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Environmental Sustainability Index for Indian States 2011

Informing Environmental Action

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CHAPTER 1

INTRODUCTION

1.1 Environmental Sustainability Index (ESI): Concept and Rationale

Environmental Sustainability Index (ESI) is a comparative analysis of the environmental achievements, challenges and priorities of Indian states. It is indicative of a State's general environmental condition, capturing both historical resource endowments and achievements of policies and strategies undertaken by various stakeholders in conserving natural resources. The index aggregates indicators that reflect, *first*, anthropogenic activities of production, consumption and distribution that exert pressures on the environment, *second,* state of air quality, water quality, land use & agriculture, forests & biodiversity; *third,* measures of the impact of the current state of the environment and resource extraction on ecosystem and human health; and *fourth* , policy responses and society's efforts to preserve the environment.

The State level ESI is viewed primarily as a diagnostic tool, which seeks to highlight and provide insights into areas that require government and other stakeholder (policy makers, private sector, Non Governmental Organisations (NGOs), multi-lateral agencies, researchers, activities and concerned citizens) interventions in order to protect the environment for the future. It is developed with the objectives of (i) promoting information and evidence based policy making (ii) prioritising among different environmental concerns within the State and identifying issues that require more attention in policy and budget allocation, and (iii) measuring and monitoring sustainable development at the State level.

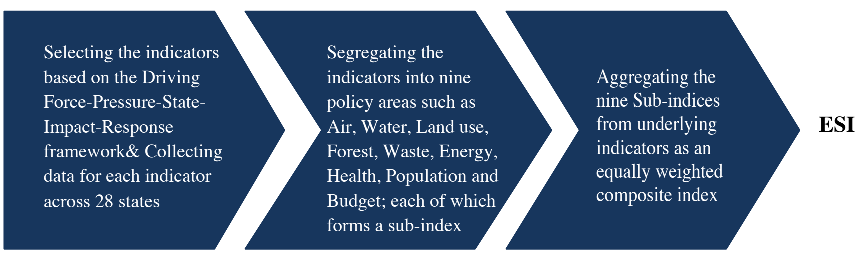
As a State's long-term sustainability is a combination of the *stock* (historical endowments of resources) and *flow* (resource extraction leading to depreciation of stock), ESI is constructed as a composite index from 41 key environmental indicators selected using the Driving Force-Pressure-State-Impact-Response (DPSIR) framework. These indicators capture the driving forces that extract from and pollute the environment (Driving Force); depletion and pollution (Pressure); present condition of the environment (State), impact on the ecosystem and human health (Impact) and policy and societal efforts to reduce impacts and protect the environment (Response). Contiguously, these indicators are also grouped under nine thematic sub-indices for interpretation from a policy perspective. These sub-indices are: Air Quality & Pollution, Water Quality & Availability, Land Use & Agriculture, Forests & Biodiversity, Waste Generation & Management, Energy Management, Impact on Human Health & Disaster, Population Pressure on Ecosystem and Environmental Budget. It is important to note here that while the DPSIR categorisation is used to select a comprehensive set of variables and as a framework for comparative analysis, it does not play a role in calculating the ESI score for each State. The latter is done by aggregating indicators grouped under each of the nine sub-indices to obtain scores for each, which are then added to obtain the total ESI score for each State.

ESI is designed to compare Indian states with their peers and does not indicate an absolute level of achievement. Although there are no clear normative benchmarks or thresholds for 'good' performance on many of the indicators, the scores on each indicator can be ordered from 'better' to 'worse'. Based on the aggregate ESI, States are categorised into five groups: most sustainable (top 20 percentile), more sustainable (within 60-80 percentile), moderately sustainable (within 40-60 percentile), less sustainable (within 20-40 percentile) and least sustainable (bottom 20 percentile). A higher ESI score indicates that the State enjoys the benefits of higher environmental quality currently, and/or has been able to create the potential to maintain its environment over the long run. A lower ESI reflects greater pressures on the ecosystem, higher levels of pollution and degradation, vulnerability to environmental predicaments and/or less responsive policies by institutions and civil society. While the overall ESI scores provide a quick snapshot of State performance, the sub-indices are far more informative, highlighting areas for State intervention.

1.2 Constructing ESI: The Framework

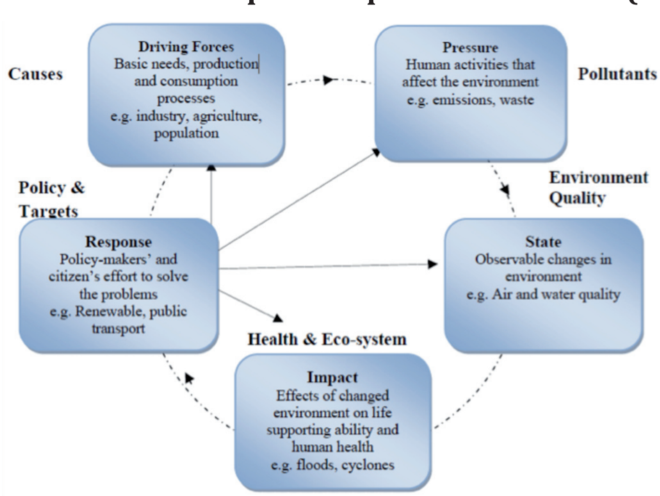
The Index is prepared in three steps: (i) selecting indicators based on the DPSIR framework and collecting data on each indicator; (ii) grouping of indicators into nine policy areas/sub-indices, and (iii) adding the equally weighted nine sub-indices to form a composite index.

