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DIVERSIFICATION OF LIVELIHOODS AND ITS IMPACT ON THE WELFARE OF TRIBAL HOUSEHOLDS IN DINAJPUR DISTRICT OF BANGLADESH

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ABSTRACT

This study aims at identifying the factors affecting their diversification of livelihood as well as to examine the effect of livelihood diversification on their household welfare. Considering the tribal people living area, six villages were purposely selected from the Sadar Upazila of Dinajpur district and then a total of 100 samples were collected by using pre-testing survey questionnaire with help of random sampling technique. Descriptive statistic, logistic regression and Ordinary Least Squared (OLS) were used to analyze the collected data for achieving the ultimate objective of the study. The result revealed that household size, age, farming experience, education, and training received, credit access and numbers of dependents are the statistically significant influencers for adoption of the livelihood diversification. The study also showed that diversification, age, religious status, marital status, education has positive significant effect on the household welfare of tribal people whereas numbers of dependents and land ownership of the tribal people have significant ($p \leq 0.01$) negative effect on their household welfare. This study also suggests that policy makers and authorities should facilitate them with more educational facility, sanitation, training on self-development skills and self-employment for the betterment of their living standards.

Keywords: Household welfare, livelihood diversification, logistic regression, tribal people

I. INTRODUCTION

Bangladesh is the arena's maximum densely populated country and has a wealthy tribal presence. It has 1.2 million tribal people and there are approximately 58 tribes living in different parts of Bangladesh. Most of the indigenous people of Bangladesh are living in the Chittagong Hill tracks. The lifestyle of indigenous people is enormously attractive. They prefer to lead a very simple life. Women seem to be more hard-working than males (Barau *et al.*, 2019). Livelihood diversification plays a very significant role in the rural livelihood system. It is crucial to analyze the importance of livelihood diversification as it alleviates poverty and vulnerability, generates more income, enhances welfare, and promotes sustainable livelihood outcomes and the economic growth of a country (Alobo-Loison, 2015). Livelihood diversification refers as a procedure by individuals and households with the motive to find out some innovative ways that increase income, minimize both poverty and environmental risk, and

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improve their standards of living. It is regarded as an effective avenue that promotes the lifestyle of poor people in rural Bangladesh (Khatun & Roy, 2016). Livelihood diversification comprises different types of livelihood activities such as livestock, crops, poultry farming, off-farm activities and on-farm activities. On-farm activities consist of farming and agricultural production whereas off-farm activities include casual labor, migration, handicrafts, construction, business and personal services (Mahama & Nkegbe, 2021). As an agrarian economy, agriculture is considered as the key source of livelihood of the rural Bangladeshi people (Rabbani and Ahmad, 2021). Now, diversification in livelihoods is a matter of concern. Due to population explosion, income generated from agriculture has come under pressure. Most importantly, it is risky to depend only on agriculture due to fluctuation in weather risk and output price (Ahmed *et al.*, 2015). For this reason, rural households in Bangladesh are diversifying their livelihoods from agriculture to non-farm activities such as non-farm wage labor, business, agro-processing and cottage industries, construction, and other services. Shift towards off-farm activities are capable of reducing risk associated with income volatility (Salam and Bauer, 2020). To eradicate poverty, rural households diversify their income sources for ensuring sustainable livelihood.

The ethnic people hold a very significant place in the culture and economic growth of the country. The necessity of examining the sustainable livelihood of indigenous people is on rise. Hence, Dinajpur district which is Northern part of Bangladesh has been chosen as our study area. Indigenous people those who live in this upazila are Santals, Oraon, Mahali, Malpahari, Kol. Santal people are one of the most primitive and largest indigenous communities. These indigenous people are more vulnerable, poor, and victims to inequality and injustice. The businessmen and the Mahajan control them and the powerful landlords seize the land and assets by forcing them. They have lack of education, job opportunities, well-developed infrastructure, health sanitation and sufficient income sources. Caritas Bangladesh is one of the predominant organizations that work promptly to help the indigenous people. The intentions of this organization are to improve livelihood, enhance food security and make traditional community stronger. The indigenous people of Bangladesh are more vulnerable to poverty and their socio-economic condition is pathetic as compared to other citizen of the country (Barau *et al.*, 2019). As the poverty in Dinajpur district is increasing day by day, diversification of income sources can play a vital role to reduce poverty and increase the level of household well-being in the studied area. The aim of this paper is to find out the significant influencing factors of livelihood diversification along with examining its impact on the livelihood welfare of tribal people.

