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Determinants of Poverty among Households in Bhutan

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Abstract--- *This study investigates the demographic factors that affect the poverty status of households in Bhutan. A sample of 11,654 households from Bhutan Living Standard Survey conducted by the National Statistical Bureau in 2017 was used for the analysis. A logistic regression was performed with the poverty status (poor and non-poor) as an outcome variable and a set of demographic factors as the predictor variables. Further, the predictor variable were tested using Chi-square test at 0.05 level of significance. The poverty status of each household was determined by comparing Person's consumption expenditure with a standard poverty line of Nu 2,195.95 per person per month. The demographic factors showed significant influence on poverty status of the household, especially age and gender of household head, household size, qualification and employment status of household head, marital status and residence of household.*

Keywords--- *Odds ratio, Logit model, Logistic function, Binary regression.*

I. INTRODUCTION

Poverty is defined as a situation not having enough material possessions or income to meet basic personal needs. Poverty is a global issue, and Bhutan is estimated to have one-third of its population below the poverty line. Topographically, Bhutan is a mountainous country with highly rugged terrain and farming is limited to scattered mountain slopes and valleys. This makes the country highly vulnerable to natural disasters, such as flash floods, landslides and soil erosion, thus contributing to poverty.

Even within the household in a country, the concept of poverty changes with regions depending on their sources of income, resources and living standards. Large families with high dependency ratio in both urban and rural areas, high rates of unemployment, low literacy rates, lack of health and other basic are the main factors leading to household poverty. Poverty of each household in Bhutan is measured based on the expenditure. Generally, expenditure is considered as the best method to measure the poverty, since it is directly related to well-being and much easier to measure than the income.

Numerous researchers used different models to determine the poverty. The best model that helps to identify the factors which has significant impact on the probability of being poverty is the logistic regression model. The Logistic regression model is widely used by many researchers to analyze the relationship between the outcome variable and one or more predictor variables.

The current study was undertaken to analyse the determinant of poverty using the logistic regression model. The variables of interest are a set of characteristics of the household and a set of demographic factors of head of the household, which could have significant impact on the probability of being poor. Thus, the main objectives of this study are to (1) identify the variables that influence the household's poverty status using the logistic regression model and (2) analyse the poverty status of each household by comparing household member's expenditure to the poverty line.

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II. Literature Review

Achia et al [1] used the logistic regression model to investigate the important factors that affect the poverty status of households in Kenya. They found that the probability of households being poverty is influenced mainly by religion, level of education and size of household. Mok et al. [2] used the logistic regression to analyze the poverty in rural and urban. Their results show that the household with larger families and having large number of dependent increase the probability of household in poverty in urban areas. Puurbalanta & Adebanji [3] applied the Bayesian ordinal probit models to predict the risk factors that affect the household poverty.

Emese et al [4] carried out a study focusing on the individual characteristic. They used logistic regression model to estimate which characteristic have the higher risk of becoming poor. They concluded that covariates age, educational level, gender, work intensity have a significant impact on being in deprivation. The latest study on poverty was done by Ogundipe et al [5]. In their study, they used the logistic regression model to analyse the gender perspective of income inequality and poverty among the rural households in Southwest, Nigeria.

However, some literature say that the poverty is not only associated with demographic factors but also influenced by the income. Duarte [6] has used the combined approach of ordinary least square regression and the logistic regression model to study the determinants of poverty in Paraguay. He found that the household with higher income has the less chance of being in poverty compared to the household with lower income. Makame and Mzee [7] used Zanziber Household Budget Survey data to estimate the probability of poverty in Zanziber using the logistic regression model. Their studies showed that the likelihood of poverty is related to household size, education and household head.

III. Materials and Methods

III.A Data

The data used in this study is obtained from Bhutan Living Standards Survey conducted in 2017 by the National Statistics Bureau, Royal Government of Bhutan. This survey involved 11,654 households. The comparison of poverty status of households was done using the standard poverty line Nu 2,195.95 per person per month.

