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Status of Natural Resources and Socio-Economic Indicators

Dr. Hansa Jain

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On behalf of Sardar Patel Institute of Economic and Social Research (SPIESR), the committee, and the author remain grateful to the anonymous referee for her/his valuable inputs in strengthening the paper.

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List of Abbreviations

NRD	Natural Resource Depletion
PDLR	Pressure and Degradation of Land Resources
NPSWPP	Non-point Source Water Pollution Potential
UNFPA	United Nations Fund for Population Activities
DDWR	Depletion and Degradation of Water Resources
DDFR	Depletion and Degradation of Forest Resources
PCNSDP	Per Capita Net State Domestic Product
PSCPOP	Percentage of Scheduled Caste Population to Total Population
PSTPOP	Percentage of Scheduled Tribe Population to Total Population
PLIT	Percentage of Population having Literacy
PCFOAR	Percentage Change in Forest Area
SAGNSDP	Percentage Share of Agriculture to Total Net State Domestic Product
TNRD	Total Natural Resource Depletion
NSDP	Net State Domestic Product
RUPOV	Rural Poverty
RUMIG	Rural Migration
EKC	Environment Kuznet Curve

Status of Natural Resources and Socio-Economic Indicators

Dr. Hansa Jain*

Abstract

This paper is an attempt to analyse natural resource depletion and its relationship with various socio-economic activities of human beings. In order to separate the effect of one natural resource on other, four principal components of natural resource depletion are developed: pressure and degradation of land resources, non-point source water pollution potential, depletion and degradation of water resources, and depletion and degradation of forest resources. Correlation and multiple regression techniques are used to find the impact of socio-economic activities on natural resource depletion. Further, an attempt is made to find the relationship between various socio-economic activities. We find that increase in literacy and employment in rural non-farm sector is a better option to decrease the pressure on natural resources and check migration to urban areas.

Key words: Natural Resources, Natural Resource Depletion, Land Use, Principal Component, Regression, Correlation, Socio-economic Indicators

JEL Classification: Q010, Q310, Q240, C19, C49, I32, Q560, Q02

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1. INTRODUCTION

Natural resources play an important role in socio-economic development. Natural resources not only influence but are also influenced by socio-economic activities of human beings. These resources include air, water, soil, minerals, coal, petroleum, animals, and plants. In the primitive age, human beings used only those resources that supported their life. Post industrialization economic growth and increase in population have led to the mismanagement of natural resources. A resource is said to be depleted when it is used beyond its regeneration capacity. In other words, one can say that a resource is depleted when it is not able to provide gainful employment to local people. In India, the livelihood of more than 60 per cent of the population depends upon locally available natural resources especially land, water, and forests. There is a need to determine the type of relationship that exists between natural resource depletion and the performance of various socio-economic indicators and also to check further depletion of natural resources.

Grossman and Krueger (1995), Steer (1992), Susmita Dasgupta et al. (2002), and Shafik and Bandyopadhyay (1992), among others, have postulated an inverted U-shaped relationship (EKC) between economic growth and environmental degradation. But there is an interplay of local socio-economic factors that also significantly contributes to the depletion of natural resources.

2. OBJECTIVES

1. To examine the pressure on natural resources in India
2. To develop suitable indicators to determine depletion of natural resources

3. To find the interrelationship between natural resource depletion and performance of socio-economic indicators.
4. To suggest measures to reduce natural resource depletion.

3. METHODOLOGY

Data

The study is based on secondary sources of data, mainly reports of the Census of India, Central Statistical Organization, migration tables, various issues of Statistical Abstracts and official websites.

The pressure on natural resources is computed from population and land data and consumption of electricity and consumption of fertilizers in agriculture. A change in land productivity and cropping pattern reflects the utilization of natural resources. All this is reflected in the share of net agriculture output to net domestic product.

Indicators of Natural Resource Depletion (NRD)

Natural resource depletion is a very complex and intermixed picture of resource utilization. An excessive use of one resource is bound to have an influence on the quality and quantity of other resources. For example, an excessive use of land affects the forest area. High destruction of forests is associated with various types of biological, ecological, and climatic changes. It also results in extinction of several species essential for maintaining ecological balance. Unplanned exploitation of water resources not only reduces agricultural productivity but also results in desertification, soil erosion, wind erosion, water-logging, salinity etc. Excessive use of fertilizers

not only distorts the soil chemically but also deplete ground water.

With the help composite indices, we have tried to separate the depletion of land, water, and forest resources. Four composite indices have been developed with the help of principal component analysis for 14 major states of India. Variables having low loadings were ignored in the process of giving an interpretation to the component. Only the variables having high loadings in the original data matrix have been taken into consideration to obtain the composite indices.

Time series data have been divided into two parts: period 1 refers to the average for the period 1990s and period 2 refers to the average for the period 2000s. The average is taken to smoothen out uneven fluctuations. The division of the last two decades also signifies the change in the rate of depletion during the 1990s and 2000s. The composite indices are as follows:

(a) Pressure and degradation of land resources (PDLR)

India faces the most acute pressure on agricultural land. A change in land utilization pattern implies an increase or decrease in the proportion of area under different land uses at a point in two or more time periods. Most of the expansion of cultivated land has taken place at the expense of forest and grazing land. Despite past expansion of the area under cultivation, less agricultural land is available to feed each Indian.

