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Exploring Socio-Economic And Environmental Sustainability Across States

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Abstract

The idea behind sustainable development is that the cost to the environment which is caused by the growth process should be taken care of by the growth process itself. Environment has both micro and macro aspects. An important thing is to take care of the local ecological balance. Till date India has no index to measure environmental aspects. Also, this index should include not only environmental factors but also should have growth and development dimensions otherwise in today's world it would be meaningless. In furtherance to this objective, this study tries to construct an index to gauge individual states' socio-economic and environmental dimensions.

Keywords: sustainable development; Socio-Economic; environmental dimensions

1. Introduction:

One of the most important global issues is the problem of deterioration of natural resources. The most common cause for this problem is a surge in the density of population in ecologically weak areas and rapid using up of natural resources which is of nonrenewable nature. In developing countries, the pollution of air, water and soil have reached critical levels due to population pressures, socio-political conditions and one point agenda of economic growth. In such countries poverty is the major reason that distorts the environment and growth balance. Poverty via its effect of higher population has a direct liaison with environmental corrosion. As and when people are poor the resources available are used for poverty removal rather than on natural resource conservation as the first problem is taken to be more serious. The main problem is of not taking poverty and environment degradation as complementary problems, both of which needs to be addressed simultaneously. The remedy lies in making the growth process sustainable. Sustainability denotes the limits to growth that nature can tolerate without severely destroying its resources. It prominently includes pollution control and regeneration of resources, pollution absorption and other important functions is known

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as environmental space. Basically it takes cognizance of the burden that the growth process transfer to the natural environment.

Developing countries with less than one fifth of total world population consume about 75 percent of raw material. In order to maintain sustainability on global level, it is necessary to generate favorable conditions in which a successful cooperation between developed and developing countries must face multiple global challenges of sustainable development.

The word sustainable development is the development that fulfils the needs of the present people without losing and compromising the ability and resources to meet their own needs. In other words, whatever we value in present must continue in next generation. Present development should not be cost of future generation. Sustainable development includes making economic growth less energy-intensive and more equitable in its social impact, meeting the essential needs of an expanding population in the developing world for employment, food, energy, water, sanitation and health care, ensuring a sustainable and stabilized population level, conserving and enhancing the resource base, merging environmental and economic concerns in decision –making.

The concern of sustainable development came into existence in the 1960s when it was observed that pattern of economic development had led to reduction of non-renewable resources at alarming rate and has damaged layer of atmosphere which caused ozone layer destruction resulting in global warming and climate change in the world. In 1971 and 1972, experts of the Secretary General of the United Nations Conference on Human Environment and UN Conference at Stockholm has given more emphasis on the concept of sustainable development. In 1980 and 1992, the World Conservation Strategy and the Earth Summit respectively recommended that for sustainable development, maintenance of essential ecological process, preservation of genetic diversity, life support system and utilization of species and eco-system are required by protecting living resources.

2. Objective of the study:

Indian economy is definitely growing and that too at a rapid pace. Poverty has also been declining. But interstate differences can easily be seen both in state domestic products and poverty ratios. Also if environmental aspects are explored they would also show interstate disparities. The present paper titled "Socioeconomic and Environmental Sustainability: An Interstate Analysis" aims to construct an index which takes into consideration socio-economic and environmental factors for individual states. For this purpose 11 variables have been taken into consideration. The variables and their respective dimensions under study are Net State Domestic Product (NSDP), Poverty Ratio, Geographical Area, Population, Literacy Rate, Area under Forest Cover, Total Slum Population, Number of Registered Vehicles, Area under Joint Forest Management, Wasteland and Balance Ground Water Resource for Future Use. The rationale for this study is quite obvious. Literature and studies on environmental concerns are easily found in the world context which studies the entire country, but this study aims to study environmental concerns at within the country level.

