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Full Length Research Paper

Forest depletion and socio economic factors: a comparative analysis of forest areas in Pakistan

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This study is an attempt to analyze the socio-economic factors affecting forest areas in Pakistan. Time series data of some socio-economic factors is taken to analyze the effect. Two models are developed; one with national forest area as dependent variable and in second, provincial forest area. For the analysis multiple regression technique is applied and the best model is selected by step wise regression. The results showed that cultivated area expansion, construction, consumption of timber and agriculture production is more destructive than other factors. The study further showed that increase in the consumption of firewood substitutes could not significantly improve the situation. The area wise comparison between national and KPK forests showed that in 83% cases the burden of these selected variables fall on provincial forests more than national forests. The study has given more emphasis to control the land use practices.

Keywords: Socio economic factors, forest depletion, level of effect, comparison of effects

INTRODUCTION

During 1970's, there is a decrease of forest area in Pakistan at a rate of 1.5 percent per year (Dijk and Maliha, 1994). The NWFP province now known as Khyber PakhtukKhawa has 17.85% of the geographic area under forest. The province has 40% of the country's forest resources (Steimann, 2004). According to Wani et al. (2004) only 4.76% of the total geographical area of Pakistan is under forest that is very low as compare to the required area of 25%. There are a number of socio-economic factors that are causing the depletion of forest area.

Coxhead (2002) mentioned that deforestation and conversion of land to agricultural production are most important issues. In other countries like Java, within a century of agricultural development 80 percent of forest area has been converted to agriculture.Dijik and Maliha (1994) also support these results that the area under rangelands and common lands has declined in favor of cultivation in NWFP. Ewing and Tarasofsky (1996) mentioned that wood is used as raw material for construction and industrial purposes in Pakistan and its demand is increasing. Munroe and Abigail (2003) showed that residential conversion is decreasing forest cover. Schlich (1922), Sheikh and Mohammad (1977), Ayaz and Wani (2000), Knudsen (1995), Ewing and Tarasofsky (1996), Ali, et al. (1997), Ali (1999), and Michoacan et al. (2004) mentioned that one of the main reasons of deforestation is timber and firewood in the country.

The present research focuses on the identification of some of the socio-economic factors in Pakistan and on

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ranking of these factors with respect to their intensities so that priorities of the government should be properly specified and focused policy measures would be taken in national forest policies and working plans. In this context the study aims at identifying and analyzing the selected socio-economic factors that affect forest area in Pakistan and to find out the level of effect of selected socio economic variables on forest areas in the country. Further it is to compare the level of effects of these variables between the provincial and national forest areas. The study hypothesized that area under cultivation for meeting growing agriculture products demand has contributed to the reduction of forest area in Pakistan.

METHODOLOGY

For achieving the objectives, time series data for the selected variables have been taken. Secondary data is used from 1972 i.e. after the fall of East Pakistan in 1971 to 2000. The analysis is restricted to the year 2000 because of the policy period and start of war on terrorism. Multiple regression has been used and best model is selected through step wise regression. Minitab statistical package has been used. Durbin Watson test and T-test are used for detecting autocorrelation and multicollinearity. Data has been transformed to log to cease multicollinearity and autocorrelation. Further to cease autocorrelation, deflating the variables to get the real value, so transformation method has been used.

Analytical Technique and Functional Form of the Model

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\beta_K X_K + \varepsilon \quad \ldots\ldots\ldots(1)$$

Model A

Y^ = Forest area Pakistan (m hec.) and Xi are Real Agriculture value (m Rs.), Real Manufacturing value m Rs.), Real GDP (MP) (m. rupees), Real construction (m. rupees), Real Per capita income at MP (Rs.), cultivated area (m hec), irrigated area (m hec), population (Mln.), Household Gas Consumption (mm cft) Household electricity consumption (mm c), Household Coal Consumption (000 M tons), Out turn of firewood (000 cubic meter), Livestock population (million no.), Production of Paper and paperboard (tones), Production of chipboard and hardboard (tones) X16= Total road length (kilometers), Timber Consumption (cubic meter tones)

Model B

Y^ = Forest area Khyber Pakhtunkhwa (000 hec.) whereas all explanatory variables are same as above.