Figure 1: Construction of ESI



The framework utilised to capture the multiple dimensions of environmental sustainability must take into account the following. First, describe the *stock* and *flow* of environmental resources. Higher initial endowments of environmental assets (land and water availability, forest cover, mineral resources etc), place certain states in an advantageous position than others. However, this does not eliminate the need for environmental stewardship. Also, higher population pressures escalate stress on the environment by pollution and waste beyond the ecosystem's carrying capacity. Second, highlight how ecosystem and human health are affected by the *stock* and *flow* of environmental resources. Underlining human-environment interaction is important from a policy perspective. Third, delineate human responses to observed and anticipated changes in the environment and efforts to mitigate negative environmental impacts and improve present environmental conditions. This is crucial for ensuring long-term sustainability.

Figure 2 : Driving Force-Pressure-State-Impact-Response Framework (DPSIR)



The afore-mentioned three criteria, drawn from the DPSIR framework are the edifice of the index. ***D**riving forces* encapsulate human activities of production, consumption and distribution that affect the environment. ***P**ressures*, which manifest in the form of emissions and waste, are a result of human activities, affect a variety of natural processes and may result in observable changes in the ***S**tate* of the environment. ***I**mpact* captures the changes on ecological systems, human health and socio-economic welfare of society, arising from changes in the *State* of the environment. The ***R**esponse* component measures a society's efforts (interventions and strategies by government and non-government stakeholders) to prevent, mitigate, ameliorate or adapt to changes to the environment. Therefore a model for measuring sustainability should ideally contain indicators encompassing the chain of causal links starting with *Driving force* through *Pressure*, *State*, *Impact* and eventually lead to policy *Response*. These five components provide the basis for selecting the indicators. Table 1, presents a list of these indicators.

Table 1: Framework for Selecting ESI Indicators

Components of ESI	Rationale	Indicators
Driving Force (D)	A State's sustainability is more likely to increase with lower anthropogenic pressures; i.e. extracting from and polluting the ecosystem. As ecosystems have a finite carrying capacity, higher population pressure means rapid rate of resource use and degradation.	• Population Density • Population Growth • Total Fertility Rate
Pressure on Ecosystem (P)	Anthropogenic activities of production, consumption and distribution create emissions and waste, extract and degrade the environment. States that can manage the pressure on the environment and even successfully reduce the stress so that it does not affect environmental quality, are more likely to remain sustainable in the long run.	• Density of motor vehicle usage. • Annual groundwater extraction • Irrigated Land • Grazing land • Fertiliser consumption intensity • Pesticide consumption intensity • Change in Forest Cover • Municipal Solid Waste (MSW) • Hazardous Waste

Components of ESI	Rationale	Indicators
State of Environment (S)	This reflects the observable changes in the environment, as a result of pressures exerted on it. A State shall be considered more sustainable if its initial endowment is good and ecosystem is preserved, and hence allowed to regenerate and replenish.	• Annual average SO2 concentration • Annual average NO2 concentration • Annual average SPM concentration • Annual average RSPM concentration • Mean Biochemical Oxygen Demand (BOD) • Mean total coliform • Replenishable ground water • Piped drinking water • Forest Cover • Land under Cultivation • Wasteland
Impact on health and ecosystem (I)	This captures the effects of the changed environment on human health and the environment. The degree to which a State can reduce the negative environmental impacts on basic human life and health, and protect from threats caused by environmental disturbances governs its long-term sustainability.	• Salinity, Acidity, Water Logged Land • Soil Erosion • Respiratory disease Incidence • Water borne disease incidence • Flood affected area • Drought prone area • Disaster death
Policy Response (R)	Efforts (policies, resources and creation of institutions) taken by the State to prevent, mitigate or adapt to changes in the environment enhances its ability to maintain a sustainable environment.	• Protected Area • Compensatory Afforestation (CAMPA) • Wetland • Joint Forest Management (JFM) • Gap in sewage treatment • Non-LPG fuel use • Renewable Energy • Energy Efficiency • Renewable Energy Expenditure • Environmental Budget • Expenditure-Outlay Gap

Categorising indicators under the DPSIR components is a generic classification from an action-oriented point of view. Therefore, indicators were additionally grouped into sub-indices according to broad areas or sectors across which policies are formulated and state bureaucratic and administrative institutions are organised. For example, all land related indicators such as grazing land, soil erosion, pesticide and fertiliser consumption intensity are grouped under the rubric of 'Land Use & Agriculture'. Through this process, nine sub-indices (policy areas) were formed relating to air, water, land use & agriculture, forests & biodiversity, energy, waste generation and management, impact on human health & disaster, population and government spending on the environment. The aggregate index is derived from these underlying nine sub-indices. The usefulness of ESI lies in these sub-indices; which are designed keeping in mind where information can guide policy planning and action for sustainable development. A detailed account of aggregation of all the indicators into nine sub-indices and corresponding DPSIR components is given in Table 2.