The key determinants of the diversification of livelihood are land holding size, educational status, livestock holding, sex, age, market distance, credit access, and annual income, access to training and household sizes (Abebe *et al.*, 2021 and Bora, 2020). This diversification of the livelihood has both short run and long run effect on the household. The variation between the short term and long-term effect varies depending on the existence of human, natural, financial and capital assets by the persons (Mahama *et al.*, 2021). On average, several variables including diversification of livelihood, age of the respondents, education of the respondents, credit availability for the respondents have found positive effect on the welfare of the household whereas household size has negative effect on the welfare of household (Akaakohol *et al.*, 2014; Quli 2017 and Roy and Basu 2020). To investigate the livelihood determinants and the livelihood diversification of rural households in two districts (Moulvibazar and Sylhet) Shan and Ahmed (2020) applied logit methodology, Simpson diversification index, and Descriptive statistics for data analysis. Similar methodology used by Rahman *et al.* (2019) who basically investigated the impact of loan profile (credit) on the food safety and livelihood of the tribal

people in Matiranga Upazila of Khagrachari in Bangladesh. Jannat *et al.* (2019) employed Simpson Livelihood Diversification Index, Perception Index (PI) and Agricultural Modernization Index (AMI) for examining the effect of agricultural modernization of sustainable livelihood among the tribal and non-tribal farmers of two districts namely Mymensingh and Sherpur in Bangladesh. Suchiradipta *et al.* (2018) studied about the dynamic forces of livelihood diversification about the rural tribal youth of Gomati and Dhalai in Tripura state of India where they measure the impacts of socio-economic elements on working diversification of youth tribal. Islam and Quli (2017) sought to measure the livelihood diversification policy of tribe's people in Jharkhand for their socio-economic development whose livelihood depends on the forestry.

In this study, firstly, we attempt to identify the socio-economic condition of tribal people living in Dinajpur. Second, we examine the determinants of livelihood diversification in the sampled areas. Finally, we also estimate the effect of livelihood diversification on households' well-being of tribal people living in the study areas. The policy makers, planners, and researchers should have to take some drastic steps to evaluate tribal people more appropriately for how they survive as well as deliver them beneficial information with living standard.

II. MATERIAL AND METHODS

2.1 Study areas

The exact location of Dinajpur sadar is 25.6333⁰N 88.6500⁰E which is nearly 354.34 square-kilometers. Dinajpur sadar upazila is surrounded by Kaharole and Khansama upazilas on its north side, while the east side by Chirirbandar upazila, south side bounded by West Bengal, India and the west was surrounded by Biral upazila (Figure 1). This study was concerned with the tribal people living in the Dinajpur sadar upazila.

2.2 Sampling and selection of sample

This study is based on both primary and secondary data. For primary data, this uses a multistage sampling procedure in which at first stage, Dinajpur district is selected, and then at the second stage, an upazila that is Dinajpur sadar upazila is selected since most of the tribal people are living here according to District office. Then at the third stage, six villages of Dinajpur sadar Upazila namely, Ituapara, Dighipara, Gobindopur, Majiyapara, Gormollikpur, Khosalpur where mostly tribal people are living are indicated. Finally, 100 samples were randomly collected from the six villages

2.3 Data collection procedure

The primary data were collected by field survey and secondary data used in this study collected from different published sources such as previously published articles, newspapers, books and so on for development and enrichment of the study. Questionnaire was prepared in local language for better understand by the respondents which includes basic introduction and information related to respondents, demographic and socioeconomic information, information related to income diversification and then perception, problems and recommendation regarding income diversification and household welfare. Primary data were collected randomly from sampled areas by direct face to face interview with the respondents. Before starting main survey, a pilot survey of two days was done and after giving 3 days training on the data collection for seven MSS students of economics department, Hajee Mohammad Danesh Science and Technology University with corrected questionnaire, Data were collected from 100

sampled tribal randomly during October and November of 2021 where 10 respondents were taken from Ituapara, 15 from Dighipara, 41 from Gobindopur, 9 from Majjiyapara, 16 from Gormollikpur and 9 from Khosalpur villages randomly. The largest sample was taken from Gobindopur because the inhabitants living in the Gobindopur is larger compared to any other villages. The study area is shown by a map given below where the study area Dinajpur sadar is indicated by red arrow (Figure 1).

