio-economic factors that influencing the strategy choice. The main objective of sustainable livelihood approach is to focus on households' entrance to different livelihood assets/capitals (natural, human, physical, social and financial) and the asset-based socio-economic factors and their relationship on indigenous people's livelihood strategy choice[15-17]. A household may pursue various types of livelihood strategies depending on differential access to, or endowment of, resources and make the livelihood more sustainable. Therefore, a rural household may engage in farming activities as an economic choice based on its resource endowments, household socio-economic characteristics and some exogenous factors. Figure-1 presents the main framework of the livelihood strategies and their relationship with the livelihood assets-based factors like human capital (sex, age, education, family size and dependency ratio), natural capital (farm land size), physical capital (livestock holding, input use and household distance from market), financial capital (access to credit and total cash income) and social capital (participation in co-operative, leadership and receiving training). Center of the framework in the Figure-1 is the object of this study: a household's livelihood strategies. The framework indicate that a household's engagement in a particular activity or combinations of activities is mostly depends on its asset/capital holding or access to assets. These factors are resulting to sustainable livelihood outcomes. Besides this, natural disasters or vulnerability such as sudden death of household head, floods and over rainfall in turn can affect the livelihood outcomes and to overcome this situation household taken some copping strategies like selling off livestock, land and tree, saving household expenditure and taken loan from friends and relatives. Sustainable livelihood approach mainly provides an intangible descriptive statistics on livelihood strategies and their relationship with the livelihood assets-based factors. Subsequently, econometric model analysis denotes the static impact of asset-based socio-economic factors in household's livelihood strategy choice, particularly in livestock resources based on farm activities.

Methodology

In any study/survey, primary data may be accumulated following three procedures; i. Direct observation by surveyor; ii. Questioning to respondents, based on structured interview schedules; and iii. Registers kept by sample households. Usually most of the indigenous peoples' households of rural Bangladesh don't have any records of their cash income, therefore, this study followed the 'questioning to respondents, based on structured interview schedules' method.

Study area selection and the methods of sampling and data collection: The most important pre-requisite for any in-depth study is the selection of specific study area. Keeping in view the key objective as well as limitations of resources and time, in this study, two hilly districts namely Rangamati and Khagrachari and one plain land namely Dinajpur district where the indigenous people are highly concentrated were selected. According to the suggestions of local agricultural officers, Headmen (Chief of the tribal village), Karbari (Chief of Mouza), union council members and other relevant persons, we constructed amultistage sampling frame and final sample has been selected. The sample size for this study was calculated by applying a simplified formula used by Yamane[18] as shown below:

$$n= N/1+N\ (0.09)^2 \quad (1)$$

Where: n=Sample size, N= Total population size (total household size) and e= (0.09) Level of precision. Using this above formula 303 households have been calculated, but to minimize non-sampling error this study only used 300 households as sample.

At first, Rangamati, Khagrachari and Dinajpur districts were purposively selected. Keeping in view the livelihood strategy of indigenous peoples' households, one Upazilla from each district and a total of 13 villages were selected randomly. Out of these 13; 6, 5 and 2 villages were taken from Rangamati, Khagrachari and Dinajpur districts respectively. Easy road communication and less risk were also considered for smooth data collection. In this survey, both qualitative and quantitative data were used. A structured interview schedules was used for the collection of primary data from sample *Adivasi* households, while, the secondary data was accumulated from different relevant secondary sources. The structured interview covered *Adivasis* livelihood, such as socio-demographic characteristics, economic empowerment, skill development, and participation in local institutions.

Methods of data analysis: Keeping in view the key objective as well as the nature of data available, different approaches of data analysis; descriptive and the econometric model were applied in this study. In case of descriptive analysis mean value, percentages and standard deviations were used to describe various aspects of sample respondents. Inferential statistics includes: one way ANOVA (F-test) and chi-square. Chi-square was used for only two categorical variables, while, to calculate the significant differences in mean value of more than two categories/ explanatory variables one way ANOVA (F-test) was used. To identify the factors that influences household's livelihood strategies choice, we used an econometric model (multinomial logistic regression) analysis where the livelihood strategies act as dependent variables and found to be multi outcome. Statistical Package for Social Sciences (SPSS) version 20 and STATA 11were used for data analysis.