Land for non-agricultural uses increased from 9.36 million hectares in 1951 to 22.97 million hectares in 2001. This includes all land occupied by buildings, roads, railways, or under water, (rivers and canals) and land put to uses other

than agriculture. The decline in barren and unculturable land can essentially be attributed to the increase in area under non-agricultural use.

Fallow land other than current fallows includes all land taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years. The reasons for keeping such lands fallow may be one or more of the following: poverty of farmers, inadequate supply of water, irregular monsoon, silting of canals and rivers, and unremunerative nature of farming. There was a decrease of 7.33 million hectare in fallow land between 1950-51 and 1999-2000, which is a sign of better utilization of land in the form of bringing it into cultivation.

Current fallows represent cropped area which is kept fallow during the current year. When intensification first begins, farmers are likely to simply shorten the fallow cycle on better quality (or less remote) lands, returning to them sooner rather than expanding to lower quality lands (Boserup, 1965). As fallow periods shorten, forest fallow is eventually replaced by bush and then green grass fallow, since the forest is not given time to regenerate. Soil fertility is given less chance to recover, and the length of the cropping period is also reduced.

An increase in net sown area indicates the conversion of forest and other grazing land to agricultural uses. If net sown area becomes stagnant, it would mean that additional land is not available for cultivation. In this sense, an increase in area sown more than once indicates excessive use of existing land.

A change in area under foodgrains represents a change in demand for

foodgrain and non-foodgrain crops. An increase in income results in increase in demand for non-foodgrain crops. As a result, nutrients required to maintain soil fertility decrease. Change in gross cropped area indicates the availability of cultivable land and change in gross irrigated area indicates the expansion of irrigation facilities.

Therefore, following indicators are considered important to measure PDLR:

1. Change in land not available for cultivation (as per cent of reporting area)
2. Change in fallow land (as per cent of reporting area)
3. Change in net sown area (as per cent of reporting area)
4. Change in area under foodgrains (as per cent of gross cropped area)
5. Change in gross irrigated area (as per cent of gross cropped area)
6. Change in gross cropped area (as percent of reporting area)
7. Change in area cultivated more than once (as percent of gross cropped area)

(b) Non-point source water pollution potential (NPSWPP)

Non-point source water pollution is one of the primary causes of water quality problems. Agricultural activities are considered to be a leading cause of non-point source pollution. Intensification of agricultural activities is associated with excessive use of pesticides and fertilizers. Most part of the applied pesticides and fertilizers, irrespective of crop, applicator, or formulation used, ultimately finds its way into the soil. Before pesticides are completely inactivated, they may adversely affect the

functioning of non-target microbes and other forms of life inhabiting the soil. They may also be taken up by plants or get translocated in the aquatic system by leaching or run-off, thus contaminating the plankton, fish, invertebrate, and other forms of life. Besides, traces of pesticides and fertilizers from the fields are washed into the nearest water bodies at the onset of monsoon or heavy showers and add to water pollution. Pesticide residues in food items have been a matter of concern. Even small amounts of these residues ingested daily can build up high levels in the body fat. The long term effects of these residues in human body include carcinogenicity, reduced life span and fertility, increased cholesterol, high infant mortality, and varied metabolic and genetic disorders (*Compendium of Environment Statistics*, 1999).

Consumers are affected by agricultural concomitants such as pesticides and fertilizers that run-off from fields into rivers. Polluting a river is dangerous because rivers are the primary source of drinking water for towns and cities downstream of the point of pollution.

Owing to development and accelerated process of urbanization, people in urban areas and those with higher incomes generally replace pulses with more of fruits, vegetables, and livestock products (Bansal, 1999). Indirect evidence of reduction of area under pulse cultivation may also be interpreted as the declining importance of pulses and an increase in per capita availability of livestock products reflects the growing demand for protected food (UNFPA, 1999). The consequences of this process are the increasing livestock pressure on land and forests because of increase in demand for fodder and

grazing (Chopra and Gulati, 1994). Whether the cattle is stalled or being left to graze depicts the increasing burden on foliage over the years. Illegal grazing and overgrazing in forest tracks is primarily responsible for forest degradation in India.

Besides, higher the concentration of population at a place, higher is the non-point source water pollution as various types of solid and liquid wastes are disposed off on the earth. Through irrigation of chemically treated land, various types of acidic contents are added into the water streams and underground water.

Following indicators are used to arrive at the composite index of NPSWPP:

1. Fertilizer consumption per hectare (kg/hectares)
2. Pesticide consumption per hectare (kg/hectares)
3. Change in number of livestock per 1000 hectares of reporting area
4. Change in number of persons per 1000 hectare of reporting area
5. Number of persons per 1000 hectare of reporting area
6. Change in gross irrigated area (as per cent of gross cropped area)
7. Gross irrigated area (as per cent of gross cropped area)

(c) Depletion and degradation of water resources (DDWR)

Development in irrigation potential is largely through the efforts of the government through major, medium, and minor irrigation projects.

An increase in groundwater sources indicates the exploitation of water

resources. Rural electrification and subsidies to agriculture have increased the possibility of extending irrigation facilities through extraction of groundwater. This should have an adverse impact on groundwater, river beds, ponds as well as surface water. This also weakens the soil bonding, resulting in soil and water erosion.