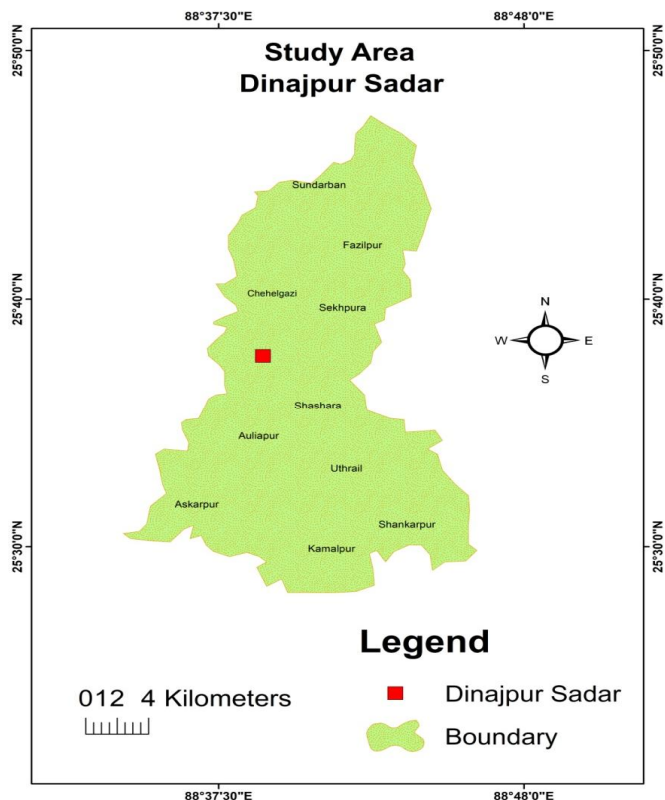


Figure 1. Map of the study area

2.4 Analytical techniques

The analytical part has been divided into two parts according to the objectives of this study: one consists of determinants of the livelihood diversification by applying the limited variable analysis i.e. logit model whereas the second part consists of the effect of the livelihood diversification on the household welfare (taking household consumption expenditure per capita as proxy variable) by using the ordinary least square method (OLS). Since the dependent variable of the first model for identifying the determinants of the livelihood diversification is dichotomous in nature, logistic regression model seems appropriate for the analysis according to the suggestion of Gujarati *et al.*, (2009) whereas, for multiple variable regression analysis having continuous dependent variable, OLS is suitable method for predicting the outcome in presenting the relationship between variables (Leng *et al.*, 2007). This section of the paper describes the process of estimation of the result and accomplishing the objectives of the study in below paragraphs.

Logit Regression Model

Previously huge studies had been done on the determination of the factors that affects the use of the technologies by the farmers in different period of time varying regions such as Adesina *et al.* (1993), Adeogun *et al.* (2008), Karidjo *et al.* (2018) and so on. All of them used logit, probit or multinomial logit or similar models for analyzing the behavior of the farmers to use. They generally used dependent variable as whether the farmers adopt the technology or not. If yes, then s/he gets 1 and 0 for the other case. Padaria *et al.* (2016) emphasized on the logit model for its simplicity and the easiness compared to others. This study applied the logistic regression model for its analysis of the first objective. The dependent variable of the first model pervading in this study is dummy in nature and logistic regression is more widely accepted for dummy analysis, that is why by observing the previous studies this study also used the proven methodology of dummy as logistic regression.

Logit regression analysis examines the influence of various factors on a dichotomous outcome by estimating the probability of the event’s occurrence. It does this by examining the relationship between one or more independent variables and the log odds of the dichotomous outcome by calculating changes in the log odds of the dependent as opposed to the dependent variable itself. The log odds ratio is the ratio of two odds, and it is a summary measure of the relationship between two variables (Olayemi *et al.*, 1995). This study is based on Akaakohol & Aye (2014). For analyzing relationship of the concern variables in our paper, we use logit model due to being a binary variable by following Gujarati (2009). Then the function is as

$$P_i = \beta_1 + \beta_2 X_i$$

$$P_i = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}}$$

For ease of exposition, we have

$$P_i = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}}$$

$$P_i = \frac{1}{1 + e^{-Z_i}} = \frac{e^{Z_i}}{1 + e^{Z_i}}$$

Where, $Z_i = \beta_1 + \beta_2 X_i$

Now considering P_i is the probability of engaged in non-farm income generating activities and $(1 - P_i)$ is the probability of not engaged in non-farm income generating activities, then the linear form of the above function is:

$$Y = \frac{P_i}{(1 - P_i)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots \dots \dots + \beta_{11} X_{11} + \varepsilon_i$$

Where, $P_i/(1 - P_i)$ is the ratio of the chance that a tribal person can be engaged in different income generating activities apart from farming (non-farm work) to the probability that a person will no longer interact in any non-farm income generating activity. The dependent variable for logistic regression is the probability of the respondent for adopting livelihood diversification shown in Table 1.

Information on several socioeconomic characteristics were captured during data collection which may affect the variation of the adoption of the livelihood that include age, sex, educational status of the respondent, number of dependents existing in the household and

so on. Based on the previous studies of Smith (2001), Akaakohol, M. A. & Aye (2014), Ahmed *et al.* (2015), Khatun & Roy (2016), Islam & Quli (2017), Suchiradipta *et al.* (2018), Mahama & Nkegbe (2021), this study employed 11 explanatory variables in the logit model with one response variable which are shown below Table 1 with their specific measurement.

