Determinants of Poverty in Rural Khyber Pakhtunkhwa Pakistan: A Logistic Regression Analysis

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ABSTRACT

Poverty can be defined as a state where the resources available to sustain the basic personnel's needs are so low that there is a lack of food, clothing, and shelter. This study is carried out to study important determinants of poverty in rural areas of Khyber-Pakhtunkhwa, Pakistan. For this purpose, data were collected from 187 respondents through a multistage sampling technique. The World Bank's $1.90 (Rs. 9986.4) per day per capita threshold level was used to classify respondents as either above or below the poverty line in the study area. Results of the logistic regression show that four out of the six variables (employment, family size, livestock, and farmland) had a statistically significant impact on poverty. Employment showed an indirect and highly significant relationship with poverty status. Likewise, family size is also statistically significant but has a negative effect on poverty. The livestock and farmland coefficients are significant and are inversely related to poverty. Based on the findings of the study, it is recommended that livestock keepers be given opportunities to get training in livestock management and marketing, which will result in a higher income. Also, demand-led activities on farmland and result-based skills and training are needed for the labour force to enhance productivity, and thus they may get out of poverty.

Keywords: Poverty Status, determinants, rural area, logistic model, Khyber Pakhtunkhwa, Pakistan

1. INTRODUCTION

Poverty is a condition or state where an individual community or an individual lacks financial resources and elements that are necessary for minimum living standards (Yin, 2023). In other words, poverty is a complex issue that affects individuals and communities in various ways. It can lead to a lack of access to basic necessities and can have significant negative impacts on health, education, and overall quality of life. Addressing poverty requires a multifaceted approach that

involves both short-term and long-term solutions, such as providing access to education and job opportunities, improving healthcare systems, and implementing social safety nets. (Mustafa & Burhan, 2013). However, it's important to note that poverty is not always solely a result of lack of resources. For example, in some cases, poverty may be a result of systemic oppression and discriminatory policies that limit access to resources and opportunities for certain groups. Additionally, poverty can also be caused by factors such as natural disasters, war, and economic instability (Noman et al., 2008). Poverty cannot be only considered/related to income & consumption rather it is multidimensional (Yang et al., 2019). It can also be considered of monetary as well as non-monetary dimensions such as health, education, water supply, gender equality, etc (Akhtar et al., 2020). The main factors responsible for poverty varies among countries due to their difference in development potential. The determinants which influence the level of poverty not only affect economic status but also affect the political, geographical, cultural, and social status of the country (Spaho, 2014).

During the year 2020 due to the outbreak of COVID-19, the world's economy was negatively affected. Apart from the world's economy, many developed nations' health systems also failed during this pandemic (Sangui & Zihao, 2015). At the start, the supply of goods was stopped due to the abrupt closure of various industries worldwide thus leading to an unusual demand shock, which had a socio-economic outcome. The negative impact of the pandemic includes unexpected restrictions, social distance among the people, and declining economic and financial ventures. Apart from this pandemic also badly affects industries (transportation, education, tourism, travelling, and hotel) and supply chains of goods (Andres et al., 2021). The pandemic also enhanced the human costs of the people of developed countries in the field of medical and health care systems. These unusual conditions exposed the poor health systems capacity of most countries around the world. These conditions led to the crisis which declined the economic value of the world's developed countries due to which millions of people lost their jobs, and the closure of businesses, ultimately resulting in the upturn of poverty and extreme depression among the masses. During this period the world is facing an extreme crisis like never before, the great lockdown further enhance the said crisis and disturb the livelihoods of the peoples by enhancing more poverty among low-income households (GoP, 2021). According to the United Nations Development Program, $220 billion in revenue losses are expected in developing countries.

According to the poverty threshold of $1.90 per day of the World Bank's macro poverty outlook for Pakistan is 36.6% for the year 2021 and more than two million people in Pakistan living in a state of poverty. Khyber Pakhtunkhwa has been a centre of natural disasters like floods and earthquakes that adversely affected the flora and fauna of the province. Its impact on health, modern development, land, health, infrastructure, and human life to the extreme Similarly, the rate of poverty in Khyber Pakhtunkhwa stands at 49 percent, and over the last few decades, Khyber Pakhtunkhwa suffered several severe shocks which included the Afghan conflict, the earthquake of 2005, the conflict of 2009 in district Swat and the floods in 2010 and now the post shocks of COVID-19s further affected the living standards of the people especially living in rural areas of Malakand agency (Khayyam & Noureen, 2020).