Multinomial logit (MNL) model specification: In case of more than two alternatives of a dependent variable and the household has to choose one (polytomous variables), we may use an econometric model which might be either multinomial logit or multinomial probit regression model. To assess the impact of descriptive variables upon dependent variable concerning numerous adoptions with un-organized response groups both of the models might be used[19]. However, multinomial probit is seldom used in empirical calculation as because of assessment difficulty to solve numerous incorporation associated to multivariate regular distribution[20]. Moreover, multinomial logit analysis displays a greater aptitude to calculate livelihood diversification and selection the variances between the livelihoods strategies of rural households[21]. It is a simple addition of the binary choice model for minimal outcomes. Therefore in this study, we engaged a multinomial logit model specification. This model made analysis of the determinants that inducing household's choices of livelihood activities regarding various choices. The multinomial logit model for a various choice problem is specified as follows:

According to Greene[19], when the i^{th} respondent faced with j choices, the utility choice may specify j as:

$$U_{ij} = Z_{ij}\,\beta + \varepsilon_{ij} \qquad (2)$$

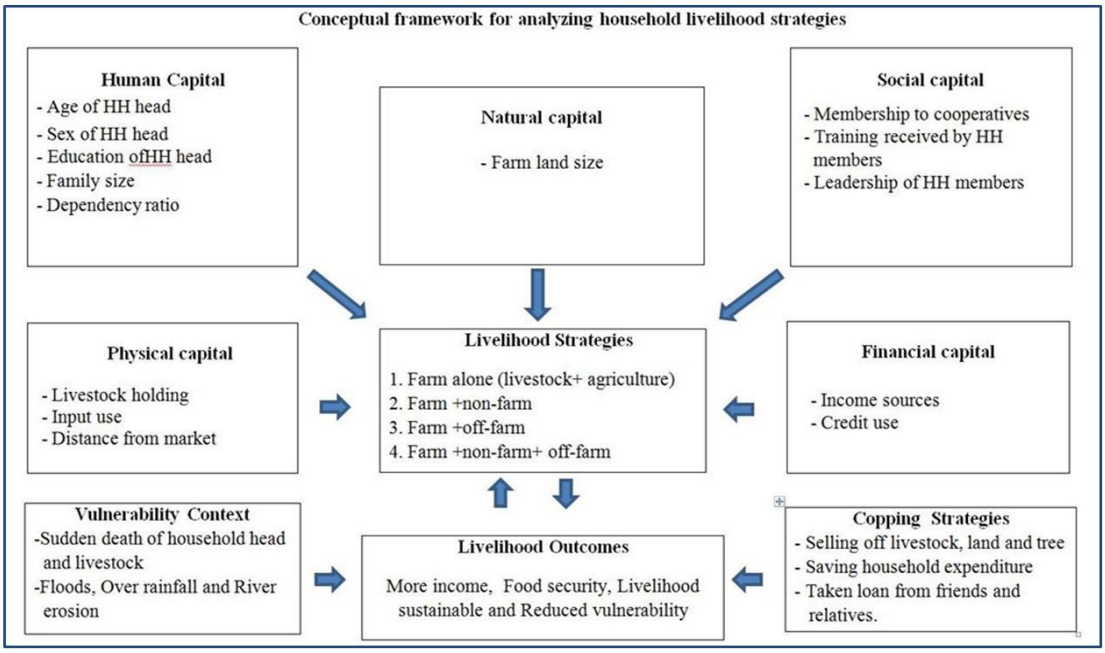

Figure-1: Conceptual framework of sustainable livelihoods approach[16].

When the respondent's choice particularly is j, it may be speculate that among the j utilities Uij is the maximum. Therefore, the probability may be derived that choice j is made as follows:

$$\text{Prob}\ (U_{ij} > U_{ik}) \text{ for all other } K \neq j \quad (3)$$

Here;
U_{ij} is for the maximum utility of i^{th} households when livelihood strategy is j, U_{ik} is for the maximum utility of i^{th} households when livelihood strategy is k.

When household's maximum utility depends on income, then livelihood strategy choice become an optimal provision and asset based, which maximizes the utility of livelihood strategy choice[14]. Therefore, livelihood strategy choice of i^{th} household's may be modeled by maximizing the utility of the j^{th} livelihood strategy between J strategies as follows:

$$\max_j = E(U_{ij} = f_j(x_i) + \varepsilon_{ij}\ ; j = 0 \ldots J \quad (4)$$

For J livelihood strategies, where the choice of i^{th} household's maximizes the utility of j^{th} livelihood strategy could be taken the value 1 and 0 otherwise. When a household with x characteristics and chooses j livelihood strategy, then the probability P_{ij} may be modeled as follows:

$$P_{ij} = \frac{\exp(Xi\beta j)}{\sum_{j=0}^{J} \exp(Xi\beta j)} = j=0 \quad (5)$$

Along with that $\sum_{j=0}^{J} Pij = \text{for any } i$

Here; P_{ij} = Probability of i^{th} household's falling into j strategies, X = Probability response predictors, β_j= For j^{th} response category, covariate effects specification.

Normalization is assumed $\beta 1 = 0$ which removes indeterminacy in the model (this ascend because probabilities sum = 1, therefore, only J factors are needed to define the J + 1 probability)[22]. Thus, exp Xiβj = 1 suggesting that the general equation (5) above is equivalent to:

$$\text{Prob}\ (y_i = j/x_i) = P_{ij} = \frac{\exp(Xi\beta j)}{1+\sum_{j-1}^{J} \exp(Xi\beta j)},\quad j=0, 2 \ldots\ldots J$$

and

$$\text{Prob}\ (y_i = j/x_i) = P_{ij} = \frac{1}{1+\sum_{j-1}^{J} \exp(Xi\beta j)}, \quad (6)$$

Here; y = A variable which categories with 0…J and polytomous in nature.