Table 1: Measurement of dependent and independent variables

Variables		vectors	Description
Dependent Variable	Probability of livelihood diversification	Y	1 for a farmer who does at least one non-farm work and 0 for a farmer who did not do any non-farm work
	Marital status	X ₁	1 for married 0 for otherwise
Explanatory Variables	Household size	X ₂	Measured in numbers
	Age	X ₃	Measured in years
	Farming experience	X ₄	Measured in years spending in farming activities
	Education	X ₅	Measured in years of schooling
	Distance to market	X ₆	Kilometers
	Training received	X ₇	Measured in days spend in training
	Land ownership	X ₈	Measured in decimal
	Credit access	X ₉	1 for credit access, 0 for otherwise
	Membership	X ₁₀	1 for yes, 0 for otherwise
	No. of dependent	X ₁₁	Measured in numbers

Source: Field survey, 2021

Ordinary least square (OLS)

To accomplish the second objective that effect of livelihood diversification on the household welfare, multivariable regression analysis of ordinary least square method (OLS) was used. The response variable in the OLS model is the welfare of the household and there are several methods by applying which one can measure the level of the household welfare. They include income method, expenditure method, a price index, real wage function which has advantage of juxtaposition for actual wage (Johanni, 2011). From them expenditure and income method are widely used and accepted method (Lekobane & Seleka, 2017), that is why these paper uses expenditure method for welfare of household.

The OLS model is as below:

$$Y_i = \delta_0 + \delta_1 X_1 + \delta_2 X_2 + \dots + \delta_8 X_8 + \mu_i$$

Where, Y = Household consumption expenditure per capita (in taka); X₁ = diversification (1 if farmer engages in non-farm income generating activity; 0 otherwise); X₂= age of the respondent; X₃ = Religious status measured in dummy variable 1 for Kristen and 0 for otherwise (this is due to most of the people have Kristen religion and others are very few); X₄ = Marital status measured as dummy where 1 for married 0 for otherwise; X₅ = Household size measure in numbers; X₆ = education measured in years of schooling; X₇ = Number of dependents; X₈ = Land ownership measured in decimal; μ_i = the stochastic disturbance term.

Multicollinearity is a problem of linear regression model which implies two or more variables assigned in the model are highly correlated (Daoud, 2017). If the problem is existed in the

model prediction, then the result will not be reliable, and the standard error will be large (McClendon, 2002). If the standard error is large in nature unexpectedly, then it causes some of the explanatory variables being insignificant although in real situation they must be statistically significant if there is no multicollinearity. Thus, this can create biasness in the prediction of the result. Variance Inflation Factor (VIF) is the most commonly used technique to find the intensity of the multicollinearity (Salmerón *et al.*, 2018 and Salmerón *et al.*, 2020). It can be measured with the help of R squared presented in the model as below.

$$VIF = \frac{1}{1 - R^2}$$

Where, R^2 is the unadjusted coefficient of determination for regression the i th explanatory variable on the remaining ones.

III. RESULT AND DISCUSSIONS

3.1 Descriptive statistics

Table 2 shows the summary statistics of the study variables which reflects that age of the respondents on average is 42 years and the minimum aged person is 18 and maximum is 80 years old. This clearly indicates that most of the respondents are young. Educational status of the respondent is on average is near 3 which specifies that most of the respondents are illiterate and have no formal education. A marital status variable indicates that most of the respondents are married in nature. The average household size for all is about 5 whereas the minimum size is 2 and maximum is 9. This clearly indicates the existence of large family. The number of dependents for household is 3 on average and this is due to having child and old aged person prevailing in the family. The average land ownership of the respondents is 3.85 decimal which is very small in general and highest number of land holding is about 85 decimal and lowest is 0. This is because most of the tribal people have no land, and they have to depend on the lands allotted by Missionary or their religious group or other organizations including government and non-government. Credit access is also noticeable for them. Average distance of the household from the nearest market is about 0.954 kilometer whereas the highest distance is captured is as 4 kilometers from their living place. The average monthly household income for them is identified as 16468 taka whereas the highest is 32400 taka per month and lowest monthly income is captured as 3400 taka. This amount is very low leading a life in modern time. This is because they mainly work in agricultural sector with very low wages. The average monthly expenditure for them is 11943 taka whereas the lowest amount is 3200 taka monthly and the ceiling amount of expenditure is captured as 30800 taka monthly (table 2). The income and expenditure are the prime indicators that focus on the earning strength and the expensive capacity of the household.

3.2 Determinants of the livelihood diversification

Table 3 shows the result of logit model and the marginal effect of explanatory variables on the dependent variables. The log likelihood ratio (-36.21) with the accuracy of LR chi square (37.26) which is significant at 1 % level of significance, it simply implies that the explanatory variables predicting the dependent are significant for estimating dependent variable in the model. Due to being logit model, Pseudo R squared is established instead of the traditional R squared of OLS. Here the Pseudo R squared is 0.33 interpreting that 33% variation of the model is captured by the explanatory variables which is generally implying the goodness of fit for the model interpreted.