3. Methodology and Data Sources:

The data has been collected from 55th Round of NSSO, Economic Survey 2007-08 and Compendium of Environment Statistics; Ministry of Statistics and Programme Implementation, Government of India. As far as the methodology is concerned, statistical techniques of Spearman's Rank correlation has been used to study the relationship between the variables under study. ANOVA is used to test whether there is any significant difference between the means of various samples. It allows us to test whether the differences among more than two sample means are significant are not. It is based on a comparison of two estimates of the population variance. One estimate is obtained from variance among the sample means and the second estimate is obtained from variation that exists within samples. This ratio is referred to as F ratio. If the calculated F ratio value is less than the critical value or table value at the particular degrees of freedoms and significance level then we accept the null hypothesis or else we reject it.

Basically, in this study out of the total eleven factors, few factors are extracted which would best represent the model and an index is constructed in order to gauge the state's relative position. For this purpose Factor Analysis is used which is one of the various interdependency techniques used in situation where no distinction is made between variables which are independent and those which are dependent variables. Instead the interdependent relationships between variables are examined. Factor analysis is used when the research problem involves a large number of variables making the analysis and interpretation of the problem difficult. It helps the researcher to reduce the number of variables to be analyzed, thereby making the analysis easier. Using factor analysis, the researcher can reduce the large number of variables into a few dimensions called factors that summarize the available data

A factor is an underlying construct or dimension that represents a set of observed variables. Factor loadings help in interpreting and labeling the factors. It measures how closely the variables in the factor are associated. These are also called factor-variable correlations. Factor loadings are correlation coefficients between the variables and the factors. Eigen values measure the variance in all the variables corresponding to the factor. They are calculated by adding the squares of factor loadings of all the variables in a factor. They aid in explaining the importance of the factor with respect to the variables. Communalities, denoted by h^2, measure the percentage of variance in each variable explained by the factors extracted. This is calculated by adding the squared factor loadings of a variable across the factors. The communality ranges from 0 to 1. A high communality value indicates that the maximum amount of the variance in the variable is explained by the factors extracted from the factor analysis. Total variance explained is the percentage of total variance of the variables explained. This is calculated by adding all the communality values of each variable and dividing it by the number of variables. Factor Variance Explained is the percentage of total variance of the variables explained by the factors. This is calculated by adding the squared factor loadings of all the variables and dividing it by the number of variables. In this study principal component analysis has been used to extract the factors while Varimax has been used to rotate the factors.

4. Discussion:

In the following analysis an attempt is made at building a model which would aim at establishing a relationship between various aspects comprising of socio-eco-environmental factors. In the following table (Table-1) states' data on net state domestic product, poverty ratio, total geographical area, population, literacy percentage, forest area, slum population, no. of vehicles, area under joint forest management, wasteland and balance ground water resource for future use is given.

The idea is more areas should be forested. This should better be done through joint forest management. This should be aimed primarily on the wasteland. This process is facilitated if there is literacy. For eradicating literacy poverty has to be first eradicated which could be done by making the growth process equal and participatory. This would require spread of industries and dilution of concentrated growth centers. This would take care of the slum problem. Meanwhile if population is low the process becomes easy. All this would lead to a sustainable development with more water left for future generation. Moreover a problem like vehicular pollution will be taken care of in the process, so that the environmental problem created by growth process is taken care off by the growth process itself. This would be true sustainable development