Table 2: Indicator Aggregation into sub-indices

	Driving Force (D)	Pressure on Ecosystem (P)	State of Environment (S)	Impact on Health & Ecosystem (I)	Policy Response (R)
Air Quality & Pollution		Density of Motor Vehicle Usage	Annual average SO_2, NO_2, SPM and RSPM concentration		
Water Quality & Availability		Annual Groundwater extraction Irrigated Land	Mean BOD Mean Coliform Replenishable Ground Water Piped Drinking Water		
Land Use & Agriculture		Grazing Land Fertiliser Consumption Intensity Pesticide Consumption Intensity	Land under Cultivation Wasteland	Salinity, Acidity, Water Logged Land Soil Erosion	
Forests & Biodiversity		Change in Forest Cover	Forest Cover		Protected Area Wetland Compensatory Afforestation (CAMPA) Joint Forest Management (JFM)
Waste Generation & Management		Municipal Solid Waste (MSW) Hazardous Waste			Gap in sewage treatment

	Driving Force (D)	Pressure on Ecosystem (P)	State of Environment (S)	Impact on Health & Ecosystem (I)	Policy Response (R)
Energy Management					Non-efficient fuel use Renewable Energy Energy Efficiency
Impact on Human Health & Ecosystem				Respiratory Disease Incidence Water borne Disease Incidence Flood affected Area Drought Affected Area Disaster Deaths	
Population Pressure on Ecosystem	Population Density Population Growth Total Fertility Rate				
Environmental Budget					Environmental Budget Expenditure Outlay Gap Renewable Energy Expenditure

1.3 Constructing ESI: Methodology

In calculating ESI, data encompassing a broad spectrum of environmental factors and drivers of sustainability were chosen according to their relevance. Initially, a list of seventy five indicators was prepared; which was subsequently reduced to forty one, largely due to data constraints. These chosen datasets were further scrutinised for accuracy and reliability.

In most cases, data were sought from the most recently available published government sources, such as

Census of India, Government Surveys (including Forest Survey of India, National Family Health Survey, Economic Survey), State Department websites (Transport, Energy, Water Resources), Central and State Planning and Budget Documents, State of the Environment (SoE) reports and Central Pollution Board Publications (National Ambient Air Quality Monitoring, Water Quality Monitoring, Waste Generation). The literature and data sources available within the Environment Information Systems (ENVIS) were also consulted for the study. Additionally, the parliamentary session data books proved useful, as they provided testimony to the concerns of policy makers regarding the environment, and measures taken to mitigate degradation.

Often, datasets had to be created by compiling data gathered from multiple sources. For example, for some indicators such as Air Quality& Pollution and Water Quality & Availability, data sets had to be prepared by aggregating data gathered from each monitoring station in the State. In certain cases, proxy variables were used to capture important measures. For example, for biodiversity, since data on threatened species of mammals, birds and reptiles as a percentage of total known breeding species were not available at the State level, proxy variables of wetland area and protected area as percentage of geographical area of the State were used. The chosen forty one indicators were grouped under nine thematic sub-indices. Annex 1 highlights this, provides a brief description of the indicator and the data source. ESI is an equally weighted average of the nine sub-indices; viz., each sub-index carries a weight of 11.11%. Also, within each sub-index, indicators are assigned equal weightage. For example, in the Waste Generation and Management sub-index, each of the indicators, viz., Municipal Solid Waste (MSW), Hazardous Waste Generated and Gap in Sewage Treatment are assigned equal weightage (33.33%). The reason behind assuming equal weights is two-fold. First, there is a lack of evidence in the literature to explicitly justify differentiated weights being assigned for each sub-index. Second, keeping in mind the need for overall improvements in environmental sustainability, it is felt that strategies and policies in each of these nine areas are equally significant. Aggregation takes place at two stages – indicators to sub-index and sub-indices to the overall ESI of the State.