Table 2: Summary statistics of the decision variables

Variable	Mean	Std. Dev.	Min	Max
Age of the respondent	42.39	14.673	18	80
Educational status	2.85	3.764	00	12
Marital status	1.0	0.333	00	01
Household size	4.97	1.623	02	09
Number of dependents	3.1	1.396	00	07
Land ownership (Decimal)	3.852	11.41	00	85
Credit Access	0.67	0.533	00	01
Distance from the market	0.954	0.82	00	04
Household income (BDT/Monthly)	16468.5	32179.419	3400	32400
Household expenditure (BDT/Monthly)	11943	11611.473	3200	30800

Source: Authors' own computation from field survey, 2021

Since logit model has odd ratios and cannot interpret the percentage change in the dependent variable due the changes in the explanatory variable, it can only predict the direction of the variables toward some way. That is why marginal effect is driven through partial derivative procedure. Marginal effect model reflects the infinitesimal variation in the response due to the changes in explanatory variables by saying exactly how much the dependent change in percentage. This result of this study reflects that number of dependents has positive significant ($p < 0.10$) influence on the livelihood diversification implying that a 1 person increase in the dependent results in the 0.07 or 7% increase in the diversification of household livelihood. This may be due to the existence of the dependent create pressure on the expenditure which forces the household to diversify their earning sources. Household size or the members prevailing in the family has negative effect on the livelihood diversification which is highly statistically significant ($p < 0.01$). This may be due to the reason that the families with large number are more dependent on the agricultural activities and does not move away from their families. Similar result has been found for training that is significant at 1% which implies that 1% increase in the training adoption by the respondent can increase their livelihood diversification by 8.7 % which cannot be ignored. Likewise, positive effect is estimated for age ($p < 0.01$), educational status which is significant at 10 % level implying that an increase in the educational level say one year can raise the level of livelihood diversification on average. Land ownership pattern has also positive significant ($p < 0.10$) effect on the livelihood diversification level.

On the contrary, farming experience ($p < 0.05$) and credit access ($p < 0.01$) have negative influence on the diversification of household indicating that an increase of them cause a decline of the level of livelihood diversification. This may be due to the reason that credit availability encourages the respondents to concern one particular earning source or the long-time spending on farming discourages to diversify. However, the parameter estimates of the logit model provide most effective the course of the effect of the impartial variables on the structured (response) variable: estimates do no longer represent real significance of alternate or possibilities. Consequently, the marginal consequences from the model, which measure the predicted change in probability of a particular preference being made with admire to a unit trade in an independent variable. Similar to the study of Bora (2020), this study also found that the household size, farming experience and credit access have significant negative effect on the adoption of the livelihood diversification of the tribal people in the study areas. Whereas age, education, training received, and number of dependents have significant positive effect of the

adoption of the livelihood diversification of the tribal people that is similar to the study of (Roy and Basu, 2020).

Table 3. Results of logit model and marginal effects

Variables	Limited Variable Analysis		dy/dx	
	Coefficients	Z-statistics	Coefficients	Z-statistics
Constant	0.783 (3.484)	0.22	0.002 (0.003)	0.80
Marital status	-0.386 (0.361)	-1.07	-0.016 (0.081)	-0.20
Household size	-1.500*** (0.419)	-3.57	-0.219*** (0.042)	-5.17
Age	0.052** (0.026)	2.02	0.129*** (0.028)	4.55
Farming experience	-1.83*** (0.492)	-3.73	-0.514** (0.247)	-2.70
Education	0.402* (0.240)	1.68	0.093* (0.050)	1.83
Distance to market	0.026 (0.022)	1.17	0.019 (0.097)	0.20
Training received	0.652** (0.307)	2.48	0.087*** (0.309)	3.51
Land ownership	0.075 (0.373)	1.73*	0.116** (0.056)	2.06
Credit access	-1.53** (0.610)	-2.51	-0.438*** (0.103)	-4.25
Membership	0.126 (0.084)	1.50	0.0613 (0.075)	0.81
No. of dependent	0.047* (0.027)	1.73	0.075* (0.043)	1.73
<i>Extra Statistics</i>				
LR chi ²	37.26***			
Pseudo R ²	00.339			
Log likelihood	-36.21			
Number of observations	100.00			

Note: Asterisks ***, ** and * refer to 1%, 5% and 10% level of significance respectively.

Source: Authors' own computation from field survey, 2021

3.3 Diagnostic check

Heteroscedasticity or heteroskedasticity is known as the disparate of residuals (error terms) which indicates the unsystematic distribution of residuals within a region. Obviously, this is a problem for ordinary least squared (OLS) analysis due to violating the basic Gauss-Markov assumption of constant variance which ensures the stability of the postulated model with having $V(\sigma_i) = E(\sigma_i^2) = \sigma_i^2 = \text{Constant}$. One of the most popular detection methods for heteroskedasticity is Breusch-Pagan test which was introduced by Trevor Breuse and Adrian Pagan (Breusch and Pagan, 1979). This study applied the Breusch-Pagan test to identify heteroscedasticity problems in existing results and models. Table 4 represents Breusch-Pagan test. Where, $\text{Prob} > \chi^2 = 0.7045$, that is $> \alpha = 5\%$ indicates that the result is free from heteroscedasticity. The Ramsey reset test advice for examining key variables that are not included in the version of the regression specification error. In other words, it is much more specific to test whether the model is successful. Therefore, the result in table 4 is $\text{Prob} > F =$

0.2118, which is $>\alpha=5\%$ or 0.05. So, we conclude that the outcome of this test is the version of unfastened from misspecification. Table 4 shows the result of multicollinearity result by VIF whereas, each variables having VIF value of less than 5 that it is expected. The mean vale of VIF is 2.355 which is also lower than 5. This clearly indicates that the result is free from multicollinearity problem indeed.

