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IMPACT OF SOCIO ECONOMIC VARIABLES ON THE FOREST AREA OF PAKISTAN (1972-2005)

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ABSTRACT

Pakistan has low forest area and a high rate of deforestation. Socio economic activities are adversely affecting this area. The study highlights some socio economic factors. These factors are analyzed by taking time series data from 1972 to 2005. Multiple regression technique is applied. The data has been log transformed. In order to check the stationarity of a given time series Augmented Dickey Fuller test is applied, while for existence of co integration Johnson's Likelihood criterion is used. Eight variables are non-stationary when both intercept and trend is included. One variable (Forest production) is non-stationary whether trend is included or not. The test results further show that the variables are co integrating and they have long-term relationships. The study shows that human population, livestock population, construction sector growth has no negative effects on the forest area of the country rather cultivated area and manufacturing growth has impacted adversely. Road construction has also affected forest area but the effect is minor. Increase in irrigated area has also adversely affected forest area. The result about forest production shows that illicit felling is far more than the legal extraction. The study recommends proper implementation of land use policy, control on encroachment and compilation of accurate data on forest production.

KEYWORDS

Deforestation, Forest area, Socio economic factors, Effect's level and multiple regressions.

INTRODUCTION

A forest is best defined as an ecosystem or assemblage of ecosystems dominated by trees and other woody vegetation (Mehmood, 2003). All definitions of forests stress the importance of trees in the system and include places where tree cover ranges from 5% to as high as 100%. Pakistan has low forest area and is ranked 113 among 140 countries (GOP, 2005). In Pakistan only 5.2% of area is under forests, which was 4.28% in 1996-97. According to FAO (2005) each year about 13 million hectares of the world's forests are lost due to deforestation. The annual net loss of forest area between 2000 and 2005 was 7.3 million hectares/year. This is equivalent to a net loss of 0.18 percent of the world's forests annually. Forests now cover nearly 4 billion hectares or 30 percent of the world's land area.

Pakistan experienced deforestation at a rate of 1.1 percent (55000 ha) annually (Hasan, 2001). Fuel wood is an important component of household economies in Pakistan. It covers about 53% of total annual domestic energy needs. It has also been estimated that 70-79% of Pakistani households use fuel wood as a main source of energy (Jawad and Benjaminsen, 2004). Pakistan consumes about 50 million m³ of firewood and timber each year, whereas the growth of fuel wood and timber in forests and plantations is 8.8 million m³ per year. If the current rate of planting (about 92 million seedlings on about 46000 ha per year) on private and community lands continues, the annual growth will increase by the year 2018 to about 22.5 million m³ that is still less than the demand (GOP, 1992). Forests are cut down for cultivation, for construction of houses, for factories, for road construction etc. Road length was 97 thousand Km. in 1981 that increased by 164% to 256 thousand in 2003-04 so growing at an average growth of 4.4% (GOP, 2005). All these factors effect is however not equal and different from one another. The present study is focusing on some objectives that are related to the effects of some factors effecting on forest area in Pakistan.

Wannitikul (2005) studied that population in Thailand have the highest negative effect but he mentioned that this perspective of blaming population growth alone for natural resource destruction in developing economies is an oversimplification of a complex social problem instead, government policy on infrastructural development, including the forest clearances and increasing cash crop production are considered as likely causes. Similarly a study by Ali, et al. (2006) also mentioned that population is not the most responsible factor in forest depletion. Write and Muller (2006) mentioned that although in the past the relationship was inverse but now 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.

Ali (1999) and Hooper et al. (2005) supported livestock population growth for seed dispersal because insufficient seed dispersal is a major limitation to natural regeneration. The majority of tropical tree species has animal-dispersed fruits but most animals, don't enter far into these deforested areas. Munroe and Abigail (2003) mentioned that the abandonment of agriculture land and changing agriculture profitability is leading to private forest re-growth. Wannitikul (2005) showed that no correlation was found between the area of irrigation systems (IRG) and forest cover in Thailand. Knight (2000) mentioned that in recent decades domestic timber has been replaced by imports and forest tourism has emerged. Schlich (1922) found that in the British Empire the import of forest products mainly timber steadily increased since 1884. Nadkarni, et al. (1989) mentioned that on Karnataka forests among the interested parties, the first one is the locals and second is commercial and industrial interests that used forests as a source of raw material. Wilkie et al. (2000) showed positive relationship between road density and land degradation in eighteen nations in Africa.

OBJECTIVES OF THE STUDY

1. To identify socio economic factors that hinder the growth of forest area in the country.
2. To analyze the selected socio economic factors that affect forest area in the country, like human and livestock population growth, cultivated area in the country, irrigated area, manufacturing growth, construction and forest production.

MATERIALS AND METHODS

The present study has focused on the analysis of macro economic data of Pakistan. To achieve the objectives of the study, secondary data from 1972-2005 taken from Economic Survey of Pakistan various issues have been used for selected variables. In order to check the stationarity of a given time series an Augmented Dickey Fuller test is used, while for existence of co integration Johnson's Likelihood criterion is used. The following multiple regression models were used for analysis.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \epsilon \tag{1}$$

Where Y represents forest area of Pakistan and $X_1 \dots X_k$ represent the explanatory variables. The error term ϵ represents the collective unobservable omitted variables.