Table 1: State-wise data on various socio - economic and environmental factors

States	NSDP	poverty	Geographical area	Population	Literacy rate	forest area	Slum population	Vehicles	JFM	wasteland	Water left
	Rs.crores	Percentage	Sq. Km	Thousands	Percentage	Sq. Km	Numbers	Numbers	In ha	Sq.Km	BCM/yr
Andhra Pradesh	183123	15.8	275069	76210	60.47	63821	5187493	5719920	1886764	51750.19	21.4286
Arunachal Pradesh	2266	17.6	83743	1098	54.34	51540	0	21144	80217	18326.25	1.2227
Assam	38624	19.7	78438	26656	63.25	26832	82289	726819	79251	20019.17	17.2678
Bihar	51194	41.4	94163	82999	47	26832	531481	750703	267240.94	10498.775	12.3043
Chhattisgarh	33614	40.9	135191	20834	64.66	6473	817908	1215745	2846762.16	34856.875	12.8497
Goa	8582	13.8	3702	1348	82.01	1224	14482	436120	13000	613.27	0.1701
Gujarat	152516	16.8	196022	50671	69.14	18962	1866797	7087490	60525.41	43021.28	7.7653
Haryana	73645	14	44212	21145	67.91	1559	1420407	2547910	56000	3733.98	1.3709
Himachal Pradesh	17884	10	55673	6078	76.48	37033	0	288813	290922.8	31659	0.2173
Jammu & Kashmir	18009	5.4	222236	10144	55.52	20230	268513	438596	49544	65444.24	3.7314
Jharkhand	37161	40.3	79714	26946	53.56	23605	301569	1216958	847967.93	10498.775	3.7751
Karnataka	132198	25	191791	52851	66.64	38284	1402971	3976584	232734	20839.28	8.9965
Kerala	89452	15	38863	31841	90.86	11265	64556	2792074	170712	1448.18	1263
Madhya Pradesh	91432	38.3	308245	60348	63.74	94689	2417091	3803528	5500000	34856.875	25.7793
Maharashtra	328451	30.7	307713	96879	76.88	61939	11202762	8968733	1411215	53489.08	16.0352
Manipur	3680	17.3	22327	2294	70.53	17418	0	106325	93941	12948.62	2.681
Meghalaya	4754	18.5	22429	2319	62.56	9496	86304	73382	495625.3786	9904.38	0.4405
Mizoram	2027	12.6	21081	889	88.8	16717	0	42145	10980	4071.68	1.19
Nagaland	4458	19	16579	1990	66.59	9222	0	171917	22930	8404.1	0.615
Orissa	52240	46.4	155707	36805	63.08	58136	629999	1524982	821504	21341.71	13.5008
Punjab	79010	8.4	50362	24359	69.65	3084	1159561	3529100	56243.95	2228.4	0
Rajasthan	98573	22.1	342239	56507	60.41	32488	1294106	3833806	376766	105639.11	1.3462
Sikkim	1375	20.1	7096	541	68.81	5841	0	17236	600	3569.58	0.0628
Tamil Nadu	167183	22.5	130058	62406	73.45	22877	2866893	8575241	445965	1276.03	7.9929
Tripura	6728	18.9	10486	3199	73.19	6294	29949	75547	34154	23013.9	0.3754
Uttaranchal	17707	39.6	53483	8489	71.62	34651	195470	515982	859028	5718.48	1.5941
Uttar Pradesh	205249	32.8	240928	166198	56.27	16796	4395276	6460198	112652.93	38772.8	37.8304
West Bengal	189489	24.7	88752	80176	68.64	11879	4115980	2547963	604334	574.3	12.131

Source:

1. Compendium of Environment Statistics India, 2007, Government of India.
2. Economic Survey, 2007-08, Government of India.

Notes:

1. Total geographic area is as per State of Forest Report 2005
2. Total forest area is as per State of Forest Report 2005
3. Total wasteland area is as per Forestry Statistics in India, 2003
4. Area under joint forest management in hectares is as per Ministry of Environment & Forests, Annual Report 2003-2004
5. Number of motor vehicles registered in India as on 31st march, 2004 is as per Transport Research Wing, Ministry of Road Transport & Highways.
6. Balance ground water resource for future use, as on 2003 is as per Central Ground Water Board
7. Population is in thousands and is as per Census 2001
8. Literacy rate is as per Census 2001
9. Area under Joint Forest Management as on 01.01.2004 as per Ministry of Environment & Forests, Annual Report 2003-2004

In the following Table-2 states have been ranked in increasing order in terms of all the variables taken in Table-1. It is very apparent that there is a marked divergence amongst the ranks of various states under different attributes. For example, Maharashtra has the highest net state domestic product, but in terms of poverty ratio it has the eight rank, in terms of water left for future consumption it has sixth rank and in terms of wasteland it has the third rank.