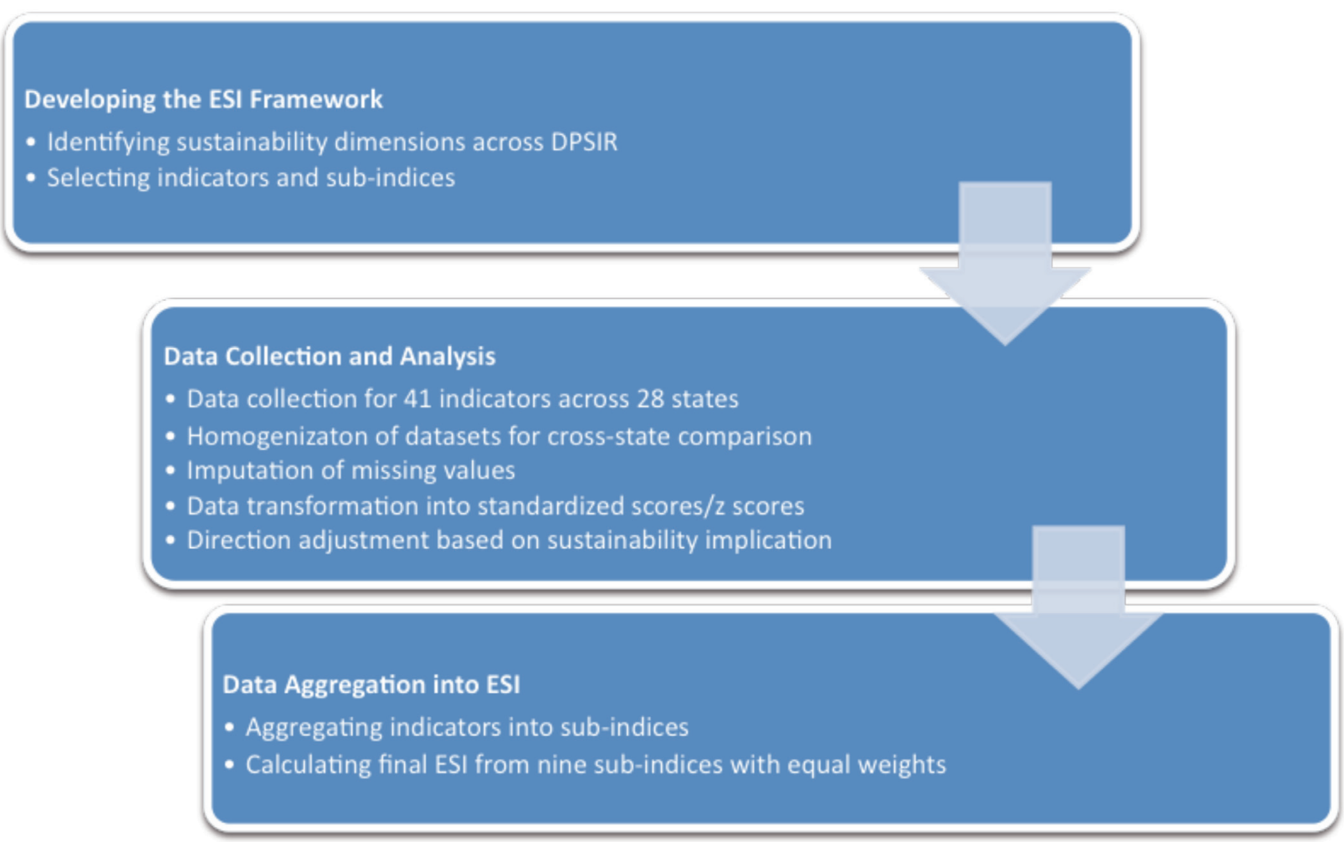
These forty one indicators are also categorised under the DPSIR framework. When the disaggregated weights are summed up for each of the five components relating to DPSIR, the weights are as follows: Driving Force (D) 7.32%, Pressure on ecosystem (P) 21.95%, State of Environment (S) 26.83%, Impact on Health and Ecosystem (I) 17.07% and Policy Response (R) 26.83%.

The first step in computing ESI involved converting data into comparable scales – percentages, ratios and concentrations. In some cases, the percentage change of a variable was taken into account to capture the rate of flow of resources or rate of accumulation of waste. This highlights State performance over the years. Also, suitable denominators such as total geographical area, population of the State and Gross State Domestic Product (GSDP) were used to transform indicators, making them suitable for comparison across states. This made sure that no State was given undue advantage because of its geographical area or population. For example, data on forest cover and replenishable ground water were made comparable by taking total geographic area of the State as denominator; data on incidence of respiratory disease and water borne disease were divided by State population; while Energy Efficiency captures energy utilised to produce one unit of GSDP.

In the second step, raw data was analysed to check for skewness and wherever appropriate data were transformed (natural logarithm function) to ensure normal distribution.. The third step involved imputing missing values in the dataset using multiple imputation maximum likelihood (EM) technique. It was assumed that data are Missing at Random (MAR), i.e. the probability that an observation is missing may not be completely random, but depends on other observed variables. Once the Missing Value Analysis (MVA) was completed, the log-transformed variables were back-transformed using an exponential function. In order to aggregate data, they must be expressed in a common unit. In the fourth step, data were transformed into z-scores, which represent standard deviations from the means, capable of direct comparison.

Some indicators contribute positively to a State's sustainability, while others have a negative impact. For example, while percentage of area under forests in a State contributes positively to sustainability; annual per capita hazardous waste generated reduces sustainability. In order to capture this effect, each of the z-scores was transformed by multiplying the values with a positive or a negative value of one. Lastly, indicators under each of the policy sub-indices were aggregated to obtain a score for each sub-index. Scores of the nine sub-indices were then added to arrive at the State's ESI. Based on the aggregate ESI score, States were categorised into five groups: (1) Most Sustainable (top 20 percentile); (2) More Sustainable (within 60-80 percentile); (3) Moderately Sustainable (within 40-60 percentile); (4) Less Sustainable (within 20-40 percentile) and (5) Least Sustainable (bottom 20 percentile). While the aggregate index reveals the relative position of states; the nine sub-indices highlights each State's performance across different sectors in greater detail.