All the above incidents have reduced demand for goods and services across Khyber Pakhtunkhwa, loss of employment, income, and other business and agricultural activities in particular. This long list of difficulties, as well as the ongoing epidemic crisis, has added a new dimension to deeper poverty in rural areas. Epidemics and lockdowns had negative effects on families, and financial conditions, parents became unemployed, markets closed because transport was unavailable and buyers disappeared (Qaisar, 2021). These facts disturbed the normal lives of the rural masses and in turn, their business activities, hence leading the people towards a state of poverty (Haleem, 2020). The study aims to identify the factors that contribute to poverty in rural areas of KhyberPakhtunkhwa, Pakistan. By understanding these determinants, policymakers and stakeholders can develop effective strategies to alleviate poverty and improve the living conditions of the rural population in the study area.

2. DATA AND METHODOLOGY

2.1 Sample Size Determination, and Sample Technique

A multistage sampling technique was used for data collection. In the first stage, District Malakand was selected purposively. The total population of Dargai is 33,583 out of which the total household size is 4478 (GOP, 2020). In the second stage three villages namely, Gadera, Gul Maqam, and Mazed Khan were randomly selected and the selection of sample size was done by using the simple random sampling technique and through face-to-face conversation, data was collected using the pre-tested schedule.

2.2 Sample Technique

Yamane's formula was used to select a sample size from the total population.

$$n = \frac{N}{1+N(e)^2} \quad \ldots\ldots\ldots 1$$

Where N represents the population size, n is equal to the selected respondents for the interview, while e is the precision level which is set to 0.05. By putting values, the required sample size was determined by putting the values in Equation 1.

$$n = \frac{357}{1+357(0.05)^2} = 178$$

In the next step, a proportionate sampling technique was used to select the required sample.

$$n_i = \frac{N_i}{N} * n \quad \ldots\ldots\ldots 2$$

n_i shows the required number of sample households in the i^{th} village, N_i is the total number of households in each village, n represents the total sample size and N is the total number of households in each village. To draw the sample size from the selected villages the proportional allocation sampling technique was used. Sample Size was obtained by using Yamane's (1967) formula which pretends a 95 percent confidence level and e=0.05 percent. A total of 178 respondents were selected and interviewed from 4 villages. The total number of households in village Dargai is 130 with the total population of households in Mazed Khan Kaly being 69 the total population of households in Gul Maqam is 62 and the total population of households in Gadera is 96 (GoP, 2020). Thus the total number of households in these villages is 357.

Table 1: Number of Respondents.

Villages	Total number of Households	Total Sample size
Dargai	130	65
Mazed khan kaly	69	34
Gul maqam	62	31
Gadera	96	48
Total	357	178

Source: Author's Own calculations.

2.3 Poverty line

The poverty line indicates the level of purchasing power needed to meet a person's minimum needs. According to World Bank, (2021) estimates, the poverty rate in Pakistan increased from 4.4 percent to 5.4 percent in 2020, as more than two million people fell below the poverty line. In the current study threshold level of 1.90 $ (Rs. 9986.4) per day per capita set by the World Bank for developing countries' was used for the status of respondents and is thus categorized as below and above poverty. A similar procedure was used by Anwar (2005), Mahler et al., (2020), and Qaisar (2021).

3. Econometric Model

3.1 Model Specification and Estimation

In most of the relevant literature, where the dependent variable is categorical, a probit model is used for analysis. Because of the categorical or dummy nature of the variables such as gender, and marital status (take the values of 0 and 1). Where 1 shows the presence of an attribute and 0 shows its absence. In literature where the dependent variable is nominal, the linear probit model (LPM) is not preferred because it takes the probability of being poor move linearly with the values of explanatory variables. Second, there is no guarantee that the probability value must lie between 0 and 1. Whereas the LPM value lies between 0 and 1. Third as per the standard assumption of the OLS the error term is normally distributed holds when the dependent variable takes the values of 0 and 1 (Gujrati, 2010).

For the current study logistic model was used because of the dummy nature of the dependent variable *Yi* takes only two values i.e., 0 and 1. While the independent variable *Xi* is continuous.

