

Construction of environmental performance index and ranking of states[†]

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The aim of our growth strategy has been effective and balanced utilization of the country's resources. Considering the influence of natural resources depletion and unabated pollution on many sectors of the economy, an environmental performance index (EPI) was evolved to recognize the efforts made by the states to arrest degradation of the environment. This article attempts to detail a methodology for constructing an EPI for the country and based on the EPI scores, rank the states and suggest options for devolving Central funds to states.

Keywords: Air and water quality, environment, performance index, scores and ranks.

THE relationship between economic growth and environmental sustainability of a country is complicated considering that large sections of the country's population depend on natural resources for their livelihood. Industrialization/urbanization if not associated with the requisite level of governance can influence the environmental health and sustainability of a state and the nation. The adverse impact felt is due to natural resources depletion and the health consequences of air, soil and water pollution and inadequate waste management. It is well recognized that environmental degradation leads to additional economic hardships to the vulnerable sections of the population.

Environmental problems therefore should no longer be viewed by the states as a consequence of development alone, but there should be continued focus on pollution abatement, promotion of adherence to environmental standards, natural resources conservation and adopting the 3Rs (reuse, recycle, recover)/4Rs (reuse, recycle, recover and remanufacture).

Considering the influence of natural resources depletion and unabated pollution on many sectors of the economy and well-being of the citizens, it is considered necessary to evolve an environmental performance index (EPI) and recognize environmental performance by states and devolve central funds.

[†]The views expressed are those of the authors and not the official views of the Planning Commission.

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Environmental indicators

Selecting the appropriate indices and methodology for arriving at acceptable environmental indices is a subject of much debate and research. Many believe that environmental degradation due to pollution be measured by actual emission data of hazardous substances, but others feel that it should include factors which influence its spread and intensity. Regional disparity and natural endowment of the state are also considered important when ranking the states.

Mukherjee and Kathuria¹ considered 63 environmental variables arranged under eight broad environmental groups and ranked 14 major states of the country. Using the factor analysis method the states were ranked on a constructed environmental quality index. Kadekodi and Venkatachalam², found a strong linkage between various natural resources and the environment with income and status of livelihood and concluded that the causal relationship between poverty and environment works in both directions.

Methodology and weightage

The three methodologies: (a) environmental quality index (EQI)³, (b) environmental indicators – Organization for Economic Co-operation and Development (OECD)⁴ and (c) 2012 environmental performance index (EPI) of Yale University⁵ which are commonly sighted are also discussed briefly in this article.

After a careful study of the above, an EPI methodology named as Planning Commission environmental performance index (PC-EPI) has been evolved for adoption, which calculates EPI scores for the selected criteria for all the states and Union Territories (UTs).

Environmental quality index

Mukherjee and Chakraborty³ suggest that the EQI for the states is linearly dependent on a set of observable indicators and can be determined by adopting the Human Development Index (HDI) method, by putting the selected variable to start with under eight broad categories, namely air pollution, indoor air pollution potential, greenhouse gases (GHGs) emissions, pollution from energy generation and consumption, depletion and degradation of forest resources, depletion and degradation of water resources, nonpoint source water pollution potential, and pressure and degradation of land resources.

The idea is that the 63 environmental variables under 8 categories when combined would give a composite EQI ranking not observed otherwise. The obtained EQI is a measure of the environmental well-being of the states, i.e. those with higher scores are characterized by cleaner environment.

Environmental indicators – OECD

The OECD set of environmental indicators is a commonly agreed upon minimum set of indicators for OECD countries and for international use, published regularly. OECD work on environmental indicators was initiated in 1989 and includes four sets of categories of indicators, each corresponding to a specific purpose and framework: (i) Core environmental indicators (CEI) – tracking environmental programme and performance. (ii) Key environmental indicators (KEI) – informing the public. (iii) Sectoral environmental indicators (SEI) – promoting integration. (iv) Indicators derived from environmental accounting – promoting integration. (v) Decoupling environmental indicators – monitoring progress towards sustainable development.