On this basis, DDWR is a composite index of following indicators:

1. Percentage share of major and minor irrigation potential to ultimate irrigation potential
2. Percentage share of major and medium irrigation potential utilized to corresponding potential created
3. Percentage share of minor irrigation potential to ultimate irrigation potential
4. Percentage share of minor irrigation potential utilized to corresponding potential created
5. Change in per cent of net irrigated area by surface water sources (canal, tanks)
6. Level of ground water development (exploitation) (in per cent)
7. Change in gross irrigated area (as per cent of gross cropped area)
8. Pump set density (number per 1000 hectare of net irrigated area)

(d) Depletion and degradation of forest resources (DDFR)

Forests facilitate the conservation of ecological balance, and biodiversity, enhance the quality of environment by checking soil erosion, water retention, and conservation, regulate water cycle, act as a carbon sink which balances carbon dioxide and oxygen in the atmosphere, and facilitate in reduction of

greenhouse gases. In a developing economy, excessive population and livestock pressure, poverty, weak institutional framework, and the requirement of forest products for essential development generate great pressure on forest resources. This in turn triggers a deforestation process. Overexploitation of forest resources compared to their incremental and regenerative capacities escalates the forest depletion and degradation process. A decrease in dense forest reflects a qualitative decline of forests in the country.

Population growth has resulted in a downward trend in per capita availability of forest and agricultural land in India since the 1950s. Population growth is expected to be faster than hoped for improvements in forest cover as well as quality. However, population pressure is always the underlying cause of overexploitaiton of natural resources including forests. Possibly poverty, corruptions, weak institutions and wasteful consumption patterns also combine with population pressure facilitating depletion and degradation of forest stock.

Land under miscellaneous tree crops and groves includes all cultivable land which is not included in 'net area sown' but is put to some agricultural use. Land under thatching grasses, bamboo bushes, and other groves for fuel, etc., which are not included under 'orchards' should be classed under this category. It reveals that much of tree crops and pastures representing common property resources have reduced significantly over time. Common property resources are important in terms of providing fuel supplies, grazing area, employment,

and income generation options for rural poor as they depend on them for sustenance. Thus, land under this category is vulnerable to severe degradation (Iyengar, 2003). This is also against the interest of reducing pollution and improving the environmental status of the country.

Poverty is said to be both cause and effect of environment degradation. Poorer people, who cannot meet their subsistence needs through purchase, are forced to use common property resources such as forests for food and fuel, pastures for fodder, and ponds and rivers for water. This also contributes to environmental degradation through overexploitation of natural resources like land, air, and water. Population pressure driven overexploitation of surface and under groundwater resources by the poor has resulted in contamination and exhaustion of water resources.

Following indicators are selected to construct the composite index of DDFR:

1. Change in dense forest area as per cent of total forest area
2. Change in open forest area as per cent of total forest area
3. Change in total forest area as per cent of geographical area
4. Change in forest area per thousand persons (in sq. km. per 1000 persons)
5. Recorded forest area as per cent of geographical area
6. Common property forest area as per cent of total forest area
7. Common property forest area as per cent of geographical area
8. Common property forest area per 1000 persons (sq. km. per 1000 persons)
9. Per cent of geographical area under national parks
10. Per cent of geographical area under wildlife sanctuaries

11. Per cent change in gross state domestic product at constant prices from forestry and logging

Common property forest area = protected area + unclassified forest area

The scores of natural resource depletion (NRD) are obtained by taking the simple average of the composite indices.

Analysis

To find the relationship between natural resource depletion and socio-economic indicators, correlation technique is used. The variations in natural resource depletion are captured with the following regression models:

$$Y = \beta_0 + \beta_1 PCNSDP + \beta_2 PSCPOP + \beta_3 PSTPOP + \beta_4 PLIT + \beta_5 PCFOAR + \beta_6 SAGNSDP + U_i$$

where

PCNSDP = Per capita net state domestic product (at 2004-5 prices)

PSCPOP = Percentage of scheduled caste population to total population

PSTPOP = Percentage of scheduled tribe population to total population

PLIT = Percentage of population having literacy

PCFOAR = Percentage change in forest area

SAGNSDP = Percentage share of agriculture to total net state domestic product

U = Disturbance term

One variable, rural poverty (RUPOV), was dropped to protect the model from multicollinearity.

Dependent variable Y refers to five variables which are:

PDLR = Pressure and degradation of land resources

NPSWPP = Non-point source water pollution potential

DDWR = Depletion and degradation of water resources

DDFR = Depletion and degradation of forest resources

TNRD = Total natural resource depletion

Further, the inter-relationship between socio-economic variables is ascertained through correlation coefficients.

4. FINDINGS

4.1 Pressure on Natural Resources in India

Table 1 shows how the pressure on natural resources has increased in India during the past few decades. From 1951 to 2001, the population has increased from 361.1 million to 1028.6 million and the degree of urbanization has increased from 17.28 per cent to 27.74 per cent. The population and degree of urbanization have further increased to 1210.2 million and 31.16 per cent respectively in 2011(Population Census, 2011).