Table 4: Test of multicollinearity

Variables	VIF	1/VIF
Constant	3.723	0.269
Diversification	3.611	0.277
Age	2.685	0.372
Religious status	2.224	0.45
Marital status	2.198	0.455
Household size	2.052	0.487
Education	1.293	0.774
No. of dependents	1.057	0.946
Land ownership	3.723	0.269
Mean VIF		2.355

Source: Author's own computation from field survey, 2021

3.4 Effect of the livelihood diversification on household welfare

To accomplish the second objective of the impact analysis of income diversification, multivariable regression analysis was derived where household consumption expenditure was taken as household welfare as a proxy variable and household income was not taken a dependent variable due to its complication in the analysis as mentioned by a previous study such as Salam *et al.*, 2019. R-squared measures the goodness of fit of the model which is estimated to be 91.9 % indicating that about 91.9 % of the variation of in the dependent variables was explained by the explanatory variables (Table 5).

In other words, this means that 91.9% of the variation in household welfare is explained by the variables included in the model, while 8.1% are explained by other factors not included in the model. This is a good indication and also moves us towards the test of multicollinearity as a threatened. Table 4 indicates that diversification of livelihood has a significant positive impact on the welfare of the household that is significant at 1% level. The age of the respondent ($p<0.01$), marital status ($p<0.05$) and religious status ($p<0.05$) also have similar effects on the household welfare. The educational level of the tribal people measured in years of formal education has significant positive ($p<0.05$) relation with the household consumption expenditure of tribal people implying that an increase in the formal educational status will result in the improvement of the household welfare on average which means that if the educational status of the respondent rises by 1 % that leads to an increase in the household welfare by 0.8 % on average having *ceteris paribus*. This means that an increase of the livelihood diversification will improve the welfare of the household measured by the consumption expenditures. More specifically, a 1% increase in the diversification of livelihood can increase the welfare of the household by 4.9 % ($p<0.01$) on average in general with *ceteris paribus*.

In addition, the land ownership pattern of household has significant positive impact ($p<0.01$) on the household welfare indicting that a household with more land ensured more expenditure on average. On the other hand, the number of dependents prevailing in household has negative effect on the welfare of the household that is significant at 1% level. This finding is consistent with that of Babatunde and Qaim (2009) and Akaakohol & Aye (2014) and the finding of this

study on credit access is also against Rahman *et al.* (2019) because they have shown a positive impact of credit on the livelihood diversification whereas this study estimates negative impact of credit access on the livelihood diversification of tribal people. From them religious status estimates that people who were Kristen, had a significant greater impact of income diversification on the household welfare that is significant ($p \leq 0.00$).

Table 5: Results of the multivariate ordinary least square model

Variables	Coefficients	St.Err.	t-value	p-value
Constant	0.444	0.509	0.87	0.384
Diversification	0.049***	0.018	2.66	0.009
Age	0.269***	0.061	4.41	0.000
Religious status	0.077**	0.034	2.28	0.025
Marital status	0.122**	0.054	2.27	0.025
Household size	-0.003	0.007	-0.47	0.64
Education	0.008**	0.004	2.10	0.039
No. of dependents	-0.808***	-0.052	-15.44	0.000
Land ownership	0.025***	0.008	3.21	0.002
<i>Extra Statistics</i>				
R-squared		0.919		
F-test		128.474***		
Akaike crit. (AIC)		-209.062		
Bayesian crit. (BIC)		-185.615		
Breusch-Pagan test		0.14		
Ramsey RESET test		3.72		

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$;

Source: Author's own computation from field survey, 2021

Moreover, this study looked for examining effect of livelihood diversification measuring as dummy dependent variable on welfare of tribal household in Dinajpur. In referring to the result of regression analysis, the positive significant welfare effect of educational status, age, marital status, land holdings and diversification of livelihood were found. These findings are consistence with outcome of Akaakohol and Aye (2014) which was done in Makurdi, Benue State, Nigeria, they analyzed the effect of socioeconomic characteristics as key indicators for influencing of livelihood diversification and also found positive effect of them on well-being of the household living in the study areas, as well as Zakaria *et al.*, (2019) who showed positive welfare effect of livelihood diversification and similar positive welfare effect was also captured by Asfaw *et al.*, (2019), Gautam and Andersen (2016), and Adepoju and Obayelu (2013). On the contrary, Mahama and Nkegbe (2021) did study in Ghana where they found that sex, education, age, household size and organizational ownership among socioeconomic characteristics had negative impact on the household well being. Akaakohol and Aye (2014) also identified as negative significant effect of household type, household distance from nearest market, farming experience and membership of organization on household welfare of tribal people.