The estimated regression parameters, or regression coefficients, for the model denoted by \hat{Y} are given by

$$\hat{Y} = b_0 + b_1 X_1 + b_2 X_2 + \dots + b_k X_k \tag{2}$$

- Y^{\wedge} = Log Forest area Pakistan
- X_1 = Log Population
- X_2 = Log Livestock Population
- X_3 = Log Cultivated Area
- X_4 = Log Irrigated Area
- X_5 = Log Forest Production
- X_6 = Construction Growth
- X_7 = Manufacturing Growth
- X_8 = Log Road Length

RESULTS AND DISCUSSION

STATIONARITY OF THE TIME SERIES

Table I present the results of the unit root test. Eight variables are non-stationary when intercept is included only, and after inclusion of trend the variables remain non-stationary. One variable (Forest production) is non-stationary whether trend is included or not.

TABLE I: ADF TEST FOR STATIONARITY

Variables	Include intercept only		Include intercept and trend		Result
	Computed Value	Critical Value	Computed Value	Critical Value	
Forest Area	-0.5584[0]	-3.6422	-3.2196[1]	-4.2712	I(1)*
	-6.8127[1]	-3.6576	-6.7772[1]	-4.2826	I(1)**
Population	-1.2746[1]	-3.6496	-0.1545[0]	-4.2605	I(1)*
	-4.4768[0]	-3.6496	-4.6746[0]	-4.2712	I(1)**
Livestock	-1.3840[0]	-3.6422	-3.9230[0]	-4.2605	I(1)*
	-7.8726[0]	-3.6496	-5.3036[1]	-4.2826	I(1)**
Cultivation	-2.3718[1]	-3.6496	-2.8324[0]	-4.2605	I(1)*
	-3.8668[1]	-3.6576	-8.7968[1]	-4.2712	I(1)**
Irrigation	-1.3569[0]	-3.6422	-1.9322[1]	-4.2712	I(1)*
	-6.3292[1]	-3.6576	-8.6578[0]	-4.2712	I(1)**
Forest Prod	-4.7016[0]	-3.6422	-4.6603[0]	-4.2605	I(0)*
					I(0)**
Cons Gro	-2.8764[0]	-3.6496	-2.9750[1]	-4.2605	I(1)*
	-5.3877[1]	-3.6576	-10.280[0]	-4.2712	I(1)**
Manu Gro	-3.3654[0]	-3.6422	-3.3423[0]	-4.2605	I(1)*
	-5.6437[1]	-3.6576	-7.4723[1]	-4.2712	I(1)**
Road Length	-2.6544[0]	-3.6422	-1.8234[1]	-4.2712	I(1)*
	-6.0182[0]	-3.6496	-6.9850[0]	-4.2605	I(1)**

CO-INTEGRATION OF THE VARIABLES– THE JOHANSEN TEST

Johansen Likelihood Ratio (LR) test is used to find out the co integration in the regressions used for analysis. The result of Likelihood Ratio (LR) test is depicted in table II. The Likelihood Ratio (LR) test results point out that the assumption of no co integration has been rejected for all equations by Likelihood Ratio (LR) statistics. The test denotes the existence of five co integrating equations as the calculated values of Likelihood Ratio (LR) statistics are greater than the critical values at 5 percent as well as 1 percent. The test results show that the variables are co integrating and they have long-term relationships.

TABLE II: JOHANSEN CO INTEGRATION TEST RESULT WITH INTERCEPT (NO TREND) IN CE AND NO INTERCEPT IN VAR

(Variables included in the co integrating vector: FA P LS CV IR FP CG MG RL).Test assumption: No deterministic trend in the data. Lag interval is 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.926885	319.7203	192.89	204.95	None **
0.880772	236.0172	156.00	168.36	At most 1 **
0.802162	167.9622	124.24	133.57	At most 2 **
0.746425	116.1123	94.15	103.18	At most 3 **
0.606873	72.20528	68.52	76.07	At most 4 *
0.475137	42.32940	47.21	54.46	At most 5
0.287983	21.70163	29.68	35.65	At most 6
0.259061	10.83274	15.41	20.04	At most 7
0.037947	1.237953	3.76	6.65	At most 8

(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 5 co integrating equation(s) at 5% significance level

RESULT OF MULTIPLE REGRESSION MODELS

The results of multiple regressions are given in table 3. Each variable is separately explained under the following title.

1 GROWTH IN HUMAN POPULATION

Population is generally considered as one of the most important factor that is responsible for deforestation. But the model results show that population of Pakistan has not negatively affected the forest area of the country. A unit increase in the population of the country has brought about 0.83 positive changes in the forest area. This leads to the conclusion that effects of population may be positive or negative depending on the situation in the country that whether it is used as human resource for natural resource generation or as a source of only consumption. This also implies that if population growth has slow down then its effects are not adverse. Population growth has decreased from 3% in 1970s to 2.6% during 1990s

2 INCREASE IN LIVESTOCK POPULATION

Grazing pressure destroys the upper fertile layer of soil, uprooted young tree crops thus putting negative pressure on forest resources. But the model results show that livestock population has positive impacts on the forest area of Pakistan. A unit increase in livestock population has 0.04 units increase in the forest area. Increase in livestock population is not causing any negative pressure on forest area mainly because the growth in its population is slow in Pakistan. As compare to the past decades free grazing is now limited and stall-feeding is gaining importance. In areas where there is less stall feeding people have started planting those trees (fodder trees) which they can use for their animals.