III.B Methods

To analyze the data, the study used the logistic regression analysis. The logistic regression is applied to estimate the determinants of poverty among households in Bhutan. The outcome variable (Y) is household's poverty status with two possible outcomes: (1) the household is poor and (2) the household is non-poor. These possible outcomes are coded as 1 (poor) and 0 (non-poor), as predictor variables are considered as demographic factors of head of the household and characteristic of the household. The model shows how these predictor variables affect the probability of being poor in Bhutan. The variable of interest are defined in Table 1.

Chi-square test of independence

For the Chi-Square test of independence computation, the test statistic is given by

$$\chi^2 = \sum_{i=1}^{R} \sum_{j=1}^{C} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (3.1)$$

where O_{ij} is the observed cell counts in the i^{th} row and j^{th} column of the table, E_{ij} is the expected cell count in the i^{th} row and j^{th} column of the table, computed as

$$E_{ij} = \frac{n_i \times n_j}{n} \quad (3.2)$$

where $n_i = \sum_j n_{ij}$ is the sum of i^{th} row, $n_j = \sum_i n_{ij}$ is the sum of j^{th} column and n is the total sample size. χ^2 has $(R-1)(C-1)\ d.f.$

Table I: Characteristic of the variables.

Variables	Characteristic
	Predictor Variables
Residence	1 if the household is in rural area, 0 if the household is in urban area.
Household Size	The total number of members in the household, classified into three categories. 1 if the household size is from 1-5, 2 if the household size is from 6 -10, 3 if the household size from 11 and above.
Gender	1 if the household head is male, 0 if the household head is female.
Age	Age of the household head in year, classified into seven categories. 1 if age of the household head is from 18-27, 2 if age of the household head is from 28-37, 3 if age of the household head is from 38-47, 4 if age of the household head is from 48-57, 5 if age of the household head is from 58-67, 6 if age of the household head is from 68-77, 7 if age of the household head is from 78 and above.
Qualification	1 if the household head is with no education, 2 if the household head is with primary education, 3 if the household head is with secondary education, 4 if the household head is with tertiary education.
Marital Status	1 if the household head is divorce, 2 if the household head is married, 3 if the household head is never married, 4 if the household head is widow
Employment status	1 if the household head is self-employed (who owned business and company). 2 if the household head is unemployed (who depends on farming and agriculture). 3 if the household head does any work for wages (formal occupation).
Region	1 if the household is in East, 2 if the household is in East Central, 3 if the household is in West,

	4 if the household is in West Central.
	Outcome Variable
Household's poverty status	1 if poor (less than poverty line), 0 if otherwise.

Logistic regression

Let Y be a dichotomous random variable, the simplest form of logistic regression model can be written as;

$$\text{logit}\,(\pi) = ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X, \tag{3.3}$$

where π is the probability of occurring the outcome Y, i.e, $Y = 1$ and $\pi/(1-\pi)$ is the odds of Y being equal to 1, the ratio of the probability of occurring outcome Y and the probability of not occurring the outcome Y, β_0 and β_1 are called constant and regression coefficient, respectively. By taking antilog on both sides of equation (2.1), we can estimate the probability of the occurrence of outcome Y for a given value of predictor X as

$$\pi = P(Y = 1|X = x) = \frac{e^{\beta_0+\beta_1 X}}{1+e^{\beta_0+\beta_1 X}} = \frac{1}{1+e^{-(\beta_0+\beta_1 X)}}. \tag{3.4}$$

The predictor variable X can be either continuous or categorical. We can extend the logistic regression model for k predictor variables as

$$\text{logit}\,(\pi) = ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k. \tag{3.5}$$

Therefore,

$$\pi = P(Y = 1|\boldsymbol{X} = (x_1, x_2, \dots, x_k)) = \frac{e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k}}{1+e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k}}. \tag{3.6}$$

The logit variable $ln(\pi/(1-\pi))$ is log of odds of the outcome, i.e., the household falling below the poverty line. The parameters in equation (2.5) are estimated using maximum likelihood method. The value of regression coefficients $\beta_1, \beta_2, \beta_3, \dots, \beta_k$ measures the relation between $X_1, X_2, X_3, \dots X_k$ and logit of Y. Each coefficient value is the change in log odds from a 1 unit increase in the X with all the other variable constants and for every unit increase in X the odds ratio increase by e^{β}.