Note: The probability Pi1 is resulting as the limitation that the J probabilities sum =1. That is, Pi1 = 1− Pij. Like a binary logit model J log-odds ratios may be calculated and specified as follows:

$$\text{In}\ [pij/piJ] = x'\ (\beta j - \beta J) = x'\beta j, \text{ if, } J = 0 \quad (7)$$

Coefficient interpretation: Multinomial logit model and binary logit models are almost same in case of interpretations, thus multinomial logit model is considered as the extension of the binary logit models[23]. During multinomial case the provability assessment is made between j and J strategies (between any strategies with the last). In the multinomial model marginal effects are measured and thereby predicted probability assessments become more interpreted[24]. Therefore, in every marginal effect contains the sub vector of β, either as a probability or a weighted average and that may be appeared asδ_{ij}. The marginal effect and probabilities of the individual character may be obtained by differentiating equation (7) with respect to the covariates and specified as follows:

$$\delta_{ij} = P_{ij}\ \partial\ [\beta - \Sigma 1_j = 0\ P_{ij}\beta_j] = P_{ij}\ [\beta - \beta -] \quad (8)$$

Here,
δ_j is used as a marginal effect, when the explanatory variable and the probability depends on j strategies.

Multinomial logit model and the explanation of the variables: Different livelihood strategies pursuit by indigenous people households are considered to be the dependent variable and the households were grouped on the basis of their choice of livelihood strategies. Therefore, for multinomial logit model we hypothesize the polytomous dependent variable with the following values: when the strategy choice is farm-alone (livestock + agriculture) then Y=1; when farm + non-farm then Y=2; Y=3, when the choice is farm + off-farm and when the strategy choice is the combination of farm + non-farm + off-farm then Y=4. Expected sign, measurement as well as the definition of independent variables are mentioned in Table-1.

Results and discussion

Descriptive analysis: During explanative and inferential analysis, some dissimilarity were identified between four livelihood groups in terms of households' assets (human, social, physical, financial and natural) based factors that affect the choices of livelihood strategies pursued by rural household. F-tests (ANOVA analysis) were used to compare the mean values of continuous variables in all livelihood groups. Subsequently, Chi-square tests were used to examine the statistical difference between the four groups of households. The results revealed that the four groups significantly differ to some extent in the terms of households' social, economic and institutional characteristics. According to F-values, 5 independent variables, namely educational level of household head (HHH), family size, land size, ownership of livestock and total annual cash income were found to differ significantly among the four groups (Table-2). The households who were pursuing farm-alone as their

livelihood were found to be relatively better land size than the others, with a significant ($p<0.10$) mean value of 1.21 hectare, while it were 0.95, 0.62 and 0.50 hectares respectively, for the rest three groups. Livestock holding was another important household characteristic which was sometimes considered as the scale of wealth measurement of sample household. The total mean value of the ownership of livestock in Livestock Unit (LU) is 2.16 LU for the households of the study. Proportionally, those household depending on farm-alone for their livelihood owned almost twice greater livestock than the rest of the categories with a significant difference at less than 1% probability level. Significant ($p<0.05$) variations were observed between four groups in terms of total annual cash income, and also for household head's educational level and family size at 10% level of significance (Table-2). Accordingly, 3 out of the 6 discrete variables were found to be significantly different among the four categories (Table-3). More specifically, the chi-square test revealed that access to credit, involvement in local leadership and receiving training were significantly ($p<0.01$ and $p<0.05$) different among the four groups.

Household livelihood strategies and wealth category: As mentioned before there are four different types of livelihood strategies pursued by sample households to earn their living and fulfill their objectives for improved and sustainable livelihood. From the survey result it was observed that a significant part, about 53.33% of the total sample households mainly depend on farm-alone (livestock based) livelihood strategies, while the rest (46.7%) part pursue non/off-farm activities along with farming to fulfill their requirement that farm-alone is incapable to do. Out of 46.7% households, about 32.66% derived their livelihood from farm + non-farm activities (Table-4). In this study, total sample households were categorized in three groups based on wealth and the chi-square test clearly indicated the significant ($p<0.01$) difference among that three wealth ranking groups in terms of livelihood strategy choice.

Comparing the three wealth categories, more proportion (83.33%) of better-off wealth ranking households pursue their livelihood based on farm-alone activities, while the same proportion (50%) for poor as well as medium wealth ranking sample households respectively, depends on the farm-alone strategy. About 36.92% of poor and 32.14% of medium wealth ranked households pursue the non-farm livelihood activities. Our results also revealed that besides, farm-alone strategy, most of the poor wealth ranking sample households are engaged in non/off-farm activities. The probable reason for the poor to participate in all kinds of livelihood strategies could be due to their interest to gain their effective outcomes from all kind of activities. However, the better-off wealth categories rely more on farm-alone activities than other livelihood strategies may be due to major asset possession (cultivable land size and livestock) than their counterparts (Table-5). Ghosh and Bharadwaj[25] also showed that the engagement of rural households in non-farm activities is one of the survival strategies.