Figure 3 : ESI Framework and Methodology



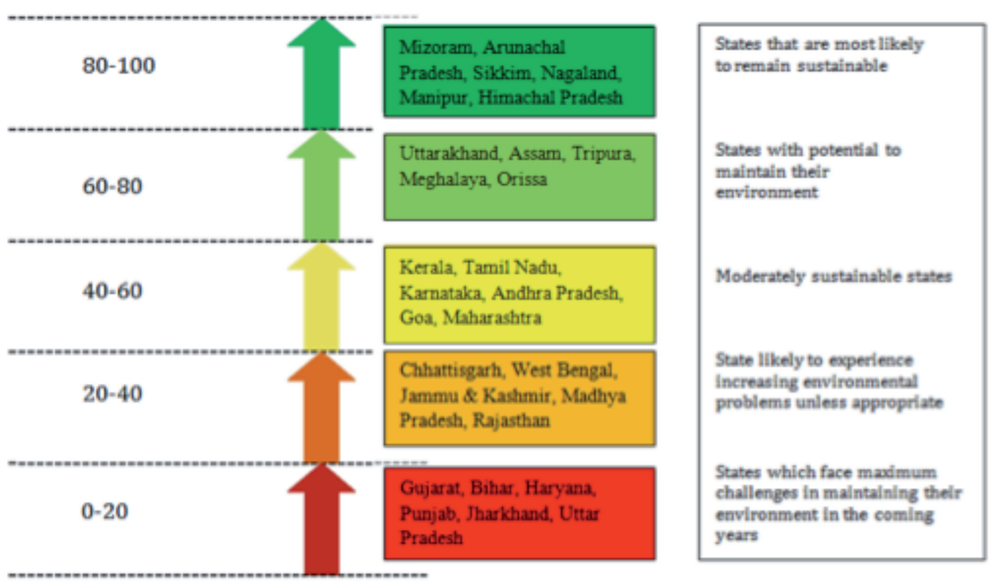
CHAPTER 2

Findings & Analysis using DPSIR & Sub-indices

ESI is a relative measure of sustainability that compares all Indian states in order to predict the pressure each state will face in managing its environmental resources in the coming years. A higher ESI for a state means that the state currently faces fewer challenges than states with a lower ESI, but not necessarily that a state's present trajectory will preserve its current level of environmental quality. A higher ESI, therefore, should not lead to complacency amongst highly ranked states, nor should a low ESI be viewed as irreversible or necessarily an indication of lack of state effort.

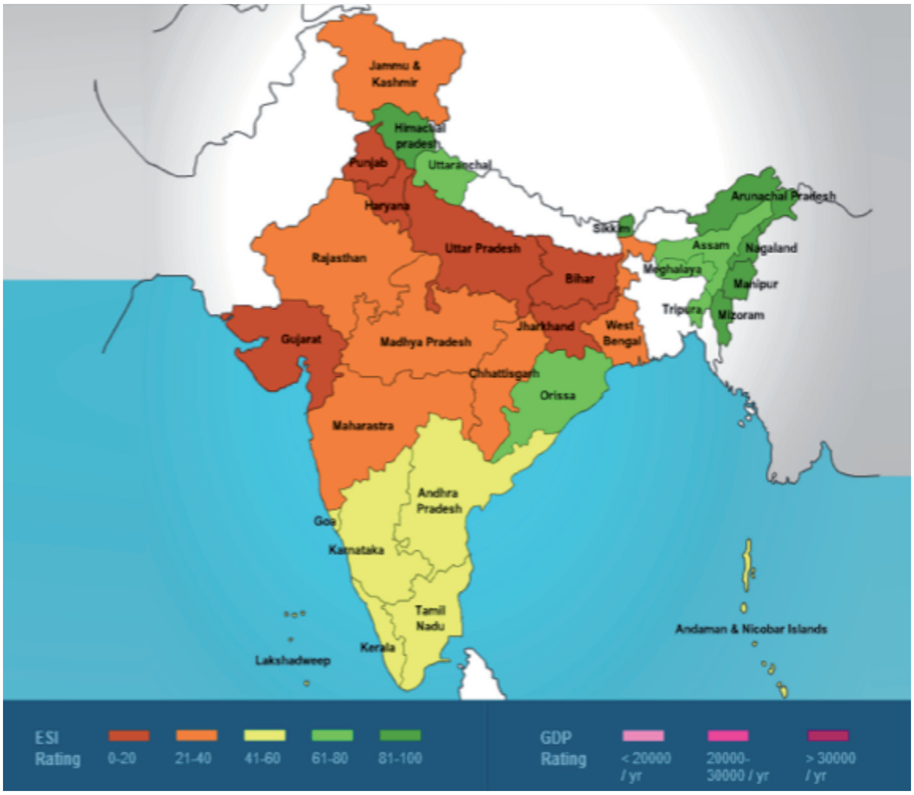
As per ESI 2010, the states that are 'most sustainable' (lie in the top 20 percentile) are largely the Himalayan states (Arunachal Pradesh, Manipur, Mizoram, Nagaland, Sikkim) and Himachal Pradesh The 'least sustainable' (bottom 20 percentile) are Bihar, Haryana, Gujarat, Punjab, Rajasthan and Uttar Pradesh. The various states in each of the five sustainability classes are shown in Figure 4.