IV. Main Results

In this section, we present the results of the analysis with regard to household's poverty status and demographic factors. At the first step, chi-square test is performed to check the association between the variables. Since dependent variable is household's poverty status with two outcomes (poor and non-poor), the logistic regression analysis is used to analyze the relation between the categories of predictor variables and the dependent variable.

IV.A Test of independence

The Table 2 given below shows the result of chi-square test of independence. The independent variables; residence, household size, gender, age, qualification, marital status and employment status were found to be significant at p-value less than 0.05 respectively.

Table II: Result of Chi-square test.

Predictor variables	χ^2	df	p-value
Residence	279.66	1	**0.000**
Household size	351.31	2	**0.000**
Gender	5.3295	1	**0.021**
Age	106.13	6	**0.000**
Qualification	174.19	3	**0.000**
Marital status	35.683	3	**0.000**
Employment status	6.9509	2	**0.031**
Region	5.517	3	0.138

IV.B Logistic Regression Analysis

The specification of the model is given as

$$ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 ,$$

where X_1 is the residence, X_2 is household size, X_3 is gender, X_4 is the age household head, X_5 is qualification, X_6 is marital status and X_7 is employment status.

When the data is fitted using the logistic regression model, we see that some of predictor's sub-categories variables have no individual significant contribution on household being poor as observed in Table 3. The Table 3 show the results of determinants of becoming poor in Bhutan based on the head of the household.

With regard to the gender of the household head, the results show that the probability of household becoming poor is significantly correlated to the gender of head of the household. As shown in Table 3, male-headed households were more likely to be poor compared to female-headed households (OR=1.777, p-value < 0.05). It means when a household is led by male the probability of becoming poor increases by 1.777 times.

Many researchers state that chance of household being poor is directly proportionate to the household size, which is true in Bhutan. The results show that the larger household size has a negative impact on the probability of becoming poor. Households having members more than 11 (β = 2.506, OR=12.25, p-value < 0.05) are more likely to be poor compared to the reference category. This result implies that the probability of becoming poor increases with the increase in the family size.

The educational qualification (no education and tertiary education) included in the analysis were positively significant. This result implies that the higher educational qualification of head of the household has a vital role to

play in keeping the household away from the poverty. Households having an unlettered reference person has high (OR=3.560) possibility to become poor compared to those, having higher qualification. With the odds ratio of 0.403, the household with highly educated reference person has the less chance of household becoming poor.

Table III: Results of the logistic regression.

Variables	Estimate	Odd ratio	Std. Error	z-value	p-value
Intercept	-5.976	0.002	0.494	-12.084	0.000
Residence					
Urban	Reference				
Rural	2.603	13.50	0.261	9.956	0.000
Household size					
1-5	Reference				
6 - 10	1.233	3.431	0.104	11.83	0.000
11+	2.506	12.25	0.293	8.526	0.000
Gender					
Female	Reference				
Male	0.574	1.777	0.116	4.922	0.000
Age					
18-27	Reference				
28-37	0.256	1.291	0.338	0.756	0.449
38-47	0.019	1.019	0.340	0.056	0.955
48-57	0.022	1.022	0.338	0.067	0.946
58-67	0.149	1.160	0.314	0.435	0.663
68-77	0.211	1.235	0.360	0.586	0.558
78+	0.394	1.483	0.408	0.965	0.334
Qualification					
Secondary	Reference				
None	1.269	3.560	0.263	4.819	0.000
Primary	0.435	1.545	0.305	1.422	0.155
Tertiary	-0.908	0.403	0.352	2.794	0.005
Marital status					
Never Married	Reference				
Divorced	1.345	3.840	0.769	1.750	0.080
Married	1.401	4.059	0.718	1.951	0.051
Widow	1.624	5.078	0.734	2.211	0.027
Employment status					
Self-employed	Reference				
Unemployed	-0.343	0.709	0.113	-3.046	0.002
Wage	-0.234	0.791	0.149	-3.565	0.017