The increase in population indicates the pressure on land and water resources for fulfillment of consumption needs. The degree of urbanization indicates the demand for resources for a better quality of life. This includes

the development of roads, railways, schools, hospitals, buildings, etc. and basic services like drinking water, power, fuel, communication, etc. All this is reflected in the changes in the pattern of land utilization.

The level of urbanization in India is on rise and it has to deal with problems of land intrusions on productive agricultural lands. This is because urban land use persistently competes with rural land use on the basis of more favourable land rent in the free market. Again, higher level of urbanization would automatically lead to greater proportion of area under non-agricultural uses.

As shown in the table, from 1951 to 2001, thanks to afforestation efforts the forest area has increased from 14 per cent in 1951 to 23 per cent in 2001. It is still against the National Forest Policy 1988 stipulation of target of 33 per cent. Even within this recorded area, only 416.81 thousand sq. km. or 12.68 per cent of the country's total land area comprises dense forest with a crown density of more than 40 per cent, thus reflecting a qualitative decline of forests in the country (GoO, 1999). Barren and unculturable land has decreased by 49 per cent, other uncultivated land (excluding fallow land) has decreased by 42.39 per cent, fallow land has decreased by 11.42 per cent, net sown area has increased by 19 per cent, gross cropped area has increased by 44 per cent, cropping intensity has increased by 22 per cent, net irrigated area has increased by 175 per cent and gross irrigated area has increased by 238 per cent. Most of the expansion of agricultural land has taken place at the expense of forest and grazing land. The negligible increase in the net sown area after 1981 indicates that the expansion of land for agriculture has almost come to a standstill. The

livestock population has increased from 292 million in 1951 to 470.1 million in 1992.

Table 1
Pressure on Natural Resources in India

Indicators	1951	1981	2001
Population (in million)	361.1	685.1	1028.6
Urbanization (%)	17.28	23.31	27.74
Forest (million hectares)	40.48	67.47	69.02
Non-agricultural uses (million hectares)	9.36	19.66	22.97
Barren and unculturable land (million hectares)	38.16	19.96	19.44
Other uncultivated land (excl. fallow land) (million hectares)	49.45	32..31	28.49
Fallow land (million hectares)	28.12	24.75	189.74
Net sown area (million hectares)	118.75	140	141.23
Gross cropped area (million hectares)	131.89	172.63	189.74
Area sown more than once (million hectares)	13.14	32.63	48.51
Cropping intensity	110.1	123.3	134.30
Net irrigated area (million hectares)	20.85	38.72	52.24
Gross irrigated area (million hectares)	22.56	49.78	76.34
Livestock population (million)	292.0	419.6	470.1 (1992)
Consumption of electricity for agriculture (million kwh)	17817 (19% of total consumption)		97596 (1998-99) (33% of total consumption)
Consumption of fertilizer ('000 tonnes)	65.6	6064.1	19368.0

Sources: Census of India, 2001; Department of Agriculture and Cooperation, Ministry of Agriculture, 2002, www.agricoop.nic.in

This shows that there has been both horizontal and vertical pressure on natural resources. The increase in consumption of electricity in agriculture from 18.64 per cent to 32.89 per cent and consumption of fertilizers from 88.62 kg/hec to 95.33 kg / hec also signifies this fact. Today every million hectares of land supports 7.27 million people. Besides, the increase in non-agricultural use of land by 145.41 per cent may be attributed to rise in human population as well as launching of development programmes.

4.2 Land Productivity

Land is the most important natural base of the Indian agricultural economy. Land productivity is measured by agricultural production per hectare of gross cropped area. In Table 2, land productivity is measured in terms of the average yield during three different time-periods: 1980-81 to 1990-91, 1990-91 to 2000-1 and 2000-1 to 2005-6. The percentage change in average yield is shown in columns 5 and 6. Growth of land productivity has decreased in Andhra Pradesh, Assam, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Maharashtra, Orissa, Punjab, Rajasthan, and West Bengal. The highest decline is in Maharashtra and then in Haryana, Rajasthan, and Himachal Pradesh. Land productivity has increased in Bihar, Karnataka, Madhya Pradesh and Uttar Pradesh. Although extremely good rains led to an excellent year for agriculture in 1988, there has been a general decline in agricultural (especially food) production per capita over the past 15 years despite large increases in land used for agriculture. Many factors have contributed to the decline: climate change, increasing inability of farmers to purchase agricultural inputs, decline in soil productivity, and expansion of