Figure 4 : Sustainability percentile groups



The colour-coded map of India (Figure 5) shows states' sustainability according to the ESI. While these are largely congruent with common perceptions on environmental conditions across states, there are a few unexpected patterns as well. As expected, states with abundant initial endowments of natural resources, viz., forests, such as the Himalayan states and Kerala lie in the top 20 percentile. However, other resource rich states, viz., minerals, such as Chhattisgarh and Odisha, Jharkhand and Madhya Pradesh, and Bihar lie under the 'moderately' sustainable, less sustainable and least sustainable categories respectively. Also, States such as Assam, Meghalaya and Tripura have not scored as high as their other north-eastern counterparts, and are found in the 'more sustainable' category.

Figure 5 : Environmental Sustainability Index of 28 states



2.1 Interstate comparison under DPSIR Framework

Large states such as Gujarat, Punjab and Uttar Pradesh that have experienced intensification of industrial and agrarian activities have done so at the expense of environmental health and have scored lower on the ESI. However, states such as Kerala, West Bengal and Tamil Nadu, have maintained environmental conditions in spite of high intensity of economic activity and demographic pressures, and have a higher ESI score. Such revelations emphasize both the value and weaknesses of the macro snapshot that the summary ESI offers. On the one hand, ESI neatly aggregates the contributions of states' initial endowments as well as the rate of consumption and replenishment of its environmental assets with the help of the DPSIR analytical framework. On the other hand a high ESI score is hard to interpret as either a summary of State performance or a guide for policy. What is oft-found is that states that face lower *Pressure*s or have better *State* of environment do not necessarily fall into the 'most' or 'more' sustainable categories.

This fact can be further understood by considering a disaggregated ESI in terms of the five components of the ESI. When all states were considered in relation to the *Pressure* component, it was evident that states endowed with higher natural resources and sparse population (such as the north-eastern states, Jharkhand) are also the ones that face less pressure on their environment. That is, they lie on the right side of the Y-axis in Figure 6. However, differences are seen when overall ESI scores are considered. While most of these fall in the 'most' and 'more' sustainable categories some such as Madhya Pradesh, Jharkhand and Bihar fall in the orange and red categories respectively. Likewise, consider Figure 7, which presents State-wise quality of environment, measured in terms of air and water quality and forest cover. States on the right side of the Y axis are a combination of states that lie in the 80-100 (Mizoram), 60-80 (Meghalaya) and 40-60 percentiles (Tamil Nadu). In Figure 8, what is seen is that while some of the 'most' sustainable states like Himachal Pradesh and Sikkim reveal a significant impact, other states such as Rajasthan (Less Sustainable) and Uttar Pradesh and Bihar (Least Sustainable) face a lower impact even though their overall sustainability is low. West Bengal's high score in this area boosts its ESI despite its lower scores in *State* and *Pressure* components.