All the variables are explained as under:

$P_r = (Y_i = 1: \ Below\ Poverty\ line)$

$P_r = (Y_i = 0: Above\ poverty\ line)$

For $Y_i = 1$

$$P_r = \frac{1}{1+e^{-z_i}} \qquad where\ Z_i = \beta X_i + \mu_i \quad \text{.....3}$$

For $Y_i = 0$

$1 - P_i = \frac{1}{1+ e^{z_i}}$ ……..…….. 4

By taking the ratio of equations 1 and 2

$$\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{zi} \quad \text{……..……5}$$

Where,

$Pi/(1 - Pi)$ is a simply odd ratio in favor that a respondent being above the poverty line.

Now take the log of the odd ratio.

$$Ln\left(\frac{Pi}{1-Pi}\right) = Zi = \beta X_i + \mu i \quad \text{……6}$$

The odd ratio is a linear function of Bs and Xs, and L is known as the logit (log of the odd ratios)

For the current study putting Xi, the model will be as follows;

$$Zi = \beta X_i + \mu i \quad \text{……7}$$

$z_i = \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 EMPStatus + \beta_4 THOUSESZ + \beta_5$FARMLAND + β_6LSTOCK ……8

Table 2: Variables used in the Logistic Regression Model

Variables	Explanation	Measurement
----------Dependent Variable z_i----------		
Poverty Status	0 = None	1 = Yes
----------Independent Variables (Xi)----------		
Age	Household head's age in years	0 = Male 1 = Female
EMPStatus	Employment status of the household	0 = Unemployed 1 = Employed
THOUSESZ	The total size of the household	In numbers
FARMLAND	Farmland holding	0 = Not Owner

		1 = Owner
LSTOCK	Whether a household has livestock	0 = Otherwise 1= Yes

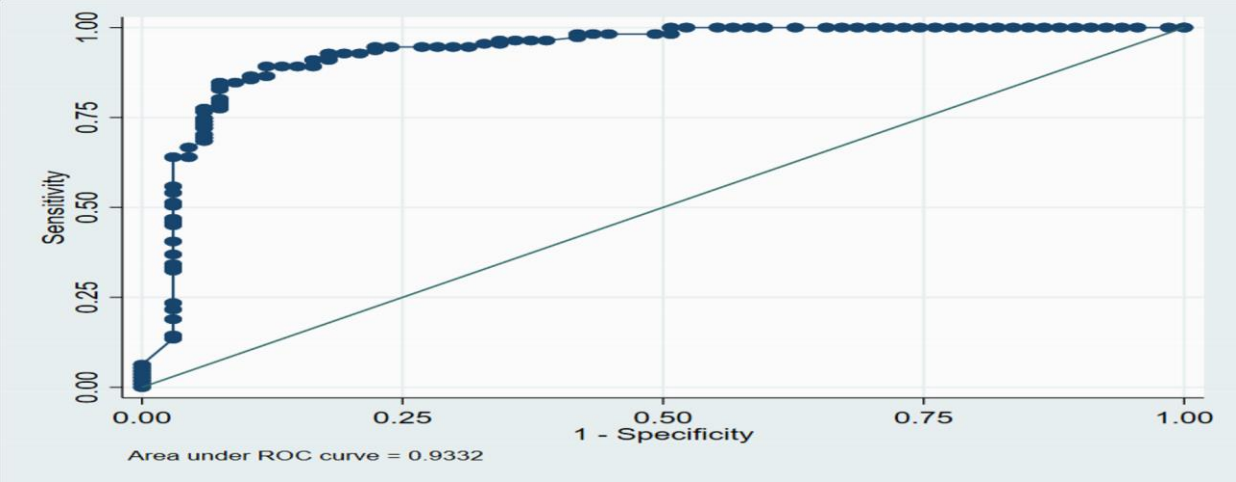
Source: Author's calculations.

3.2 Receiver Operating Characteristic Curve (ROC Curve):

The receiver operating characteristic curve, or ROC curve, was first evolved by electrical engineers and radar engineers at the time of World War II. The procedure was developed for operators of troop radar receivers starting in 1941, which led to its name. Further introduced to psychology, medicine, radiology, biometrics, forecasting, and so on. ROC curve is a graphical plot that shows the characteristic ability of a binary classifier system as its bigotry threshold is varied. The ROC curve is made by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings. The true-positive rate is also known as sensitivity, recall, or chance of detection. The false-positive rate is also known as the probability of a false alarm and can be calculated as (1 - specificity).