Table 2: State-wise ranking on various socio economic and environmental factors

States	geographic area	NSDP	population	poverty	literacy	slum	forest area	vehicles	water	JFM	wasteland
Andhra Pradesh	4	4	5	21	22	2	2	5	4	3	4
Arunachal Pradesh	14	26	26	18	26	23	5	27	20	18	14
Assam	16	15	14	14	19	19	10	17	5	19	13
Bihar	12	14	3	2	28	14	11	16	9	13	16
Chhattisgarh	10	17	17	3	17	12	23	15	8	2	7
Goa	28	21	25	24	3	22	28	20	26	26	27
Gujarat	7	6	10	20	11	7	15	3	13	20	5
Haryana	20	12	16	23	14	8	27	12	18	22	22
Himachal Pradesh	17	19	20	26	5	24	7	21	25	12	9
Jammu & Kashmir	6	18	18	28	25	16	14	19	15	23	2
Jharkhand	15	16	13	4	27	15	12	14	14	6	17
Karnataka	8	7	9	9	15	9	6	6	11	14	12
Kerala	21	10	12	22	1	20	20	10	1	15	25
Madhya Pradesh	2	9	7	6	18	6	1	8	3	1	8
Maharashtra	3	1	2	8	4	1	3	1	6	4	3
Manipur	23	25	23	19	9	25	16	23	16	17	15
Meghalaya	22	23	22	17	21	18	21	25	23	9	18
Mizoram	24	27	27	25	2	26	18	26	21	27	21
Nagaland	25	24	24	15	16	27	22	22	22	25	19
Orissa	9	13	11	1	20	13	4	13	7	7	11
Punjab	19	11	15	27	10	11	26	9	28	21	24
Rajasthan	1	8	8	12	23	10	9	7	19	11	1
Sikkim	27	28	28	13	12	28	25	28	27	28	23
Tamil Nadu	11	5	6	11	6	5	13	2	12	10	26
Tripura	26	22	21	16	7	21	24	24	24	24	10
Uttaranchal	18	20	19	5	8	17	8	18	17	5	20
Uttar Pradesh	5	2	1	7	24	3	17	4	2	16	6
West Bengal	13	3	4	10	13	4	19	11	10	8	28

Source: same as Table 1

In the following Table-3 a correlation matrix is given which shows the degree of correlation among the various variables. All the boxes denoted by S or S (-VE) denote significant correlations. As is evident net state domestic product is positively correlated with population, geographic area, slum, no of vehicles and area under joint forest management. Population is significantly and positively correlated with NSDP, poverty, geographic area, slum, area under forest, no of vehicles, water left for future generation and area under joint forest management. Poverty is significantly and positively correlated with population, geographic area, water left for future consumption and area under joint forest management. Literacy in significantly and negatively correlated with geographic area and wasteland. Geographic area is positively correlated with all variables except literacy. Slum population is significantly and positively correlated with NSDP, population, geographic

area, number of vehicles, water left, and area under joint forest management. Area under forest cover is positively and significantly correlated with population, geographic area, water left, area under joint forest management and wasteland. Number of vehicles is significantly and positively correlated with NSDP, population, geographic area, slum population, water left and area under joint forest management. Water left is positively correlated with all factors except literacy, water left and wasteland. Area under joint forest management is significantly and positively correlated with all variables except literacy and wasteland. Wasteland area is significantly and positively correlated with geographic area and forest area and negatively correlated with literacy.

Table 3: Correlation matrix of various socio - economic and environmental factors

	NSDP	POP	POV	LIT	AREA	SLUM	FOR	VEH	WATER	JFM	WASTE
NSDP		S			S	S		S	S	S	
POP	S		S		S	S	S	S	S	S	
POV		S			S				S	S	
LIT					S (-VE)						S (-VE)
AREA	S	S	S	S (-VE)		S	S	S	S	S	S
SLUM	S	S			S			S	S	S	
FOR		S			S				S	S	S
VEH	S	S			S	S			S	S	
WATER	S	S	S		S	S	S	S		S	
JFM	S	S	S		S	S	S	S	S		
WASTE				S (-VE)	**S**		S				

Source: Same as Table 1

Notes: 1. S denotes positive correlation significant at 0.05 percent

2. S (-VE) denotes negative correlation significant at 0.05 percent

In the following Table-4 the result of ANOVA is given in which various states are compared to each other in terms of variance in the given variables. Here the null hypothesis is that there is no significant difference between the states as far as these 11 variables are concerned. The alternate hypothesis is that there is significant difference between the states in terms of these 11 variables. Since the p value is less than 0.05(significance level), we fail to accept the null hypothesis and accept the alternate hypothesis that there is a significant difference between amongst the states.