Figure 6 : Pressure on Ecosystem

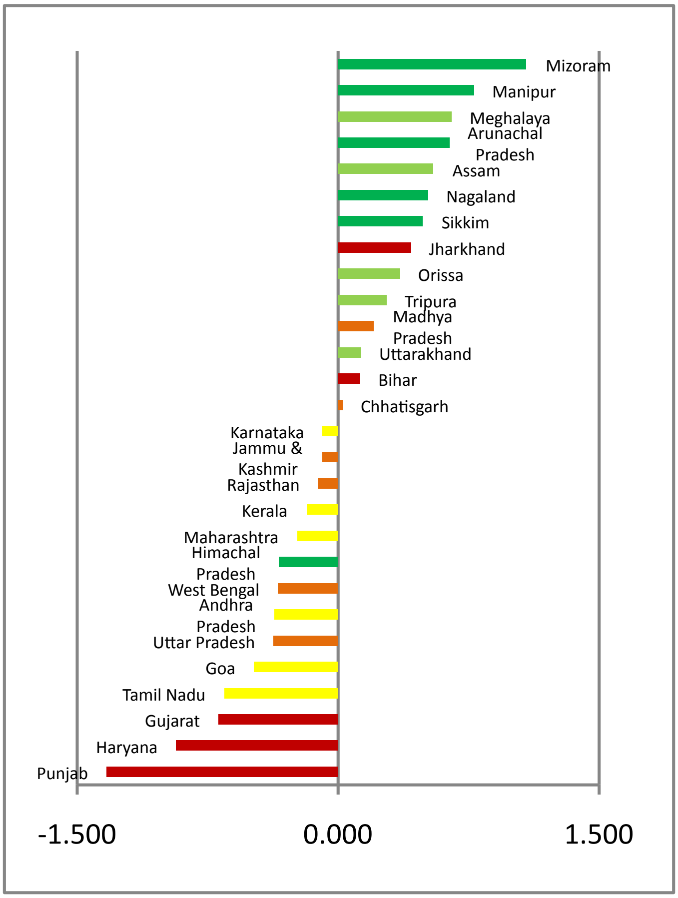


Figure 7 : State of Environment

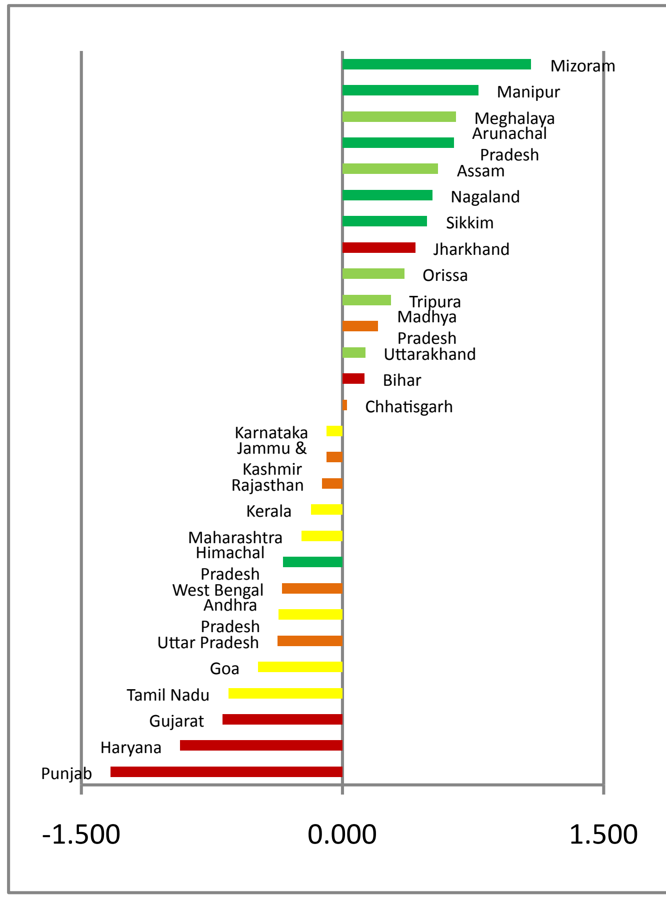


Figure 9 outlines Policy Responses, a measure of a State's efforts to maintain and ameliorate its environment in terms of forest and wetland conservation, waste and energy management practices and budgetary allocations towards environment sectors. What is found is a correlation between State per capita income and response/efforts made to protect the environment. States with low per capita income, such as Jharkhand, Odisha, Meghalaya, and Manipur lie on the left side of the Y-axis, while high-income states such as Gujarat, Kerala and Goa, are more responsive to taking care of their natural resources. There are exceptions here such as Arunachal Pradesh, which has shown a stronger response despite being a lower-income state, and Punjab, which is a high-income, but scores low on responsiveness due to less budgetary allocation towards environmental sectors.

Figure 8 : Impact on health and ecosystem

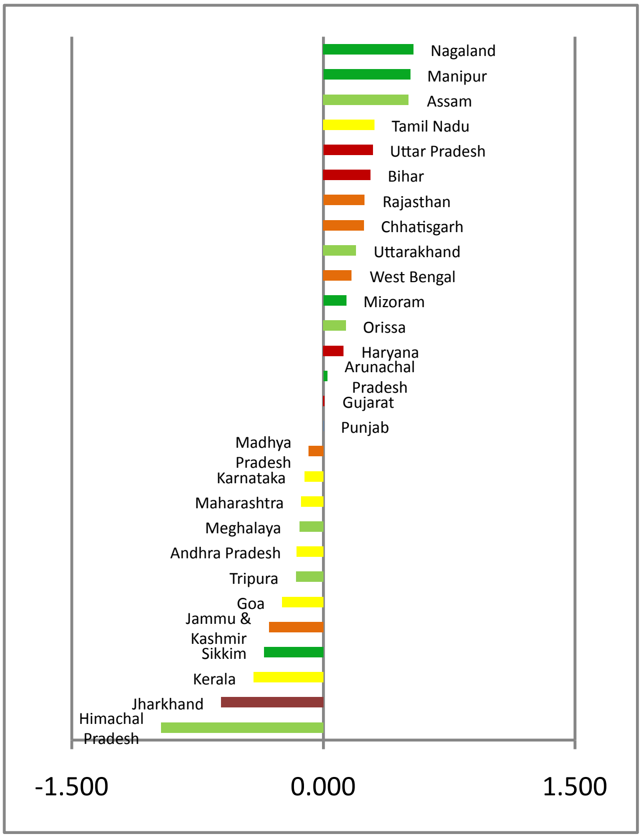
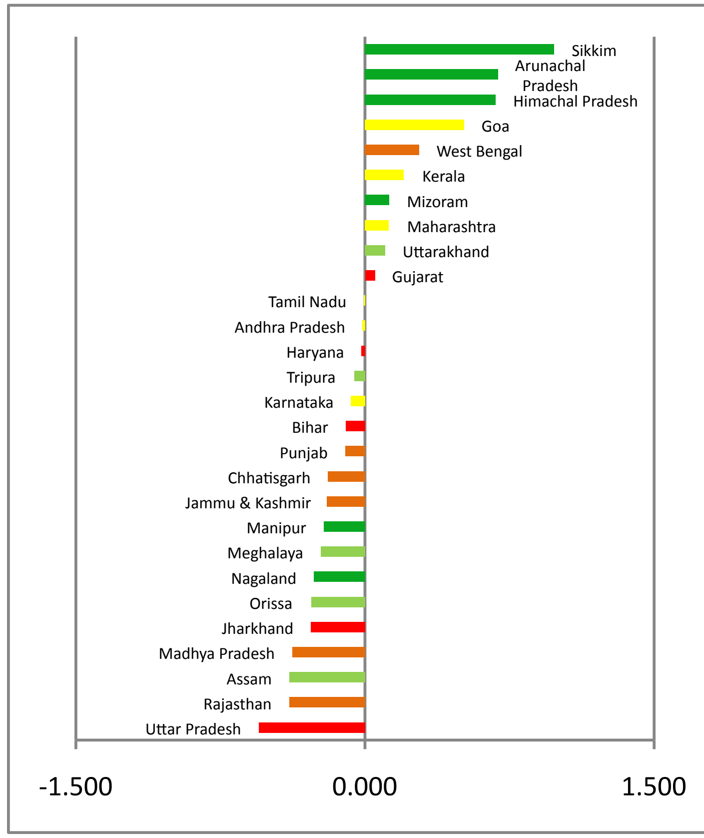