Household income composition of the livelihood activities: In our study; crop sale (19.5%), income from livestock and the product of livestock sale (33.8%), petty trade (17.8 %) or small business, handicrafts, weaving or spinning, driving vehicles and causal wage were found to be the main sources of annual cash income for the sample households by its share. The study also indicated that a large variation within the groups of households having the same economic opportunities in both the size and sources of income. As shown in Table 5,on-farm activities dominantly pursued by all the three wealth ranking groups mostly by the medium and better off households with increasing share in income. Results of our study also revealed that, in term of income composition the poor households earn their annual cash income from livestock (30.3%), crop (19.7%), daily wages (12.47%), petty trade (13.8%), handcrafts (18.3%) and weaving (3.3%), indicating that poor households are mostly pursue non/off-farm activities as the livelihood strategies with 50% share of cash income. In contrast, the increasing order of income from crop (40.1%), livestock (43.2%), and petty trade (12.1%), indicate the dependency of the better-off wealth ranking sample households' income on the farm-alone livelihood strategies. Likewise, on-farm activities (crop and animal production) were found to be the key sources of annual income for the medium wealth ranking sample households. Due to the endowment of better productive resources the medium and better-off households are engaged in on-farming income activities, while the lacks adequate productive resources influence the poor group to generate livelihood outcomes from non/off-farm livelihood strategies, which is also strengthened by Berry[26].

Livelihood outcomes: Livelihood outcomes refer the overall accomplishments or total returns/outputs of livelihood activities such as: generation of more cash income, improvement of well-being, vulnerability reduction, improvement in food safety and better use of natural assets of the sample households[27;15]. Household's livelihood strategies or activities based on proper use of assets resulting to the household's livelihood outcomes over time[28]. In terms of outcomes of this study, the income shares of the major three livelihood activities, the major income share (53.33%) comes from farm-alone, while the rest of income shares are distributed as non-farm (32.66%), off-farm (9.0%) and 5% from the combined share of non-farm + off-farm activities (Table-4). The results suggest that the poor and medium wealth ranking groups are mainly depending on non/off-farm livelihood activities and these dependency is a survival mechanisms but not viewed as a choice of livelihood strategies and act as a pushing factor in absence of alternative strategies. Therefore, non/off-farming strategies appear more of a coping mechanism rather than f to accumulate wealth and reduce poverty of the indigenous peoples' household. These results also indicate the limitations of the poor and less poor which lead them to pursue non/off-farm activities rather than livestock based on farm activities.

The model result: As specified in the methodology part, multinomial logit model was used for this study to assess the

influence of assumed asset-based (human, natural, social, physical, and financial) factors as the descriptive variables on households' livelihood strategies choice. The dependent variable is the group of households on acceptance of livelihood activities, taking a value of 1 for farm-alone household (n1=160), a value of 2 is for farming + non-farming (n2=98), a value of 3 for choosing farm + off-farm activities (n3=27) and a value of 4 for combined choice like farm + non-farm + off farm (n4=15) (Table-4). This study used the variance inflation factor (VIF) as well as the contingency coefficients to examine the grade of multicollinearity and connotation among descriptive variables, respectively. In addition, Hausman assessment[29] was used to test the rationality of the independence of the irrelevant alternatives (IIA). Based on this supposition the test result accept the null hypothesis of independence of livelihood strategies and approve multinomial logit model (MNL) specification for analyzing determinants of livelihood strategy choice among the group of households. From the MNL model approximation of parameter only deliver the direction of the effect but not reflect the actual magnitude or unit probability change of the independent variables on the dependent variable. Therefore, statistically significant unit probability change might be measured only through the marginal effects from the MNL[19,20]. The maximum likelihood test ratio statistics indicated by the chi-square test (sign. = 0.0000) is greatly significant, might be proposed that the model has strong explanatory power. In all cases, the first alternative farm-alone (livestock rearing + agriculture) was used as a base category to estimate coefficients of choice with other three alternatives.

Table-1: Definition of variables used in MLM and expected sign.