Table 2
Agriculture Production per Hectare of Gross Cropped Area

States	Average Yield (in tones)			% change	
	1980-81 to 1990-91	1990-91 to 2000-1	2000-01 to 2005-6	Between (3) and (2)	Between (4) and (3)
	1	2	3	4	5
Andhra Pradesh	1351.33	1733.33	2066.67	28.27	19.23
Arunachal Pradesh	NA	1125.00	1199.17	-	6.59
Assam	1150.00	1327.00	1437.83	15.39	8.35
Bihar	1151.33	1452.33	2696.33	26.14	85.66
Gujarat	892.00	1109.33	1324.50	24.36	19.40
Haryana	1963.00	2644.67	3082.67	34.73	16.56
Himachal Pradesh	1455.67	1665.00	1681.33	14.38	0.98
J & K	1567.67	1564.00	1550.67	-0.23	-0.85
Karnataka	869.67	752.33	1281.83	-13.49	70.38
Kerala	1695.00	1969.67	2129.00	16.20	8.09
Madhya Pradesh	843.00	1080.33	2037.33	28.15	88.58
Maharashtra	721.33	883.67	853.50	22.51	-3.41
Manipur	NA	2328.00	2311.33	-	-0.72
Meghalaya	NA	1531.00	1635.50	-	6.83
Mizoram	NA	1781.00	1885.83	-	5.89
Nagaland	NA	977.00	1517.33	-	55.31
Orissa	955.00	1076.33	1173.67	12.70	9.04
Punjab	3012.00	3629.67	3975.83	20.51	9.54
Rajasthan	670.00	881.00	1011.67	31.49	14.83
Sikkim	NA	1317.00	1355.67	-	2.94
Tamil Nadu	NA	2056.00	1923.67	-	-6.44
Tripura	NA	2119.00	2192.33	-	3.46
Uttar Pradesh	1491.33	1937.67	3725.50	29.93	92.27
West Bengal	1546.67	1957.67	2392.00	26.57	22.19
All India	1192.67	1525.00	1665.00	27.86	9.18

Source: Directorate of Economics and Statistics, Ministry of Agriculture

cropping onto marginal lands. This should have an adverse impact on the rural population engaged in agriculture.

The impact of economic growth on cropping pattern can be easily visualized from the change in the percentages of area under different crops to total cropped area (Table 3). Major change is observed in the cropping pattern

Table 3
Cropping Pattern According to Land Use Statistics

(% of total cropped area)

	1950-51	1960-61	1970-71	1980-81	1990-91	1999-2000	2000-1	2001-2	2002-3	2003-4
Rice	23.5	22.3	22.6	23.3	22.9	24.0	24.1	23.6	23.8	22.4
Wheat	7.6	8.5	11.0	12.8	12.9	14.6	13.9	13.8	14.3	13.9
Total cereals	61.1	60.2	61.4	60.8	55.4	54.4	54.6	53.3	53.6	52.6
Total Pulses	15.6	15.5	13.9	13.2	13.4	11.7	11.5	12.1	12.1	12.9
Total	76.7	75.7	75.4	73.9	68.1	66.1	66.1	65.4	65.7	65.5
Sugarcane	1.3	1.6	1.6	1.7	2.1	2.4	2.5	2.5	2.7	2.3
Condiments & spices	0.9	1.0	1.1	1.2	1.3	1.5	1.5	1.7	1.7	1.6
Fruits & vegetables	1.7	1.9	2.0	1.7	3.6	4.3	4.4	4.6	5.1	4.7
Total oilseeds	8.3	8.3	8.9	9.1	13.5	13.9	13.3	13.2	13.5	13.8

Source: Ministry of Agriculture, Directorate of Economics and Statistics

during the last decade. The percentage of area under foodgrains has decreased from 76.7 per cent in 1950-51 to 65.5 per cent in 2003-4. Area under major food crops such as wheat, cereals, and pulses has continuously decreased after 1999-2000. On the other hand, area under sugarcane, condiments and spices, fruits and vegetables, and oilseeds is continuously increasing. It seems that the cropping pattern is biased to meet the needs of the high income group. It might

also create deficiency in the nutrients required to raise soil fertility.

The impact of the agricultural economy on the state economy can be seen in Table 4. Almost all the states are experiencing continuous decline in their share of agriculture sector to the net state domestic product. The maximum decline is in Karnataka, Madhya Pradesh, and Orissa. The share of agricultural income in states like Punjab and Haryana has also declined.

Table 4
Agriculture in Net State Domestic Product

	1993-94	1998-99	1999-2000	2000-1	2001-2	2002-3	2003-4	2004-5	% change (9)-(2)
1	2	3	4	5	6	7	8	9	10
Andhra Pradesh	33	28	26	28	26	22	23	23	-10
Arunachal Pradesh	35	29	31	31	28	26	26	24	-11
Assam	37	36	34	32	34	33	31	29	-8
Bihar	48	46	64	43	39	42	37	39	-9
Gujarat	22	24	16	15	19	14	20	17	-5
Haryana	42	35	34	32	31	29	29	29	-13
Himachal Pradesh	27	21	18	19	20	18	19	19	-8
J & K	32	32	32	32	32	31	32	32	0
Karnataka	35	27	29	30	24	21	17	18	-17
Kerala	26	23	21	16	15	14	14	13	-13
Madhya Pradesh	36	29	27	22	26	22	25	22	-14
Maharashtra	19	16	16	16	16	14	12	11	-8
Orissa	38	33	27	26	29	22	25	24	-14
Punjab	48	41	42	41	41	39	38	38	-10
Rajasthan	33	32	28	24	29	19	29	25	-8
Tamil Nadu	24	20	18	17	18	13	12	13	-1
Uttar Pradesh	38	35	36	35	33	32	30	29	-9
West Bengal	30	26	25	24	25	22	21	20	-10

Source: Central Statistical Organization

It can be seen that the states which are agriculturally rich, have shown more than 10 per cent decline in their share of natural resource depletion from

agriculture to total natural resource depletion, while this percentage is less than 10 for the agriculturally poor states. This indicates that the place of agriculture especially in the agriculture rich states is gradually taken up by the non-agriculture sector; else, these states are facing a crisis on the agriculture front.