Core environmental indicators: The OECD core set of environmental indicators is a major tool for analysing environmental policies and measuring environmental performance. Characteristics of the core set are that they are designed to help integrate environmental concerns into sectoral policies. Each set focuses on a specific sector (transport, energy, household consumption, tourism, agriculture).

The OECD's core set of indicators on the environment comprises climate change, ozone layer depletion, eutrophication, acidification, toxic contamination, urban environmental quality, biodiversity, cultural landscapes, waste, water resources, forest resources, fish resources, soil degradation (desertification, erosion), material resources and socio-economic, sectoral and general indicators.

2012 environmental performance index

The 2012 EPI offers a composite index of current national environmental protection efforts. Recognizing

that on-the-ground conditions are the ultimate gauge of environmental performance, the EPI focuses on measurable outcomes that can be linked to policy targets and tracked over time.

The EPI builds on measures relevant to two core objectives – (i) reducing environmental stress to human health (the environmental health objective) and (ii) protecting ecosystems and natural resources (the ecosystem vitality objective).

The quantitative metrics underlying the 2012 EPI encompasses 22 indicators. The indicators serve as a gauge of long-term environmental policy success. For each country and each indicator, a proximity-to-target value has been calculated based on the distance from a country's current results to the policy target.

Using the 22 indicators, scores are calculated at three levels of aggregation, First, building on 2–8 underlying indicators (each representing a dataset), scores are calculated for each of the six core policy categories – environmental health, air quality, water resources, biodiversity and habitat, productive natural resources and climate change. The weight given to each indicator varies. Second, the environmental health subcategories and the ecosystem vitality categories are aggregated with weights of 30% and 70% respectively, as indicated in the EPI⁴.

Finally, the overall EPI is calculated based on the arithmetic mean of the two broad objective scores.

The Planning Commission environmental performance index

The PC-EPI was evolved after careful perusal of all variables and categories considered under various studies. To begin start with 5 categories comprising 16 indicators were chosen and the normal deviation and distance travelled method was used for indicators for which standards have been notified and in respect of indicators with no standards, i.e. forests, etc. a method was evolved and these integrated to arrive at a composite index. The idea is that the 16 indicators selected, when combined could give a composite EPI ranking of the states. The criteria are air pollution, water quality, forests, waste management and climate change (Table 1). Indicators were sought to cover the full spectrum of issues underlying each of the major components of the environment, i.e. criteria identified. To ensure the use of the best-suited metrics, the indicator selection criteria applied were relevance (the indicator clearly tracks the environmental issue of concern), performance orientation (the indicator tracks ambient conditions or on-the-ground results to national standards and requirements) and data quality (the data used represent the measures taken by the states).

The cumulative EPI is a measure of the environmental well-being of the states, i.e. states with a score of 1 are characterized by cleaner environment, adherence to

Table 1. Environmental performance index criteria and indicators

Criterion	Indicators	No. of variables in 2012
Air pollution	NO _x , SO _x , RSPM	3
Forests	TFC as percentage of state GA and contribution to national average. Increase/decrease in forest cover. Growing stock and afforestation efforts.	4
Water quality	Percentage of domestic waste water and surface water quality (DO, BOD and TFC) and groundwater extraction %.	3
Waste management	MSW, bio-medical and hazardous wastes	3
Climate change	Preparation of SAPCCs, RE growth rate including mini hydro. Electricity intensity of SGDP	3
Total		16

RSPM, Respirable suspended particulate matter; TFC, Total forest cover; DO, Dissolved oxygen; BOD, Biological oxygen demand; MSW, Municipal solid waste; SAPCC, State action plan for climate change; RE, Renewable energy; SGDP, State gross domestic product.

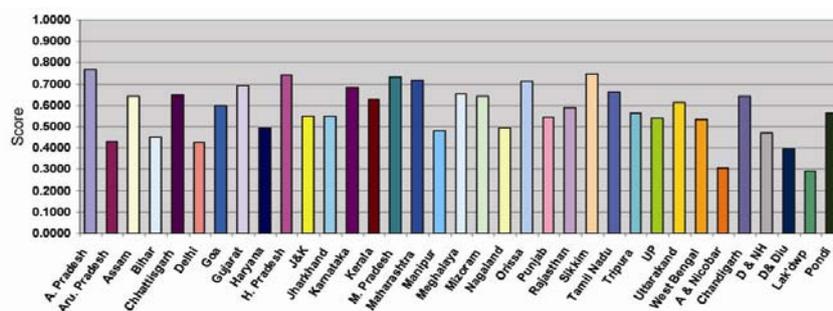


Figure 1. Final ranking of the states.