Variables	Description and measurement	Expected sign
Dependent variable		
Y=1, Farm alone	On-farm (Livestock +Agriculture)	
Y=2, Farm + NF	Combination of Farm and non-farm	
Y=3, Farm + OF	Combination of Farm and off-farm	
Y=4, Farm + NF +OF	Combination of Farm +non-farm + off-farm	
Code	Definition of independent variables	
SEXOHHH	Sex of household head is a dummy variable (0= Female, 1= Male)	-ve
AGEOHHH	Age of household head in years	+ve
EDULOHHH	Household head's education level	+ve
FAMSOHH	Family size of the household in number	+ve
DEPRATIO	Dependency ratio of the household	+ve
LANDSIZE	Land size owned by the household in hectares	-ve
LIVESHOL	Livestock hold by the household in livestock unit (LU)	-ve
DISTFNMAR	Distance of the market from the household(kilometer)	-ve
CREDACC	Credit accessed by the household (0= No, 1= Yes)	-ve
LEADER	Households involvement in social leadership (1= Yes,0= No)	+ve
MMTCOOP	Membership of the household in cooperatives (1= Yes,0= No)	+ve
INPUTUSE	Farm input use by the household (1= Yes,0= No)	-ve
TRAIN	Training received by the household (1= Yes,0= No)	-ve
INCOME	Total annual cash income of households (1USD = 75 Taka)	+ve

Table-2: Descriptive statistics for continuous independent variables.

	Livelihood strategies of the household						
Variable	Farm only	Farm +NF	Farm +OF	Farm +NF +OF	Total	F-value	P-value
	Mean	Mean	Mean	Mean	Mean		
AGEOHHH	45	42.30	51.00	40.2	46.92	0.67	0.45
EDULOHHH	1.26	2.00	1.16	2.21	1.29	2.11	0.087*
FAMSOHH	4.78	3.60	4.70	3.56	4.56	2.47	0.093*
DEPRATIO	1.40	0.75	1.88	1.73	1.64	2.12	0.12
LANDSIZE	1.21	0.95	0.62	0.50	0.97	1.61	0.084*
LIVESHOL	2.14	1.62	0.98	1.10	2.16	9.65	0.001***
DISTFNMAR	5.87	4.64	5.03	4.11	5.56	0.36	0.76
INCOME	89200.0	69220.5	47000.7	51600.7	67110.24	(χ^2=14.9)	0.025**

Source: Survey result, 2016. ***, ** and * represent the level of significance at 1%, 5% and 10% probability respectively.

Table-3: Descriptive statistics for discrete independent variables.

Variables	Response	Livelihood strategies of the households (%)						
		Farm alone	Farm +NF	Farm +OF	Farm +NF +OF	Total	χ^2	P-value
SEXOHHH	Male	75.42	100	89.69	53.33	80		
	Female	24.58	00	10.31	46.67	20	7.94	0.58
CREDACC	Yes	24.43	83.33	7.21	53.33	22.7	17.21	0.001***
	No	75.57	16.67	92.79	46.67	77.3		
LEADER	Yes	93.29	94.73	95.23	100	94	11.03	0.001***
	No	6.71	5.27	4.77	00	6		
MMTCOOP	Yes	49.04	54.79	25.86	41.66	45.66	3.76	0.51
	No	50.96	45.21	74.14	58.44	54.34		
INPUTUSE	Yes	40	30.61	41.66	53.33	37.66	1.33	0.67
	No	60	69.39	59.44	46.67	62.34		
TRAIN	Yes	92.61	89.69	100	71.42	91	7.69	0.031**
	No	7.39	10.31	00	28.58	9		

Source: Survey result 2016, *** and ** represent the level of significance at 1% and 5% probability respectively.

Table-4: Livelihood strategies of sample households by wealth category.

Livelihood strategies	Total sample		Poor (N=130)		Medium (N=140)		Better off (N=30)	
	n	%	n	%	n	%	n	%
Farm alone	160	53.33	65	50.00	70	50.00	25	83.33
Farm + NF	98	32.66	48	36.92	45	32.14	5	16.67
Farm + OF	27	9.00	7	19.29	20	14.28	0	0.00
Farm + NF + OF	15	5.00	10	7.69	5	3.50	0	0.00
Total	300	100	130	43.3	140	46.7	30	10
$\chi^2$9.896								
P-value 0.001***								

*** represents the level of significance at 1% probability.

Table-5: Households' total annual cash income composition.

Cash income composition	Wealth category of HH (%)			Total (N=300)
	Poor (N=130)	Medium (N=140)	Better-off (N=30)	
On-farm	50	50	83.3	53.3
Crop	19.7	16.9	40.1	19.5
Livestock and their product	30.3	33.1	43.2	33.8
Non-farm	36.9	32.1	16.6	32.6
Petty trade	13.8	19.3	12.1	17.8
Handcrafts	18.3	7.4	3.4	9.4
Weaving/spinning	3.3	5.4	1.1	4.3
Fishing	1.5	00	00	1.1
Off-farm	13.07	17.8	00	14.00
Daily labor in local area	9.07	1.8	00	8.2
Daily labor near unban	1.7	0.7	00	1.5
Wage labor in other area	1.7	5.2	00	2.1
Driving vehicle	0.6	10.1	00	2.2
Total mean of cash income	52720.17	69970.25	99150.62	67110.24

Table-6: Multinomial logit model results showing households' choice of livelihood strategies.