RESULTS AND DISCUSSION

The Regression equation for Model A where dependent variable is the forest area of Pakistan:

LOG Forest Pak = 1.63 – 0.843 X_1 + 0.151 X_2 + 1.01 X_3– 0.189 X_4 – 0.095 X_5– 3.45 X_6 +0.722 X_7+ 1.22 X_8 + 0.099 X_9– 0.452 X_{10} + 0.0058 X_{11} + 0.0205 X_{12}+ 0.111 X_{13}– 0.0189 X_{14}– 0.0779 X_{15} + 0.115 X_{16} - 0.0096 X_{17}……(A)

S = 0.01012 R-Sq = 98.3% R-Sq(adj) = 95.6%
F= 37.04 P = 0.000

Durbin-Watson statistic = 2.40

The value of F = 37, P = 0.000 in the model shows that model is overall significant. The value of R square shows that model explains 98% variations. Rest of the variations may be due to other factors for example forests fires, illicit felling for which data was not available.

The Regression equation for Model B where dependent variable is the forest area of Khyber Pakhtunkhwa:

Log forest N = 6.91 - 1.23 X_1+ 0.146 X_2 + 2.52 X_3– 0.298 X_4– 1.13 X_5– 8.13 X_6+ 2.59 X_7+ 0.77 X_8+ 0.265 X_9– 0.561 X_{10}+ 0.0445 X_{11}+ 0.0367 X_{12} + 0.211 X_{13}– 0.0514 X_{14}– 0.113 X_{15}+ 0.025 X_{16}– 0.0396 X_{17}…… (B)

R-Sq = 98.2% R-Sq (adj) = 95.4% F = 35.30P =0.000Durbin-Watson statistic = 2.35

The value of F = 35.30, P = 0.000 shows that model is overall significant. The value of R square shows that model explains 98.2% variations.

The effect of increase in agriculture production value of the country has negative effects on the forest area of Pakistan. A unit increase in the real construction value of the country also negative effects but at a rate of 0.188 units. However this effect is lower than the effects of agriculture production on forests. A unit increase in the real construction value of the country negatively affects the provincial forests at a rate of 0.2983 units. Agriculture production has higher effects both on the forests of Pakistan and on the forests of Khyber Pakhtunkhwa as compare to the effects of construction.

The model shows that as per capita income in Pakistan is increasing, the forest area of Pakistan is negatively affected. An increase in cultivated area of the country brings about 3.44 units decrease in the forest area of Pakistan. Its negative effect on forest area is higher than construction. Consumption of electricity negatively affected the forest areas in the country. Positive effects of irrigated area are found.

The effect of increase in manufacturing product value in the country has positive though very minor effects on the forest area of Pakistan. The national income effect on the forest area of Pakistan is found positive. Roads in Pakistan has no negative effect on the forest area rather a one unit increase in the road leads to have positive

Table 1. Best Regression Model A, Dependent Variable= Forest Area Pakistan

Predictor	Coef	StDev	T	P	Significant
Constant	3.0122	0.8316	3.62	0.001	*
LOG popu.	0.8123	0.1458	5.57	0.000	*
LOG cultiv.	–3.0532	0.8198	–3.72	0.001	*
LOG livestock	0.08526	0.02921	2.92	0.008	*
LOG chipboard	–0.06220	0.02979	–2.09	0.048	*

S = 0.01264 R-Sq = 94.1% R-Sq(adj) = 93.2% Durbin Watson = 2.3 F = 96.51 P= 0.000

Table 2. Best Regression Model B, Dependent Variable= Log Forest Area Khyber Pakhtunkhwa

Predictor	Coef	St Dev	T	P	Significance
Constant	7.059	2.407	2.93	0.007	*
Log r agr	-0.8459	0.1801	-4.70	0.000	*
Log r man	0.8562	0.1646	5.20	0.000	*
Log cult	-5.145	2.321	-2.22	0.036	*
Log popu	1.4634	0.3968	3.69	0.001	*