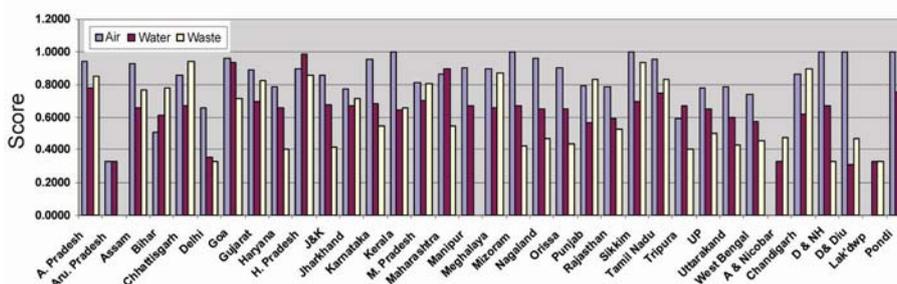


Figure 2. Air quality, water quality and waste management ranking of the states.

environmental standards, including implementation of legislation and institutional mechanisms and efforts towards natural resources conservation.

Table 2 presents PC–EPI scores and ranking of the states and UTs as of June 2012 for the five categories separately, based on arithmetic mean of scores of all the indicators covered under each category and ranking of the states, based on mean cumulative scores (Figure 1).

With a EPI score of 0.7696, 0.7478, 0.7414, 0.7334 and 0.7167, Andhra Pradesh, Sikkim, Himachal Pradesh, Madhya Pradesh and Maharashtra in that order have been ranked as the best-performing states respectively.

Ambient air quality performance scores are depicted in Figure 2 for all the 25 states and 7 UTs. The indicators considered for measuring the performance are sulphur dioxide (SO_x), nitrogen oxide (NO_x) and respirable suspended particulate matter (RSPM). The data in respect of all the three

indicators are the annual average. It is observed that all the states meet the prescribed national ambient air quality standards in respect of SO_x of 50 µg/m³. In respect of NO_x, three states do not meet the 40 µg/m³ national standard. In respect of RSPM, except for Kerala and Mizoram, none of other states meets the 60 µg/m³ RSPM national standard. States that meet the standards have been given a score of 1 for each indicator and the average scores derived from the cumulative score and the states ranked. Mizoram, Kerala, Sikkim and Puducherry with an average score of 1 are ranked as the best in terms of air quality.

Three indicators: (i) sewage disposal, (ii) water quality of rivers, viz. dissolved oxygen (DO) and total coliform count and (iii) percentage of groundwater exploitation have been considered for the state-wise performance scores for water quality. Except for Himachal Pradesh which according to the data made available has set up

Table 2. Planning Commission environmental performance scores and ranking of states