Variable	Households' livelihood strategies								
	Farm +non-farm			Farm +off-farm			Farm+ non-farm + off-farm		
	Coef.	P-value	Marginal effect	Coef.	P-value	Marginal effect	Coef.	P-value	Marginal effect
SEXOHHH	-.3236	0.517	-.0375	-1.942	0.011**	-.0404	-1.315	0.134	-.0126
AGEOHHH	.0369	0.017**	.0088	.02011	0.556	.00003	.0306	0.414	.00015
EDULOHHH	-.2541	0.001***	-.0584	-.2002	0.041**	-.0016	-.2705	0.012**	-.00293
FAMSOHH	-.1750	0.111	-.0415	-.2651	0.141	-.0041	-.0144	0.942	.0016
DEPRATIO	-.0796	0.716	-.0135	-.2351	0.439	-.0044	-.3963	0.292	-.00709
LANDSIZE	-1.6521	0.011**	-.3587	-2.357	0.068*	-.0346	-2.673	0.082*	-.03713
LIVESHOL	-.4922	0.000***	-.10152	-1.158	0.000***	-.0218	-.8756	0.003***	-.0125
INPUTUSE	-.4064	0.420	-.08349	-1.247	0.069*	-.0239	-.4276	0.573	-.00417
CREDACC	.1429	0.772	.06232	-1.635	0.069*	-.0384	-1.125	0.221	-.02311
TRAIN	-.1907	0.698	-.02013	-.7898	0.278	-.0151	-1.999	0.033**	-.0279
DISTFNMAR	-.0247	0.568	-.0057	-.0782	0.184	-.00149	-.0627	0.377	-.00088
MMTCOOP	-.2263	0.603	-.0557	.3477	0.635	.01060	-.4466	0.588	-.00701
LEADER	-1.128	0.016**	-.2718	-.6025	0.510	-.00113	-.7219	0.452	-.00343
INCOME	.7415	0.013**	.1711	.4650	0.165	.0022	1.016	0.045**	.01291
CONSTANT	-4.1802	0.112		4.078	0.3118		-3.551	0.232	
No. of obs.				300					
Log likelihood				-221.427					
LR $chi^2(58)$				241.13					
Prob> chi^2				0.0000***					
Pseudo R2				0.4013					

***, **, and * stand for significant at 1%, 5% and 10% level. Standard errors and z-ratio are not reported here because of space limitation.

Interpretation of econometric results: From the interpretation of econometric results it was found that among 14 assumed explanatory variables six, six and five variables were significantly affecting the livelihood strategies choice of sample households into non/off-farm activities (Table-6). The reasonable inference and marginal impact of the assed-based factors or significant independent variables on the selection of households' livelihood activities are presented as follows:

Sex (SEXOHHH): Socio-economically negative impact of gender on household's access to assets greatly affects livelihood diversification[22]. In the study, it was found that sex had a negative and significant ($p<0.05$) impact on the diversification of sample household's livelihood strategies choice into off-farm activities. From our results it is denoted that female headed households are not participating in off-farm livelihood strategies.

This result denotes that the households headed by female are less probable to partake in off-farm activities. The probable intention is that female headed households have extra household tasks in family managing. In contrast, male headed households have more propensities to increase their income by means of diverse strategies. When other possessions keep constant, the probability of a household expanding into off-farm strategies reduces by 4% in case of female head household. These findings are also supported by the result of Ellis[8] and Adugna[24].

Age (AGEOHHH): The household head's age positively and significantly ($p<0.05$) affects the household's livelihood strategies choice into farm + non-farm activities. This study indicates that old aged farmers are very much interested to expand the income strategies into non-farming activities. The probable justification for positive association is that as age increases farmers have more chances to have more children, this in turn helps availability of labor to engage in diverse activities. The second reason, the increment in the number of children may result in more family members and this can create more demand for basic necessities. From the model result, if other variables remain constant, the likelihood of a household strategies choice into off-farm activities is amplified by 0.8% with a unit change in age. This result is consistent with previous studies[30,8], that show household-head age is the main driving force towards livelihood diversification.

Household head education level (EDULOHHH): Achievement through education illustrates one of the most significant factors of income earning from non-farm activities. This study indicates that education level of household head negatively and significantly affects the household livelihood strategies choice into non-farm, off-farm and a combination of non-farm + off-farm strategies at 1% and 5% level of significance, respectively. This result opposes the prior expectation that, household heads with a level of education have more chance to contribute in non-farming activities; consequently, this person has more prospects to maintain jobs in non-farm than on-farm. The potential clarification is that most of the sample household's head attained normal education with below primary level which not adequate to be officially working, and ability challenging income options. Keeping other variables constant, the probability of a household's expanding into non-farm, off-farm and combination of non-farm + off-farm strategies decreases by 5%, 0.1% and 0.2%, respectively. This is similar to other findings[31].