4.3 Analysis of Scores of Natural Resource Depletion

Tables 5 and 6 analyse the scores of natural resource depletion (obtained through principle component analysis) for periods 1 and 2. A high score means high level of natural resource depletion. In period 1 (Table-5), the PDLR is highest in Haryana, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh.

Table 5
Scores of Natural Resource Depletion (Period 1)

	Scores of				Aggregate Score	Rank
	PDLR	NPSWPP	DDWR	DDFR		
Andhra Pradesh	3	12	4	1	30	8
Bihar	6	6	5	11	28	4.50
Gujarat	12	9	8	8	37	10
Haryana	14	13	12	7	46	14
Karnataka	2	7	10	10	29	6.50
Kerala	5	4	6	6	21	2
Madhya Pradesh	10	2	3	14	29	6.50
Maharashtra	11	3	9	13	41	13
Orissa	1	1	2	12	16	1
Punjab	8	14	14	2	38	11.50
Rajasthan	13	5	11	9	38	11.50
Tamil Nadu	4	10	13	5	32	9
Uttar Pradesh	7	11	7	3	28	4.5
West Bengal	9	8	1	4	22	3

Source: Computed

NPSWPP is very high in Punjab, Haryana, Andhra Pradesh, Uttar Pradesh, and Tamil Nadu. DDWR is found to be very high in Punjab, Tamil Nadu, Haryana, Rajasthan and Karnataka. DDFR is highest in Madhya Pradesh followed by Maharashtra, Orissa, Bihar and Karnataka. The ranks in ascending order shows that as a whole, natural resources are highly depleted in Haryana, Maharashtra, Punjab, Rajasthan and Gujarat.

In period 2 (Table 6), Punjab has the highest score for PDLR followed by Haryana, Rajasthan, West Bengal and Andhra Pradesh. For NPSWPP and DDWR, the same states have maintained high level of depletion. DDFR is high in Punjab, Haryana, Rajasthan and Orissa. If all the scores are added up, Punjab has the highest depletion of natural resources followed by Haryana, Rajasthan, Andhra Pradesh and Tamil Nadu.

Table 6
Scores of Natural Resource Depletion (Period 2)

	PDLR	NPSWPP	DDWR	DDFR	Aggregate Score	Rank
Andhra Pradesh	10	12	9	5	36	10.5
Bihar	6	3	3	12	24	4
Gujarat	4	9	4	8	25	5
Haryana	13	13	11	13	50	13
Karnataka	9	7	10	4	30	8
Kerala	5	6	5	3	19	3
Madhya Pradesh	1	2	1	1	5	1
Maharashtra	8	5	6	7	26	6
Orissa	2	1	2	10	15	2
Punjab	14	14	13	14	55	14
Rajasthan	12	4	12	11	39	12
Tamil Nadu	3	10	14	9	36	10.5
Uttar Pradesh	7	11	7	2	27	7
West Bengal	11	8	8	6	33	9

Source: Computed

Further the difference between the scores of natural resource depletion (for periods 1 and 2 is calculated (Table 7). Positive sign indicates increase in depletion of natural resource and negative sign indicates decrease in depletion of natural resource.

Table 7
Change in Scores of Natural Resource Depletion

	Change in Scores of				Change in
	PDLR	NPSWPP	DDWR	DDFR	
Andhra Pradesh	7	0	5	4	6
Bihar	0	-3	-2	1	-4
Gujarat	-8	0	-4	0	-12
Haryana	-1	0	-1	6	4
Karnataka	7	0	0	-6	1
Kerala	0	2	-1	-3	-2
Madhya Pradesh	-9	0	-2	-13	-24
Maharashtra	-3	2	-3	-6	-15
Orissa	1	0	0	-2	-1
Punjab	6	0	-1	12	17
Rajasthan	-1	-1	1	2	1
Tamil Nadu	-1	0	1	4	4
Uttar Pradesh	0	0	0	-1	-1
West Bengal	2	0	7	2	11

Note: Positive sign indicates increase in scores and negative sign indicates decrease in scores.
Source: Computed.

The table shows that PDLR has increased in Andhra Pradesh, Karnataka, Punjab, West Bengal, and Orissa, NPSWPP has increased in Kerala and Maharashtra, DDWR has increased in West Bengal, Andhra Pradesh, Rajasthan, and Tamil Nadu, and DDFR has increased in Punjab, Haryana, Andhra Pradesh, Tamil Nadu, Rajasthan, West Bengal, and Bihar. As a whole, aggregate natural resource depletion has increased in Punjab, West Bengal, Andhra Pradesh, Haryana, Tamil Nadu, Karnataka, and Rajasthan.

However, some of the states have now become concerned about their natural

resources. Madhya Pradesh, Maharashtra, and Gujarat have started taking care of their natural resources. They have obtained the negative difference on the scores of DDFR, DDWR and PDLR. Bihar is taking care of its water resources and Karnataka is now concerned about its forest resources.