3 CULTIVATED AREA

It was assumed that as the cultivated area in the country is increased forest area is depleted. The model shows the same results in Pakistan that cultivated area of the country has negative impacts on the forest area of Pakistan. The people of the area first encroach to forest areas and then start cultivation and construction especially on terraces. The model shows that one unit increase in cultivated area of the country brings about 2.3081 units decrease in the forest area of Pakistan. In the overall regression model, the factor with highest effect is (T= -2.56 P=0.017) the cultivated area affecting on forest area of the country. Its negative effect on forest area is higher than construction and manufacturing sector in Pakistan.

4 IRRIGATED AREA

The model results show negative effects of irrigated area on the forest area of Pakistan. As one unit change is made in the area of irrigation, 0.3170 units decrease in the forest area. The important fact is with increasing irrigation facilities agriculture activities for food production has increased in Pakistan.

5 FOREST PRODUCTION

Firewood production, timber production, production of chipboard and hardboard all effect on forests growth but it depends whether it is sustainably produced or not. The model shows that the effect of forest production is 0.05300 units. The effect is however found positive. The model results imply two important things; one the unit effect is minor and secondly the effect is not adverse on the forest area. These results are opposite to general information. The main reasons are that illicit felling for which data was not available. Secondly firewood is mainly obtained from plantation in Punjab and the official figures for firewood production are not accommodating production from private farm plantation.

6 CONSTRUCTION GROWTH

It is generally assumed that increase in the construction activities deplete the forest resources. The model results show that increase in the construction sector growth has effects at minor rate of 0.02% on the forest area. However this effect is not negative. Govt. of Pakistan (1986) however mentioned that projects in areas like housing schemes, ports and harbors, roads, mining, dams and reservoirs, energy, fertilizers, industrial irrigation and many others do consider forest cutting, land clearing and restoration of the disturbed areas etc.

7 MANUFACTURING SECTOR GROWTH

The effect of increase in manufacturing growth in the country has negative effects on the forest area of Pakistan. If there is one percent increase in the value of manufacturing it results in decrease in forest area of Pakistan at a rate of 0.12 %.

8 ROAD CONSTRUCTION

Road construction destroys forests because these are built by cutting trees. Roads in Pakistan has negative but minor effect on the forest area i.e. a one unit increase in the road leads to decrease forest area by 0.00285 units on the forest area of Pakistan.

TABLE 3: REGRESSION RESULTS, DEPENDENT VARIABLE = LOG FOREST AREA PAKISTAN

Predictor	Coef	StDev	T	P	VIF
Constant	2.0516	0.9149	2.24	0.034*	
Log popu	0.8356	0.1450	5.76	0.000*	71.7
Log live	0.04389	0.03134	1.40	0.174	13.8
Log cult	-2.3081	0.9020	-2.56	0.017*	66.6
Log irri	-0.3170	0.3178	-1.00	0.328	50.5
Log Fore	0.05300	0.02797	1.90	0.070*	1.6
Construc	0.0002240	0.0003836	0.58	0.565	1.4
Manufact	-0.0015281	0.0007087	-2.16	0.041*	1.6
Log road	-0.00285	0.04661	-0.06	0.952	33.1

* shows it is significant

S = 0.01229 R-Sq = 96.4% R-Sq(adj) = 95.3%

F = 84.57 P = 0.000, Durbin-Watson statistic = 1.89

CONCLUSION AND RECOMMENDATIONS

Pakistan has low forest area and a high rate of deforestation. Although the forest production has increased but still the demand supply gap is high. The pressure on forests comes from different areas including socio economic activities of the population both at micro and macro level, for example, cultivation, construction of houses, factories, road construction, human and livestock population growth etc.

The study revealed that human population growth has slow down so its effect is not adverse on the forest area of Pakistan. Livestock population and grazing is also found not a threat to forest area depletion because of check on free grazing and increasing trend of stall feeding. Irrigated area has negative contribution towards forest area. However, cultivated area has shown high negative effects on forest area of Pakistan. Its negative effect is not only high but also higher than manufacturing and road construction. Construction sector has grown but in areas other than forest areas so its effect is not negative. Results about forest production are against the general assumption that these have negative effects on forest area but since most of fuel wood and timber is extracted illegally in Pakistan so the official data is not the true representative of forest production.

On the basis of above analysis it is suggested that cultivated area is increased at the costs of forest area so there is a need to clearly demarcate the forest area. Further land use policy should be strictly implemented and terraces without permission should not be allowed to cultivate. The data for fuel wood and timber should be properly maintained or at least proper estimation for illicit felling should be constructed so as to get better analysis of the situation.

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