Farm land size (LANDSIZE): The econometric model results revealed that household's land ownership area has a negative and significant relationship with the livelihood strategies choice into non-farm, off farm and non-farm + off-farm activities at 5% and 10% level of significance, respectively. Therefore it may be suggested that indigenous people households that have more land are more involved in livestock based farming activities and thereby intensifying their annual cash income. The model results imply the possibility of spreading to non-farm, off-farm and combining non-farm and off-farm activities decreases by 35%, 3.4% and 3.7%, respectively, for those farmers with large farm size in hectare. Similar studies by Tesfaye[32] and Mujib et al.[33] reveals that insufficient arable land sizes have a positive and significant association of household's livelihood strategies diversification into non/off farm activities.

Livestock holding (LIVESHOL): Livestock is a core and liquid asset for improvement of livelihood. This study indicates that the possession of livestock in LU negatively and significantly affects the household livelihood strategies choice into non-farm, off-farm and a combination of non-farm + off-farm strategies at less than 1% probability levels. The results directs that a household having bigger size of livestock are less probable to expand the living strategies into non/off-farm activities in compared to small number of LUs pursuers. In the study area, mainstream of indigenous people's household depend on livestock production for their farm income. The income produced from livestock helps households to accomplish family prerequisite including food. Here, households who can get the essential quantity of foodstuff from livestock product may not implicate in additional income producing activities because of their objective is to intensify their asset holding. Instead, households that has insufficient livestock they are expanding their sources of income assortment by partaking into non/off-farm livelihood activities and thereby hasten the degree of divergence. Rendering to the study, when other variables are constant, the likelihood of expanding the livelihoods to non-farm, off-farm as well as the combination of non-farm + off-farm strategies are decreases by 10%, and 2%, 1% respectively, in compare to those household with more LU. Different previous studies also support this notion[24; 34].

Inputs use (INPUTUSE): Use of improved farm inputs like chemical fertilizer, quality seeds and improved breed of livestock has negative and significant ($p<0.10$) inspiration on the household choice of selecting expanded income approaches into farm + off-farm strategies. Study results denotes that the households with significant access to use of recent farm inputs are less probable accept farming with off-farming activities as a livelihood strategy than those who have no contact. The probable explanation is that using current technology most possible increase the invention and efficiency of crops and livestock product, and this can support household to get admission to more food and produce more income to facilitate their family necessities. When other factor kept constant, the model result exhibited that the likelihood of selecting farm with off-farm activities is decline by 2.3%. This study drives along with the result by Woinishet[35] and compete with the conclusion by Adugna[24] in that use of agricultural input positively associated to livelihood diversification.

Access to credit (CREDACC): This study revealed that Access to credit negatively and significantly affects the household's livelihood strategies choice into off-farm activities at 10% level of significance.

Our results suggest that the probability of contributing in expanded income strategy decline by 3.8% for a household who have the access to credit. From these negative influences it may be recognized to the statistic that the use of credit permits families to monitor on-farm strengthening by retrieving farm efforts which finally may expands the output, which is similar to other findings[36].

Training (TRAIN): The model result indicates that training on agricultural and livestock rearing had negative and significant influence on livelihood strategies choice into the combination of non-farm + off-farm livelihood activities at 5% probability level. The probable reason is that training enhances skills, knowledge and experiences, which help households to get better production, and thereby leads to obtain more income to fulfill their family requirements. The finding of the model result also depicts that, when other factor kept constant, the chance of diversifying the income strategies into the combination of non-farm + off-farm activities drop by 2.7%. As opposed to this study, Dilruba and Roy[30] indicate the positive association of training and livelihood diversification.

Leadership of household head (LEADER): Household head's participation in local leadership positively and significantly ($p<0.05$) inspire household livelihood strategies choice into non-farm activities. The study results infers that household head's participation in leadership activities influence them to expand living strategies into non-farm strategies. The conceivable cause may be household heads' sharing in local leadership may help to gather informative knowledge and experience. Other factors kept constant, the marginal effect of the model result shows that the probability of choosing farming with non-farming as a livelihood strategy is amplified by 27.1% for the household who have the participation in leadership activities. This finding is also supported by the results of Dilruba and Roy[30].

Household cash income (INCOME): As predicted, total annual cash income positively and significantly ($p<0.05$) motivate household livelihood strategies choice into non-farm as well as the combination of non-farm + off-farm activities. The justified cause is that the households with different sources of income can easily engage themselves in different types of non/off-farming activities and able to earn more income and that increased income leads them to invest in more income generating activities. Other factors kept constant, the marginal effect of the model result shows that the probability of choosing non-farm and the combination of non-farm + off-farm as a livelihood strategies are amplified by 17.1% and 1.2%, respectively for the households who have the participation in diverse livelihood activities. This finding is also supported by the results of previous studies[35,37-38].