4.4 Correlates of Natural Resource Depletion

An attempt is made to find the factors responsible for natural resource depletion. The correlates of natural resource depletion are shown in Table 8. It can be seen that NSDP, NPSWPP, and DDWR have a high degree of positive correlation with PCNSDP. These indicators alongwith PDLR have a high degree of negative correlation with RUPOV and PSTPOP. DDWR and PDLR have a high degree of positive correlation with PSCPOP and DDWR, and DDFR has a high degree of positive correlation with PCFOAR. As a whole, total natural resource depletion (TNRD) is highly positively correlated with PCNSDP and PSCPOP and highly negatively correlated with RUPOV and PSTPOP. This implies that economic growth is leading to natural resource depletion. The negative correlation of RUPOV and PSTPOP with NRD and the positive correlation of PSCPOP with NRD are surprising results.

Table 8
Correlates of Natural Resource Depletion

Indices of	PCNSDP	RUPOV	PSCPOP	PSTPOP	PLIT	PCFOAR	SAGNSDP
PDLR	0.49	-0.62*	0.57*	-0.56*	-0.08	0.34	0.39
NPSWPP	0.68*	-0.72*	0.49	-0.75*	0.19	0.32	0.14
DDWR	0.61*	-0.69*	0.59*	-0.68*	0.13	0.51*	0.05
DDFR	0.26	-0.21	0.33	-0.14	-0.30	0.57*	0.15
TNRD	0.65*	-0.71*	0.63*	-0.68*	-0.02	0.43	0.23

*5% level of significance.
Source: Computed

4.5 Regression Results

In order to make the relationship more clear, regression analysis is carried out. The regression coefficients in Table 9 shows that PCNSDP has a positive and significant impact on PDLR, NPSWPP, and DDFR at 10 per cent level and on total depletion at 5 per cent level. This implies that the economic growth is taking place at the cost of land, water, and forest resources. PCFOAR is also found to have positive and significant impact on DDWR and TNRD at 5 per cent significance level and PDLR and TNRD at 10 percent significance level. This shows that cutting of forests is resulting in degradation of water and land resources. An increase in agricultural share is found to have a significant impact on PDLR. Since agricultural land is limited, agricultural productivity has gone up by applying intensive practices. PSTPOP is found to have a negative and significant impact on NPSWPP and TNRD at 5 per cent level and PDLR and DDWR at 10 per cent level. R square is found to be significantly high for DDWR, NPSWPP, PDLR and TNRD.

Table 9
Regression Coefficients

Variables	PDLR	NPSWPP	DDWR	DDFR	TNRD
Constant	13.132 (1.276)	6.974 (.675)	17.705 (1.831)**	23.541 (1.519)*	61.353 (3.781)*
PCNSDP	.000 (1.622)**	.000 (1.867)**	.000 (.606)	.001 (1.470)**	.002 (3.983)*
PSCPOP	-.143 (-.622)	-.098 (-.422)	.256 (1.185)	.063 (.182)	.078 (.216)
PSTPOP	-.247 (-1.79)**	-.279 (-2.010)*	-.243 (-1.87)**	.057 (.272)	-.713 (-3.268)*
PLIT	-.233 (-1.962)*	-.128 (-1.071)	-.170 (-1.52)**	-.374 (-2.093)*	-.905 (-4.832)*
PCFOAR	.177 (1.448)**	.048 (.391)	.231 (2.016)*	.093 (.504)	.549 (2.850)*
SAGNSDP	.348 (1.738)**	.214 (1.063)	-.124 (-.658)	-.073 (-.244)	.364 (1.155)
Multiple R	.880	.878	.895	.698	.971
R Square	.774	.772	.800	.487	.943
Adj R Square	.579	.576	.629	.047	.894

*5 % level of significance ** represents 10 % level of significance.

Source: Computed.

4.6 Interrelationship between Socio-Economic Variables

Natural resource depletion has a direct and adverse impact on farm sector employment. If the agriculture sector is not able to provide sufficient livelihood, agricultural cultivators and labourers either migrate or seek

employment in the rural non-farm sector. In order to find how various socio-economic variables are inter-related, correlation coefficients are obtained (Table 10). Rural migration is positively and significantly correlated with rural poverty. The correlation between rural poverty and scheduled tribe population is 0.598 which is positive and significant. This implies that rural poverty is highly influenced by scheduled tribe population and least influenced by scheduled caste population. The correlation coefficient between rural migration and percentage of scheduled tribe population is positively high compared to that between rural migration and percentage of scheduled caste population. This indicates that scheduled tribe population comprises major portion of the migrants.

Table 10
Interrelationship Between Socio-Economic Variables

	RUMIG	RUPOV	PSCPOP	PSTPOP	PLIT	FSE	RNFSE
RUMIG	1						
RUPOV	.801(**)	1					
PSCPOP	-.036	-.137	1				
PSTPOP	.414	.578(*)	-.432	1			
PLIT	-.281	-.473	-.189	-.298	1		
FSE	.010	.388	-.133	.558(*)	-65(*)	1	
RNFSE	-.010	-.388	.133	-.56(*)	.65(*)	-1.00(**)	1

FSE refers to farm sector employment and RNFSE refers to non-farm sector employment.

*5% level of significance **1% level of significance.