IV. CONCLUSION AND POLICY IMPLICATION

The objective of this paper was to analyze the impact of diversification on the welfare of households. From the findings of this study, it is clear that education, training and level of diversification have positive effect on the household welfare and so the improvement on these issues should be enhanced. They are the economically backward society, depend highly on agricultural activities and have lack of potential skill to improve them. Very few of them

received training on technical skills and self-employment which paves the way for them to engage new income generating activities. Due to having little assets, they have to involve income generating activities in early life. However, small quantity received educational aid from different sources in general which is very negligible for them. Specialized schools by government for them and preprimary education by different NGOs can be introduced as well as a special stipend for ensuring compulsory education of the tribal people can also be taken. Training with daily basis payments can also be introduced to encourage them to receive training on different self-employment skills. The government of Bangladesh is also providing this type of training with daily basis payment in several districts of Bangladesh which should also be introduced in the study areas for tribal people. This improvement cannot be made by a single authority, for this purpose, NGOs, governmental organizations and the local influential elite class should come forward to improving their living standards. However, this study was limited to small sample size and one district of Bangladesh. This can be further improved by covering all of Bangladesh as a study area with having a large sample size.

Furthermore, training and education have been identified as having a significant positive effect on the welfare of the tribal households. So, the government and the policy makers should arrange more training on their skill development and self-employment. In this case, many non-government organizations (NGOs) were found to contribute much in this field. In particular, Missionary (according to the local language) have made a great contribution to their development and the group is still providing sanitation, housing land, educational facilities for children, etc. which cannot be ignored. However, this organization makes no contribution to the training provided to the development of the tribal people. They should focus on providing the training related to self-development which may improve their condition by having better options for livelihood. The government and the policy makers should make easier ways to access in education for them by raising awareness more among them. Land ownership is a serious issue for them because most of them are involved in farming lands gifted by religious groups or other sources and very few had their own cultivated lands. Therefore, the government should manage some alternative ways for their better farming capacity as well as their development.

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REFERENCES

- Abebe, T., Chalchisa, T., and Eneyew, A. (2021). The Impact of Rural Livelihood Diversification on Household Poverty: Evidence from Jimma Zone, Oromia National Regional State, Southwest Ethiopia. *The Scientific World Journal*, 2021.
- Adeogun, O.A., Ajana, A.M., Ayinla, O.A., Yarhere, M.T., and Adeogun, M O. (2008). Application of logit model in adoption decision: A study of hybrid clarias in Lagos State, Nigeria. *American-Eurasian Journal of Agriculture and Environmental Science*, 4(4): 468-472.
- Adepoju, A.O., and Obayelu, O.A. (2013). Livelihood diversification and welfare of rural households in Ondo State, Nigeria. *Journal of Development and Agricultural Economics*, 5(12): 482-489.

- Adesina, A.A., and Zinnah, M.M. (1993). Technology characteristics, farmers' perceptions and adoption decisions: A Tobit model application in Sierra Leone. *Agricultural economics*, 9(4): 297-311.
- Ahmed, M.T., Bhandari, H., Gordoncillo, P.U., Quicoy, C.B., and Carnaje, G.P. (2015). Diversification of rural livelihoods in Bangladesh. *Journal of Agricultural Economics and Rural Development*, 2(2): 32-38.
- Alobo-Loison, S. (2015). Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review. *Journal of Development Studies*, 51(9), 1125–1138. <https://doi.org/10.1080/00220388.2015.1046445>
- Akaakohol, M.A., and Aye, G.C. (2014). Diversification and farm household welfare in Makurdi, Benue State, Nigeria. *Development Studies Research. An Open Access Journal*, 1(1): 168-175.
- Asfaw, S., Scognamillo, A., Di Caprera, G., Sitko, N., and Ignaciuk, A. (2019). Heterogeneous impact of livelihood diversification on household welfare: Cross-country evidence from Sub-Saharan Africa. *World Development*, 117: 278-295.
- Babatunde, R.O., and Qaim, M. (2009). The Role of Off-farm Income Diversification in Rural Nigeria: Driving Forces and Household Access. CSAE conference 2009 on economic development in Africa, St Catherine's College, Oxford, March 22–24.
- Barau, A.A., Afrad, M.S.I., Rahman, M.S. and Rahman, M.A. (2019). Indigenous peoples' livelihood practices in south-eastern Bangladesh and the question of sustainability. *Sustainable Development*, 27(4): 809–816.
- Bora, D. (2020). Determinants of Livelihood Diversification among Rabha Tribes of Assam: A Case Study. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(7): 4058-4069.
- Breusch, S.T., and Pagan, A. (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica*. 47(5):1287-1294.
- Daoud, J.I. (2017). Multicollinearity and regression analysis. *Journal of Physics: Conference Series*, 949: 1, p. 012009).
- Gautam, Y., and Andersen, P. (2016). Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of rural studies*, 44: 239-249.
- Gujarati, D.N., Porter, D.C., and Gunasekar, S. (2009). *Basic econometrics*. Tata mcgraw-hill education.
- Islam, M.A., and Quli, S.M.S. (2017). Forestry-based livelihood diversification strategy for socio-economic development of tribes in Jharkhand. *Agricultural Economics Research Review*, 30(1), 151-162.
- Jannat, A., Islam, M., Alamgir, M., Al Rafi, D.A., and Ahmed, J.U. (2021). Impact assessment of agricultural modernization on sustainable livelihood among tribal and non-tribal farmers in Bangladesh. *GeoJournal*, 86(1): 399-415.
- Johanni, J. (2011). Household welfare: how to measure and index. A thesis for Award of BA at Ave Maria University. Florida.
- Karidjo, B.Y., Wang, Z., Boubacar, Y., and Wei, C. (2018). Factors influencing farmers' Adoption of Soil and Water Control Technology (SWCT) in Keita valley, a semi-arid Area of Niger. *Sustainability*, 10(2): 288.
- Khatun, D., and Roy, B.C. (2016). Rural Livelihood Diversification in West Bengal: Nature and Extent. *Agricultural Economics Research Review*, 29(2): 183. <https://doi.org/10.5958/0974-0279.2016.00046.x>
- Lekobane, K.R., and Seleka, T.B. (2017). Determinants of household welfare and poverty in Botswana, 2002/2003 and 2009/2010. *Journal of Poverty*, 21(1): 42-60.