Vulnerability context and household copping strategies: Vulnerability denotes to changeable actions that can weaken livelihoods and cause people to fall into poverty or hardship. Some of these measures have an unexpected commencement (e.g. cyclones) while others change over a long period (e.g. soil fertility, conflict), but all can have undesirable possessions on livelihoods[39]. *Adivasi* community is generally a very vulnerable group. Naturally this group is more prone to crisis events such as sudden illness or death of household head or natural disasters as they rarely have any means of tackling let alone overcome such situation on their own, and naturally in the event of such crises, they are plunged into even deeper poverty[4]. Different types of natural disasters or crises, e.g., over rainfall, flood and river erosion (especially for plain-land) or accidental death of livestock animals were faced by *Adivasi* households. They also reported that robbery or land disputes frequently happened.

Adivasi are not always able to cope with the difficulties that they face[4]. In the study, we found the number of incidences where the *Adivasi* households resorted to a negative or harmful coping strategy for instance selling off their mainassets like livestock, poultry, land and tree to cope with crisis. Besides they also practiced such kind of the positive coping mechanisms in any crisis, i.e. use of saving household expenditure and informal assistance like taken loan from friends or relatives.

Conclusion

Using data from 300 sampled rural households of indigenous people in Bangladesh, four livelihood strategies are identified and analyzed; on-farm (livestock rearing + agriculture), farm-alone plus non-farm, farm-alone plus off-farm and the combination of farm + non-farm + off-farm. On the basis of study result it is rational to discourse the limitations of the indigenous people households in selecting livelihood activities and the linkages of farm with non/off-farm also need to be considered as well. Though, agriculture has a vital role as a source of income for livelihoods of indigenous people households. However, due to small farm size, uncontrolled population growth, land topography, environmental disaster; the total production from crop is declining day by day, and for this reason livestock took place as an alternative income earning option other than farming activities. In addition, the contribution made by non-farm or off-farm activities to indigenous people households is important for the poor wealth ranking group, although these livelihood activities and these dependency is a survival mechanisms but not viewed as a choice of livelihood strategies and act as a pushing factor in absence of alternative strategies.

According to the survey results, total annual cash income positively and significantly ($p<0.05$) motivate household livelihood strategies choice into non-farm as well as the combination of non-farm + off-farm activities. The households with different sources of income can easily engage themselves in different types of non/off-farming activities. However, the better the land size and more livestock possession has the more tendencies for household to pursue farm-alone income strategy with significant outcome in case of total income as well as food-

security rather than diversify their livelihood activities with a broad option. The results of this study also indicate that low resources endowments was main characteristics of poor wealth groups and this insufficient resource could not enable them to generate sufficient livelihood outcome. To overcome the situation, mainstream of poor wealth ranking households pursue other livelihood options rather than farm-alone, which is not worthy.

The descriptive and inferential analysis (F-test, chi-square econometric models) displayed that among the categories of sample households regarding family size have a significant differences, household head education level, ownership of livestock, land size, income source, and credit access. The econometric model result indicates that out of the 14 hypothesized variables in the model, 10 were found to significantly influence household's adoption of alternative livelihood strategies at 1%, 5% and 10% probability levels. These variables include sex, age, education, farm size, livestock ownership, participation in social leadership, annual cash income, credit access, input use, and training. Consequently, the multinomial logit model results suggest that the household head's contribution in leadership activities as well as the age of household head has a positive and significant association in the choice of non-farming livelihood strategies. However, the level of education of household head, land ownership as well as livestock holding in LU has the negative and significant effect on the livelihood divergence into non/off-farming activities as well as to the combination of non-farm and off-farm livelihood strategies. In addition, the variable income positively and significantly inspire the livelihood strategies choice into non-farm and combination of non-farm and off-farming strategies. Likewise, access of credit and input use had negative and significant influence on the household decision of selecting diversified livelihood strategies into farm and off-farming strategies, while training of household has negative and significant influence on livelihood strategies choice into farm plus non-farm plus off-farm activities.

On the basis of our study results, the subsequent policy recommendations are likely parts of involvement which might assistance to accept best substitute livelihood strategies in the study area. i. Center Government along with other responsible authority may take required steps to produce consciousness across the indigenous people's community to let women and men simultaneously participate in all advance events since sex variable has negative and significant influence on household livelihood strategies choice. ii. More consideration would be paid in increasing household heads' education level through forming and creating formal as well as informal education since education and training have an important role in diversification of livelihood strategies. iii. Center Government along with other responsible authority may take required steps for the improvement of livestock sector by accumulating improved breeds, better veterinary services, improved forage, easy marketing facilities, credit access facilities and enhanced the livestock production that aimed at improving rural household welfare in general and food security status. iv. The significantly negative impact of land size on the divergence of livelihood strategies choice suggests responsible authority to take necessary steps especially for land asset-poor households. v. Policy formulation to cover the approach to resolve socio-economic difficulties by evolving and strengthening cost-effective organization and encouraging more income generating opportunities due to the strong positive association of total annual cash income on livelihood strategies of the household. vi. Timely promoting credit access and adequate supply of modern technology and extension services to curb the strong negative association of credit access and input use with the diversification of livelihood strategies into non-farm as well as off-farm activities.

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