Table 4: ANOVA of states on various socio - economic and environmental factors

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.405E+13	27	2.742E+12	1.5496786	0.043986	1.5256948
Within Groups	4.955E+14	280	1.77E+12			
Total	5.696E+14	307				

Source: Excel output

5. Factor Analysis:

All the above variables named above are related to socio-economic and environmental factors. NSDP, poverty ratio and literacy rate is for socio-economic aspects; geographical area, area under forest cover, total slum population, number of registered vehicles and wasteland is for environmental aspects, area under joint forest management is for awareness and efforts to save environment and water left for future consumption is for taken sustainability aspect into consideration. Studying all these factors simultaneously would be very tedious. In order to reduce the variables under study factor analysis is done.

Table 5:Communalities

	Initial	Extraction
nsdp	1.000	.979
poverty	1.000	.848
area	1.000	.962
population	1.000	.857
literacy	1.000	.804
forest	1.000	.779
slum	1.000	.832
vehicle	1.000	.878
jfm	1.000	.824
wasteland	1.000	.880
water	1.000	.605

Source: SPSS output, Extraction Method, Principal Component Analysis.

The above Table-5 has been taken from the SPSS output file of the factor analysis. It shows the Communalities which indicate the amount of variance in each variable that is accounted for. Initial communalities are estimates of the variance in each variable accounted for by all components or factors. For principal components extraction, this is always equal to 1.0 for correlation analyses. Extraction communalities are estimates of the variance in each variable accounted for by the components. The communalities in this table are all high, which indicates that the extracted components represent the variables well.

Table 6: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.937	44.882	44.882	4.937	44.882	44.882	3.817	34.699	34.699
2	1.978	17.984	62.866	1.978	17.984	62.866	2.192	19.927	54.626
3	1.266	11.507	74.373	1.266	11.507	74.373	1.653	15.026	69.653
4	1.068	9.706	84.079	1.068	9.706	84.079	1.587	14.426	84.079
5	.744	6.768	90.847						
6	.348	3.163	94.010						
7	.285	2.595	96.605						
8	.196	1.784	98.388						
9	.136	1.238	99.627						
10	.027	.245	99.872						
11	.014	.128	100.000						

Source: SPSS output, Extraction Method: Principal Component Analysis.

In the above Table-6 which has also been taken from the SPSS output file the eigenvalues and the total variance explained has been shown. The variance explained by the initial solution, extracted components, and rotated components is displayed. This first section of the table shows the Initial Eigenvalues. The Total column gives the eigenvalue, or amount of variance in the original variables accounted for by each component. The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables. The Cumulative % column gives the percentage of variance accounted for by the first n components. As eigenvalues greater than 1 are extracted, so the first **four** principal components form the extracted solution. The second section of the table shows the extracted components. They explain nearly 84% of the variability in the original eleven variables, so you can considerably reduce the complexity of the data set by using these components, with only a 16% loss of information. The rotation maintains the cumulative percentage of variation explained by the extracted

components, but that variation is now spread more evenly over the components. The large changes in the individual totals suggest that the rotated component matrix will be easier to interpret than the unrotated matrix. The Total column gives the eigenvalue, or amount of variance in the original variables accounted for by each component. The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables. The Cumulative % column gives the percentage of variance accounted for by the first n components. For example, the cumulative percentage for the second component is the sum of the percentage of variance for the first and second components.