Source: Computed

The positive and significant correlation between scheduled tribe population and farm sector employment and negative and significant correlation between

scheduled tribe population and rural non farm sector employment imply that if scheduled tribe population increases, farm employment will increase and rural non-farm employment will decrease significantly. Owing to lack of skill, and resources, this section of population prefers to work on farms. The negative and significant correlation of literacy rate with non-farm sector employment indicates that an increase in literacy increases skill for the population to work in the non-farm sector. The correlation coefficient between rural non-farm sector and farm sector employment is perfectly negative.

5. CONCLUSIONS AND SUGGESTIONS

It is said that poor people always try to fulfill their short-term needs from easily accessible natural resources. But neither the scheduled caste nor the scheduled tribe population is responsible for the depletion of natural resources. Rather the schedule tribe population adversely influences the depletion of natural resources. This implies that it is not poverty which destroys the natural resources; rather it is the economic growth and unfair agricultural practices that are responsible for the depletion of natural resources. The poor owe mostly marginal land and they cannot afford the cost of irrigation and chemical inputs. An increase in scheduled tribe population means more manpower to work on farms. Literacy rate has a negative and significant impact on DDFR, DDWR, PDLR, and TNRD. High literacy rate generates awareness about the environment and reduces the dependency on natural resources. Both literacy rate and employment in rural non-farm sector should move along with economic growth. But the results show that economic growth in India had not led to better socio-economic indicators. Thus in order to reduce the pressure on

natural resources, economic growth should be integrated with the development of socio-economic indicators.

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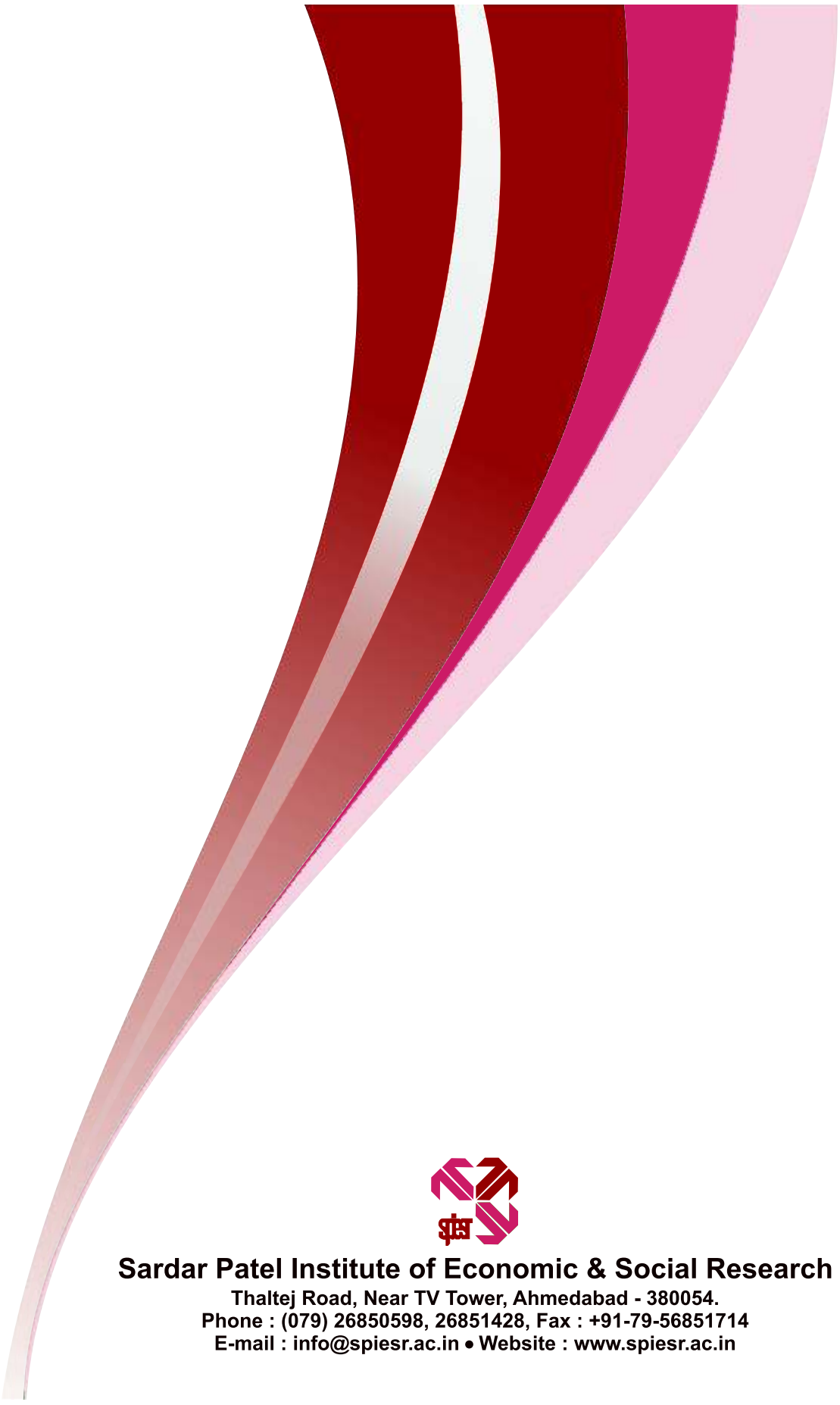

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