R-Sq = 93.7% R-Sq(adj) = 92.7% F = 89.63 P = 0.000 Durbin-Watson statistic = 1.48

effects on the forest area of Pakistan. This implies that road linkages have provided a facility to forest communities for easy movement to other areas and an access to other employment opportunities. But the model results show that population of Pakistan has not negatively affected the forest area of the country. This also implies that if population growth has slow down then its effects are not adverse. A study by Ali, et al. (2006) also mentioned that population is not the most responsible factor in forest depletion. Write and Muller (2006) while discussing the relationship between population and forest cover mentioned that although in the past the relationship was inverse but because of fast urbanization and slow growth of population has now positive and less destructive effects that lead to increase in forested area and forest regeneration. White and Dean (2004) also mentioned that empirical studies find positive links between environmental amenities and economic and population growth.

The model shows that increase in the consumption of gas by household in the country has positively affected the forest area of Pakistan particularly that of the province. Similarly livestock population has no negative impacts because of stall feeding facilities. Consumption of coal by household in the country has positive impacts on the forest area. However timber consumption, production of hardboard, chipboard and paper and paperboard leads to decrease the forest area. The effect of firewood production is found insignificant. The main reason is that illegal cutting is more than the recorded one.

The Best Regression Equation for Model A is:

Response is LOG forest area Pakistan on 17 predictors, with N = 29

LOG forest Pak = 3.01 + 0.812 LOG popu– 3.05 LOG culti + 0.0853 LOG livestock

– 0.0622 LOG chipboard

The results show that cultivation is putting heavy negative pressure on the forest area of the country.

The Best Model B Regression Equation is:

LOG forest N = 7.06 - 0.846 Log ragr + 0.856 log rmanu - 5.14 LOG culti + 1.46 LOG popu

The value of Durbin Watson = 1.48 shows that since it is close to 2 so there is no autocorrelation.

The above results show that in case of provincial forests the cultivation is again having the highest pressure on the provincial forests.

The below table shows the information taken from both the models. There is 100% similarity in the trend of effect of the selected variables on the national forests as well as provincial forests. However, the intensity of effect is more on provincial forests as compare to national forests (i.e.in 83% cases).

Table 3. Comparisons of National and Provincial Forest Areas

Predictor	Coefficient Model A	Coefficient Model B	Trend of Effect On both Forest Areas	Intensity of Effect On both areas
Forest area Pak.	Dependent variable	Dependent variable	Dependent variable	Dependent variable
Forest area Khyber Pakhtunkhwa	Dependent variable	Dependent variable	Dependent variable	Dependent variable
Real agr V.	-0.8434	-1.2253	- -	L H
Real man V	0.1513	0.1461	+ +	Approximately equal
Real GDP	1.0063	2.518	+ +	L H
Real Const. V	-0.18891	-0.2983	- -	L H
Per cap Income	-0.0949	-1.1259	- -	L H
Cult. Area	-3.447	-8.133	- -	L H
Irri. Area	0.7223	2.594	+ +	L H
Popu	1.2214	0.770	+ +	H L
Gas cons	0.0994	0.2654	+ +	L H
Elec cons	-0.4517	-0.5613	- -	L H
Coal cons	0.00576	0.04447	+ +	L H
Firewood pro	0.02053	0.03670	+ +	L H
Livestock pop	0.11064	0.2106	+ +	L H
Paper, paperboard	-0.01886	-0.05144	- -	L H
Chipboard, hardboard	-0.07792	-0.1127	- -	L H
Road length	0.11514	0.0248	+ +	H L
Timber consumption	-0.00958	-0.03960	- -	L H
Results of uniformity			**100 %**	**In 83% cases high effect in** Khyber Pakhtunkhwa

Source: Model results and primary feedback from Hazara local forest communities (2013)
L = Low H= High

CONCLUSION

It is concluded that if there is any pressure built up by agriculture, construction, cultivation, consumption of timber and firewood etc. on the forest area of Pakistan then most of the pressure is on the forests of Khyber Pakhtunkhwa. It is suggested that policies related to urban planning, agriculture, construction and demography must include forest consideration as well. So in order to save the forests of the province the government should properly plan national rural urban, irrigation, population, agriculture and construction policies carefully. Land conversion practices from forests to cultivation and construction should be stopped. Proper land use policy is important to save further fall in the forest area.

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