State/Union Territory	Air pollution		Water		Forests		Waste management		Climate change		Final environmental performance index 2012		Final environmental performance index 2011	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Andhra Pradesh	0.9406	11	0.7807	4	0.8270	6	0.8473	6	0.4523	10	0.7696	1	0.7073	4
Arunachal Pradesh	0.3333	33	0.3333	32	1.0000	1	0.7643	12	0.4885	6	0.4310	31	0.3377	34
Assam	0.9298	12	0.6536	19	0.4993	18	0.7777	11	0.3658	18	0.6426	14	0.5053	22
Bihar	0.5028	32	0.6074	26	0.3248	31	0.9373	1	0.0343	33	0.4494	30	0.3977	30
Chhattisgarh	0.8536	21	0.6656	17	0.5267	16	0.3333	31	0.2561	23	0.6478	11	0.5871	17
Delhi	0.6524	30	0.3571	31	0.3615	29	0.7121	14	0.4187	13	0.4246	32	0.4321	26
Goa	0.9608	7	0.9360	2	0.3223	32	0.7121	14	0.0645	29	0.5991	17	0.6561	10
Gujarat	0.8914	17	0.6969	8	0.5346	15	0.8255	9	0.5234	4	0.6944	7	0.5881	16
Haryana	0.7836	26	0.6524	20	0.4894	19	0.3997	30	0.1413	28	0.4933	27	0.5586	18
Himachal Pradesh	0.8939	15	0.9843	1	0.6531	10	0.8550	5	0.3208	20	0.7414	3	0.7309	2
Jammu & Kashmir	0.8571	20	0.6758	11	0.5783	13	0.4161	28	0.2139	26	0.5483	22	0.3516	33
Jharkhand	0.7703	28	0.6667	12	0.5549	14	0.7162	13	0.0374	32	0.5491	21	0.5167	20
Karnataka	0.9524	9	0.6825	10	0.7654	9	0.5418	18	0.4836	8	0.6851	8	0.6333	14
Kerala	1.0000	1	0.6433	24	0.4872	20	0.6528	16	0.3722	16	0.6311	15	0.6600	9
Madhya Pradesh	0.8127	22	0.7014	7	0.8886	3	0.8014	8	0.4629	9	0.7334	4	0.6387	12
Maharashtra	0.8647	18	0.8946	3	0.8444	4	0.5434	17	0.4365	11	0.7167	5	0.6469	11
Manipur	0.9048	12	0.6667	12	0.4601	23	0.8718	4	0.3740	15	0.4811	28	0.6158	15
Meghalaya	0.8939	15	0.6544	18	0.4355	25	0.4220	27	0.4061	14	0.6524	10	0.6629	7
Mizoram	1.0000	1	0.6667	12	0.5071	17	0.4220	27	0.6280	2	0.6448	12	0.6822	6
Nagaland	0.9608	7	0.6458	22	0.3677	28	0.4679	23	0.0378	31	0.4960	26	0.4938	23
Odisha	0.8992	14	0.6486	21	0.9949	2	0.4372	25	0.5794	3	0.7118	6	0.6352	13
Punjab	0.7925	23	0.5673	29	0.2963	33	0.8328	7	0.2414	24	0.5460	23	0.4309	27
Rajasthan	0.7857	24	0.5921	27	0.3968	27	0.5234	19	0.6543	1	0.5905	18	0.5284	19
Sikkim	1.0000	1	0.6933	9	0.6230	11	0.9333	2	0.4892	7	0.7478	2	0.5073	21
Tamil Nadu	0.9524	9	0.7431	6	0.6221	12	0.8297	10	0.1607	27	0.6616	9	0.6627	8
Tripura	0.5881	31	0.6667	12	0.7851	8	0.4008	29	0.3713	17	0.5624	20	0.3720	31
Uttar Pradesh	0.7772	27	0.6456	23	0.4652	22	0.5018	20	0.3043	21	0.5388	24	0.4925	24
Uttarakhand	0.7850	25	0.5948	28	0.8280	5	0.4283	26	0.4351	12	0.6142	16	0.8086	1
West Bengal	0.7425	29	0.5739	30	0.4009	26	0.4567	24	0.4909	5	0.5330	25	0.4859	25
Andaman and Nicobar Islands	0.0090	0	0.3333	32	0.4409	24	0.4767	21	0.2853	22	0.3072	34	0.3981	29
Chandigarh	0.8637	19	0.6132	25	0.8047	7	0.8951	3	0.0384	30	0.6430	13	0.7168	3
Dadra and Nagar Haveli	1.0000	1	0.6667	12	0.3420	30	0.3333	31	0.0000		0.4684	29	0.4081	28
Daman and Diu	1.0000	1	0.3100	35	0.1921	34	0.4697	22	0.0000		0.3944	33	0.2057	35
Lakshadweep	0.0090	0	0.3333	32	0.4690	21	0.3333	31	0.3267	19	0.2925	35	0.3587	32
Puducherry	1.0000	1	0.7500	5	0.1908	35	0.6608	15	0.2162	25	0.5636	19	0.6873	5