Table 7: Rotated Component Matrix

	Component			
	1	2	3	4
nsdp	.973	.093	.077	.131
poverty	.201	.710	-.379	-.400
area	.585	.422	-.199	.633
population	.882	.181	-.217	.003
literacy	-.015	-.189	.870	-.108
forest	.211	.766	-.054	.380
slum	.880	.168	.028	.169
vehicle	.906	.074	.108	.198
jfm	.092	.890	.035	.148
wasteland	.239	.134	-.238	.865
water	.040	.046	.766	-.119

Source: SPSS output, Extraction Method: Principal Component Analysis.

Finally, in the above Table-7 which has also been taken from the SPSS output file the factors have been rotated using the varimax method in order to find the final factor loadings of the extracted factors. The first component is most highly correlated with NSDP, population, slum and vehicles but NSDP is the better representative. The second factor is most highly correlated in poverty, forest and JFM but JFM is the better representative. The third component is most highly correlated in literacy and water but literacy is the better representative. The fourth component is most highly correlated in area and wasteland but wasteland is the better representative. Hence on the basis of the above analysis we extracted only four factors namely, net state domestic product, area under joint forest management, literacy and wasteland.

6. Index Formulation: On the basis of the above factor analysis, this study proposes a Socio-Economic-Environmental Index (SEEI)

SEEI = (NSDP+ JFM+ literacy + wasteland) of the particular state /∑ (NSDP+ JFM+ literacy + wasteland) of all the states *100

Table 8: Socio-Economic-Environmental Index (SEEI) for different states

States	SEEI
MadhyaPradesh	**27.50115**
Chhattisgarh	**14.24974**
AndhraPradesh	**10.37068**
Maharashtra	**8.76517**
Jharkhand	**4.378016**
Orissa	**4.375414**
Uttaranchal	**4.31371**
WestBengal	**3.883284**
TamilNadu	**3.003613**

Rajasthan	**2.840069**
Meghalaya	**2.494531**
Karnataka	**1.885944**
UttarPradesh	**1.743672**
HimachalPradesh	**1.664543**
Bihar	**1.608031**
Kerala	**1.279183**
Gujarat	**1.251951**
Assam	**0.674325**
Punjab	**0.672343**
Haryana	**0.652277**
Jammu & Kashmir	**0.650351**
Manipur	**0.5408**
Arunachal Pradesh	**0.493013**
Tripura	**0.312676**
Nagaland	**0.175274**
Goa	**0.10889**
Mizoram	**0.083913**
Sikkim	**0.027438**

As per the above developed SEEI the state of Madhya Pradesh is on the first rank followed by Chhattisgarh. The state of Madhya Pradesh ranked ninth in NSDP(Table 2) has the first rank as per SEEI. While Maharashtra which had the first rank as per NSDP (Table 2) has the fourth rank here with an index value of less than 10.These three states had a value of more than 10. But the disparity is very apparent. The rank value of the first sate is approximately double than that of the second state. Only three states had an index value of more than 10 while all the remaining 25 state had an index value of less than 10. Also, out of the total states, 11 states had an index value of even less than 1, with Sikkim having the lowest index value of only 0.027438.

7. Suggestions:

Environmental degradation is a serious problem. Although India is not a major polluter amongst the world nations still India is very susceptible to the state of environmental disaster because of its huge population below the poverty line. India surely is a member of the conventions looking after the environmental aspects and is also committed to the aim of preserving the ecological balance. Still, based on the above analysis, this study recommends that the huge interstate disparities in all the factors, be it socio economic or environmental, should first be removed. This is a huge opportunity.

A uniform policy for all the states will not serve the purpose very well. For example, Mumbai get flooded due to poor urban planning while Bihar gets flooded every year due to entirely different reasons. Each state should formulate policies aimed at maintaining the environmental balance keeping into concern their state specific and local peculiarities. Further this could be made one of the components of mapping a states' performance for transfer of funds from centre to state. All this should be monitored by a national body on the lines of RBI or SEBI in their respective fields. It is also necessary to have an All India body in order to fine tune the states policies and initiatives to the international treaties and conventions which India needs to honor.

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