The ROC curve shows the trade-off between sensitivity (or TPR) and specificity (1 – FPR). Classifiers that give curves closer to the top-left corner indicate better performance. As a baseline, a random classifier is expected to give points lying along the diagonal (FPR = TPR). The closer the curve comes to the 45-degree diagonal of the ROC space, the less accurate the test is. AUC is an effective way to summarize the overall diagnostic accuracy of the test. It takes values from 0 to 1, where a value of 0 indicates a perfectly inaccurate test and a value of 1 reflects a perfectly accurate test. AUC can be computed using the trapezoidal rule. In general, an AUC of 0.5 suggests no discrimination (i.e., ability to diagnose respondents are above in poverty line and below the poverty line condition based on the test), 0.7 to 0.8 is considered acceptable, 0.8 to 0.9 is considered excellent, and more than 0.9 is considered outstanding and the above curve shows that roc curve (0.9332) is considered excellent result in our case.

Figure 1: ROC curve (Receiver Operating Characteristic Curve):



4. RESULTS AND DISCUSSIONS

4.1: Logistic Regression Model

Since we want to find out the determinants of poverty i.e. a household will be either poor or not poor. Hence, the dependent variable can take only two values i.e. say 1 either a person or household will either be poor or 0 not poor. In other words, the dependent variable is a binomial or binary, or dichotomous variable in nature. In a statistical analysis where the dependent variable is binomial, logistic regression is an appropriate model for an estimate (GUJRATI, 2010). In literature where the dependent variable is nominal, the linear probit model (LPM) is not preferred because it takes the probability of being poor and moves linearly with the values of explanatory variables. Second, there is no guarantee that the probability value must lie between 0 and 1. Whereas the LPM value lies between 0 and 1. Third, as per the standard assumption of the OLS the error term is normally distributed holds when the dependent variable takes the values of 0 and 1 (GUJRATI, 2010).

4.2: Logistic Regression Results

Detailed results obtained from the logistic model are presented in Table 2. All the variables included in the model can be interpreted as the negative sign showing an inverse relation i.e. the log of odds decreases in favour that a respondent who is below the poverty line and vice versa. While the odd can simply be defined as the ratio of the probability that may be greater or less than unity. Table 3 shows that out of six independent variables (age, gender, employment, family size, and farmland), only four variables i.e. employment, family size, livestock, and farmland have a statistically significant effect on the poverty status of the respondents in the research area. The

results show that the coefficient of employment was negative, which means that there is an inverse relation between poverty and employment i.e. as the respondents get a job there is a tendency that the poverty level of the respondents will decrease and vice versa. The odd ratio is also less than one which suggests that the probability of escaping the poverty trap increases with the increase in the employment level of the respondents. Similar results were also reported by AFZAL ET AL., (2012).

Results also show a positive and significant relationship between the poverty level of the respondents and the family size. This means that as the family size of the respondents increases the probability of poverty also increases. The odd ratio of 1.494 suggests that the chance of being poor increases with the multiplicity of 1.494 with the increase in the one dependent member in the family. The negative and significant relationship between livestock with poverty status shows that as the herd size increases the probability of being poor decreases. An odd ratio of 0.197 suggests that as the herd size increases the probability of the respondents escaping the poverty trap also increases. Table 3 also suggests that the coefficient of farmland size was negative and significant. This means that there is an inverse relationship between poverty status and farmland size. An odd ratio of 0.6369 suggests that as the size of farmland increases the probability of being poor decreases. The fact is that as the farmland size increases, that enables the growers to grow more and ultimately results in increased income and high standards of living. BHUTTO AND BAZMI (2007) suggested that sustainable agriculture in Pakistan can play a significant role in the eradication of poverty.

Table 3. Logit Regression Estimates for the Determinants of Rural Poverty.

Poverty Status	Coeff.	Odds Ratio	Z	P>z
Age	0.024	1.025	0.77	0.443
Gender	0.525	1.690	0.83	0.407
Employment	-2.682	0.068	-4.37	0.000
Family Size	0.401	1.494	3.25	0.001
Livestock Status	-1.622	0.197	-3.14	0.002
Farmland Size	-0.446	0.639	-3.12	0.002

_cons	-0.812	0.443	-0.51	0.609

Number of obs = 178
LR chi2(6) = 125.66
Prob > chi2 = 0.0000
Pseudo R2 = 0.5330
Log-likelihood = -55.052999

Source: Author's estimates.

4.3: Descriptive Probabilities

Table 4 shows that the respondent's mean probability of being poor mean probability is 26 percent, and the non-poor respondent's mean probability is 7 percent.