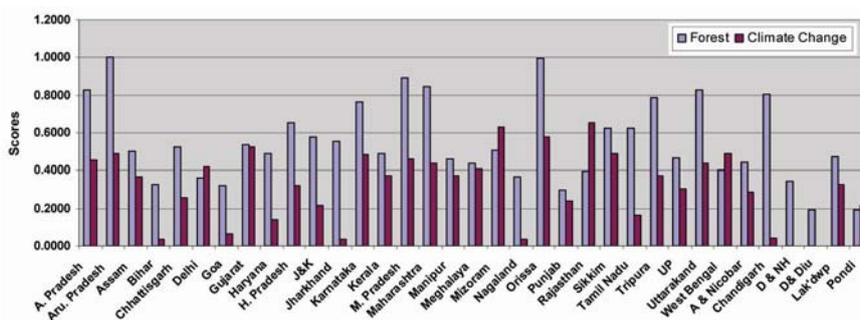


Figure 3. Forests and climate change ranking of the states.

100% treatment capacity for sewage, in respect of the remaining states the treatment capacity available ranges from 0% (10 states) to less than 20% (8 states) and above 50% only in the case of 4 states. The scores highlight the dismal performance of the states with respect to sewage disposal. With regard to surface river water quality violation in respect of total faecal coliform is as high as 100% in case of Delhi. Except for three northeastern states, all others for which data are available do not comply with the standards prescribed. Delhi, Haryana, Punjab, Rajasthan, Diu and Daman and Puducherry extract groundwater more than recharge. Jharkhand, Manipur, Mizoram and Sikkim (Figure 3) show a semblance of adherence to river water quality prescribed.

The indicators selected for ranking the states on forest performance are total forest cover (TFC) percentage of state GA and contribution to the national average, change in forest cover during 2003 to 2009, total growing stock and yearly average afforestation effort during 2009 to 2012. Based on deviation method average scores were computed for each indicator and the cumulative average scores used to rank the states. Arunachal Pradesh, Odisha, Madhya Pradesh, Maharashtra and Uttarakhand are ranked 1, 2, 3, 4 and 5 respectively (Figure 3).

Figure 2 indicates waste management in the states and considers municipal solid waste (MSW) collection efficiency, treatment and disposal capacity for MSW, hazardous waste and biomedical waste in terms of capacity set up for treatment. The results show that the country lacks the capacity to treat hazardous waste and biomedical waste in terms of capacity set up for treatment and no effort has been made to collect and dispose both MSW and biomedical waste by the states. Considering that Chhattisgarh collects 98% of the MSW, treats 100% of the biomedical waste, has the capacity to dispose 89% of hazardous wastes generated, it is ranked as the best state (Figure 2) with respect to solid waste management.

Climate change mitigation (Figure 3) was assessed in terms of availability of State Action Plan for Climate Change, renewable energy growth rate including small hydro and electricity intensity of SGDP. Arunachal Pradesh, Odisha, Madhya Pradesh, Maharashtra and Uttarakhand are ranked 1, 2, 3, 4 and 5 respectively (Figure 3).

Devolving funds based on EPI ranking of the states

Recognizing the influence of natural resources depletion and unabated pollution on many sectors of the economy, it is considered necessary to include environmental indicators as criteria, with a weightage point in the Gadgil formula, for allocation of Central assistance for state plans. Based on the PC-EPI method, performance of the states in addressing environmental issues can be adjudged. Two options for devolving funds, one 2% of gross budgetary support based on EPI ranking and second, as a long-term option addition of a weightage point of 2% to the performance indicator 3(c) of the Gadgil formula are suggested.

Option 1: Two per cent of GBS to be devolved based on EPI ranking of the states. Based on the 11th Plan average per annum (Rs 317,868 crores), 2% works out to Rs 6,357.36 crores for non-special and special category states.

Option 2: Addition of a weightage point of 2% to the performance indicator 3(c) of the Gadgil formula for environmental performance and monies also devolved based on EPI ranking of the states. The weightage allocated be adjusted in the weightage assigned to population of 60%.

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