- Leng, L., Zhang, T., Kleinman, L., and Zhu, W. (2007). Ordinary least square regression, orthogonal regression, geometric mean regression and their applications in aerosol science. In *Journal of Physics: Conference Series*, 78: 1.
- Mahama, T.A.K., and Nkegbe, P.K. (2021). Impact of household livelihood diversification on welfare in Ghana. *Scientific African*, 13, <https://doi.org/10.1016/j.sciaf.2021.e00858>
- McClelland, M.J. (2002). *Multiple regression and causal analysis*. Waveland Press. Prospect Heights III, Page 358.
- Olayemi, J.K. (1995). A survey of approaches to poverty alleviation. In A Paper Presented at the NCEMA National Workshop on Integration of Poverty Alleviation Strategies into Plans and Programmes in Nigeria, Ibadan, Nov.
- Padaria, R.N., Singh, B., Sivaramane, N., Naik, Y.K., Modi, R., and Surya, S. (2016). A logit analysis of Bt Cotton adoption and assessment of farmers' training need. *Indian Research Journal of Extension Education*, 9(2): 39-45.
- Rabbani, G., and Ahmad, B. (2021). Production and profitability of small-scale broiler farming in selected areas of Dinajpur district, Bangladesh. *International Journal of Agricultural Research, Innovation and Technology*, 11(1): 69-73.)
- Rahman, M.A., Paul, S., and Saha, J.K. (2019). Food security and livelihood of tribal people in Bangladesh: The role of microfinance. *Fundamental and Applied Agriculture*, 4(3): 881-889.
- Roy, A., and Basu, S. (2020). Determinants of Livelihood Diversification Under Environmental Change in Coastal Community of Bangladesh. *Asia-Pacific Journal of Rural Development*, 30(1-2): 7-26. <https://doi.org/10.1177/1018529120946159>
- Salam, S., and Bauer, S. (2020). Rural non-farm economy and livelihood diversification strategies: evidence from Bangladesh. *GeoJournal*, 2. <https://doi.org/10.1007/s10708-020-10269-2>
- Salam, S., Bauer, S., and Palash, M.S. (2019). Impact of income diversification on rural livelihood in some selected areas of Bangladesh. *Journal of the Bangladesh Agricultural University*, 17(1): 73-79.
- Salmerón, R., García, C., and García, J. (2020). Overcoming the inconsistencies of the variance inflation factor: A redefined VIF and a test to detect statistical troubling multicollinearity. *arXiv preprint arXiv:2005.02245*.
- Salmerón, R., García, C.B., and García, J. (2018). Variance inflation factor and condition number in multiple linear regression. *Journal of Statistical Computation and Simulation*, 88(12): 2365-2384.
- Shan, T. B., and Ahmed, J.U. (2020). Determinants of Livelihood Diversification of Rural Households in Sylhet. *Asian Journal of Agricultural Extension, Economics & Sociology*, 38(11): 97-104. <https://doi.org/10.9734/ajaees/2020/v38i1130457>
- Smith, D.R., Gordon, A., Meadows, K., and Zwick, K. (2001). Livelihood diversification in Uganda: patterns and determinants of change across two rural districts. *Food policy*, 26(4): 421-435.
- Suchiradipta, B., Sarker, A., Feroze, S.M., and Devarani, L. (2018). Dynamics of Livelihood Diversification: A Study on Rural Tribal Youth of Tripura, India. *Advances in Research*, 1-12.
- Zakaria, A., Azumah, S.B., Akudugu, M.A., and Donkoh, S.A. (2019). Welfare effects of livelihood diversification of farm households in Northern Ghana: A quantitative approach. *Scientific African*, 13(1): 1-13.