The estimated results of the employment status depict that the household headed by the persons with formal occupations are less likely to be poor with the odds ratio of 0.791. The reason being that, the formal occupations

provide them with stable and sufficient resources. Further results showed that, the household led by a person who is widowed has high (OR=5.078, p-value<0.05) chance to become poor compared to the household led by never married head of the household.

The types of residence (urban and rural) is another factor that determinant of poverty. The study finds that, the households in rural areas were more ($e^{2.603} = 13.50$) likely to be poor as compared to household in urban areas.

V. DISCUSSION

The Logistic regression is the widely used model when the outcome variable is dichotomous. Our data set used the outcome variable as household's poverty status, which is binary in nature. We apply chi-square test to find the significant variables to test our model.

The logistic regression model shows that the probability of household being poverty is directly related to the household size. It shows that the increase in family size elevates the chance of becoming poor. A one-person household significantly reduces poverty, while the addition of the members to the household progressively increases the probability of becoming poor. This result is similar to the findings of poverty studies conducted by developing countries in general such as Kenya, Indonesia, Nigeria and Albania (Myftaraji et al [9]; Anyanwu [10]; Anthony et al [17]; Rahmatina [14]).

The gender of head of the household shows significant correlation with outcome variable. This study compares the household's poverty status of male-headed household and female-headed household. This study uncovers the fact that the male-headed households are poorer compared to the female-headed households. Twerefou et al [11] mentioned that many researchers compare the poverty status of male- headed and female- headed household as the feminization poverty. Appleton [12] assessed poverty using the logistic regression and found out that the female-headed households are not poor compared to the male headed households. However, Dreze & Srinivasan [13] did not find any evidences to prove that the female-headed households are significantly poorer than the male-headed households in India.

The employment status and the qualification of head of the household had an opposite influence, implying that these variables help in enhancing the family status. Poverty of Education is the integral part of the human poverty, it is widely argued that this should be important constituents of any meaningful and comprehensive definition of poverty (Singh et al [15]). Higher the educational qualification, it has better possibility to earn income and basic need. The result was inconsistent with the study of Sapho [16], where education level was negatively correlated to the probability of becoming poor.

Residence of the household is another determinant of poverty. The households in rural area have higher chance of being poor compared to households in urban. In Bhutan, Poverty incidences is more concentrated in rural areas compared to urban areas. Poverty in rural areas is mainly attributed to the low levels of agriculture productivity, inaccessible to market and commerce, inaccessible road connectivity and the impact of rural urban migration. The result is consistent with the results of the studies conducted by Achia et al [1] in Kenya, Sapho [16] and Myftaraji et al [9] in Albania. These studies proved that the urban households were less likely to be poor compared to the rural households.

VI. CONCLUSION

The household poverty is a growing concern in the country and is said to be influenced by many factors. This study, therefore aimed to examine the determinants of poverty amongst the household in Bhutan. We applied the logistic regression model to analyze the factor which shows the significant impact on the probability of households becoming poor. In our test, we see that amongst the demographic factors, lower educational qualification, larger household size, male-headed household, households led by a person who is widowed are all related to a higher probability of household being poor.

One of the interesting findings of the current study was that the employment status of the household head played a significant role in changing the household's poverty status. In addition, household size has a negative impact on household's poverty status and the increase in household size has the highest chance of households becoming poor.

Likewise, the outcome of head of the household provides an interesting discourse on the demographic pattern of Bhutanese people. Since Bhutan is a developing country, it is possible that changes may take place in the living standard of households. Royal Government of Bhutan must initiate policy interventions to protect the vulnerable sections of the society by making pro-poor policies.

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