Table 4: Descriptive of Probabilities

Categories	Obs	Mean	Std. Dev.	Min	Max
Poor	178	0.262	0.168	0.0005627	0.50885
Non-Poor	178	0.072	0.176	0.0000181	0.943736

Source: Author's estimates.

4.4. Model Overall Statistical Significance

The significance of the overall model to fit the data well was analyzed by the log-likelihood ratio of the chi-square statistic and the pseudo R^2 (0.53) indicates that the model is satisfactory. Likelihood ratio with chi-square statistic with a value of 126.49 having a P-value of 0.000 medicates that a minimum of the coefficients of the independent variable is non-zero and gives evidence that the model is satisfactory.

4.5. Model specification test (Missing variable)

4.5.1. Link Test

This test is used to detect specification errors, that is, whether the logit function is the exact function to be used, and we have included all relevant variables in the model. When variables are omitted, variations in the dependent variable may be falsely attributed to the included variables in the

model, resulting in an inflated error for regression and distorting the animated coefficient. The main idea behind the link test is that all the independent variable included in the model is appropriate and there is no need for an additional independent variable.

The above table can be explained as our model significance is based on hatsq significance. If the result is insignificant it means that we have specified our model currently. In our care variable, _hatsq value is insignificant (p = 0.192) which implies that the overall model is specified correctly.

Table 5: Link Test for Model Specification.

poverty category	Coeff.	Std. Err.	Z	P>z	[95% Conf.	Interval]
_hat	1.102657	0.1787648	6.17	0	0.752284	1.453029
_hatsq	-0.08161	0.0626028	-1.3	0.192	-0.20431	0.041084
_cons	0.223716	0.3074412	0.73	0.467	-0.37886	0.82629
Logistic regression						
Number of obs			178			
Log-likelihood			-53.817022			
LR chi2(2)			128.14			
Prob > chi2			0.0000			
Pseudo R2			0.5435			

4.5.2. Correlation Matrix

A correlation matrix was also constructed for all the explanatory variables used in the model. The estimated correlation value between the explanatory variables is less than 0.8, which shows no relationship between the explanatory variables (Gujrati, 2010).

Table 6: Correlation Matrix

	Age	Gender	Employment	Family Size	livestock	farmland size
Age	1					
Gender	0.193	1				
Employment	-0.0628	-0.4979	1			
Family Size	0.2531	0.0193	-0.1253	1		

Livestock	0.1527	-0.1355	0.2383	0.038	1	
Farmland size	0.1826	-0.2147	0.4267	0.1785	0.3223	1

5. Conclusion and Recommendations

Poverty can be defined as a state where the resources available to sustain the basic personnel's needs are so extremely low that there is a lack of food, clothing, and shelter. In the current study threshold level of 1.90 $ per day per capita set by the World Bank for developing countries' was used for the poverty status of the respondents. The results show a positive and significant relationship between poverty status with gender status, employment level, occupation status, family size, livestock, and farmland size. The Logistic model gives the interaction between the dependent variable (poverty) and the influence of the independent variable i.e. Age, gender, employment, family size, livestock, and farmland. It was found that four out of the six variables (employment, family size, livestock, and farmland) had a statistically significant impact on poverty within a 95% confidence interval, while the other two i.e. age and gender had insignificant relation with poverty. The significance of the overall model to fit the data well was analyzed by a loglikelihood ratio of the chi-square statistic and the pseudo R^2 (0.53) indicates that the model is satisfactory. The receiver operating curve value of 0.9332 shows an excellent result in the research at hand. A correlation matrix was constructed for all the explanatory variables used in the model. The estimated correlation value between the explanatory variables is less than 0.8, which shows no relationship between the explanatory variables. Based on the findings of the study it is recommended that Providing livestock keepers with training in livestock management and marketing is crucial for increasing their income. This will enable them to learn new techniques for raising and selling their animals, which can lead to higher profits. In addition, demand-led activities on farmland can help boost productivity and improve the livelihoods of those who work on the land. This may include activities such as crop diversification or the introduction of new farming technologies. Result-based skills and training are also important for the labour force, as they can help workers develop new skills in demand in the market. By enhancing productivity through these measures, people can lift themselves out of poverty and achieve greater economic stability. Ultimately, investing in these areas is essential for creating sustainable livelihoods and improving the overall well-being of communities that rely on agriculture as a primary source of income.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analysis, or interpretation of the data; in the writing of the manuscript, and in the decision to publish the results.

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