Figure 9 : Policy Response



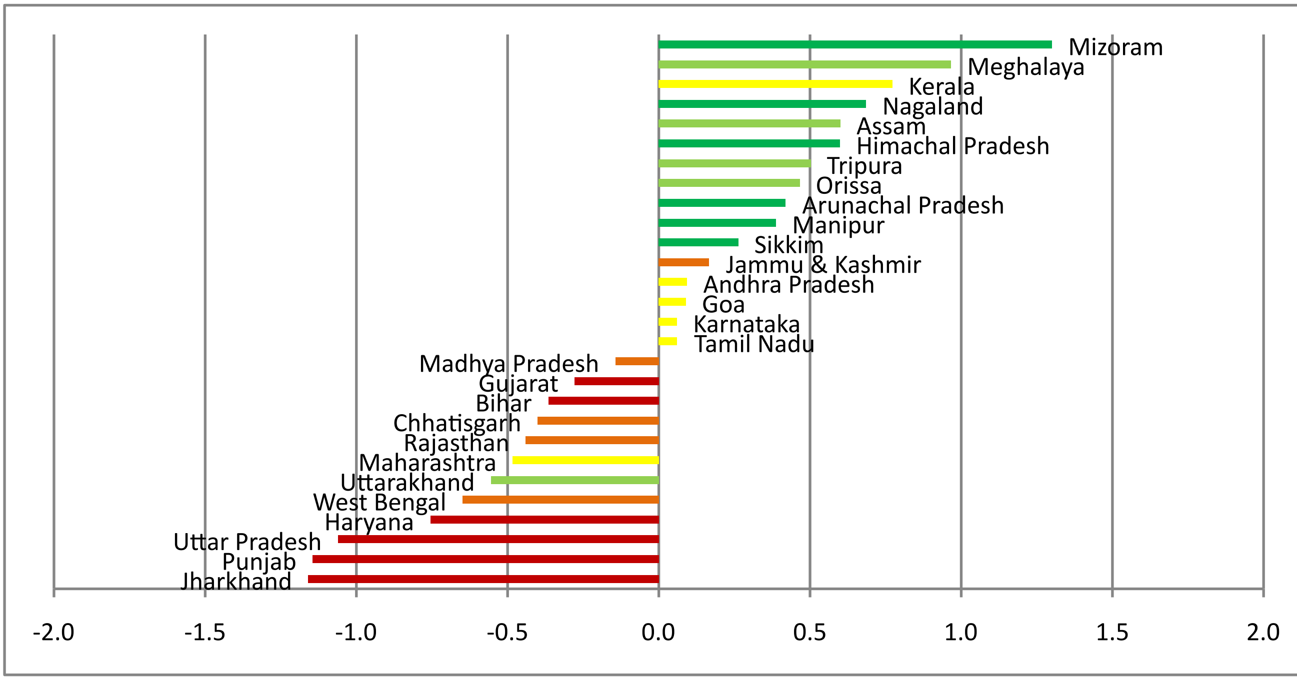
2.2 Interstate comparison across Sub-indices

While the ESI indicates the overall sustainability trajectory for a State, the sub-indices provide insight into the particular drivers of sustainability (air quality, water quality, land use, waste management etc) with implications for policy and action. Analysing patterns across the nine sub-indices reveals that states with similar overall ESI scores, may vary greatly when it comes to specific sectors or dimensions of environmental sustainability. The bar charts demonstrate the states' performance on the nine sub-indices. Values on the x-axis are the standardized scores on the respective sub-indices, while the coloured bar graph indicates the ESI percentile group in which the particular State lies.

2.2.1 Air Quality & Pollution

States that enjoy good air quality, are largely those that lie in the 'most' or 'more' sustainable categories, i.e. with high ESI scores. Uttarakhand is an exception to this. A plausible reason for this could be that air quality measurement sensors are installed in select industrial clusters/in urban and semi urban areas (two located in Dehradun). Kerala, a 'moderately' sustainable State, ranks third among all the states. This is possibly because the State's main income-generating sectors are agriculture, tourism, coir, handloom/ handicrafts and mining, and a very small traditional industrial base. Jammu & Kashmir, a least sustainable state, also performs well, given its topographical advantages.

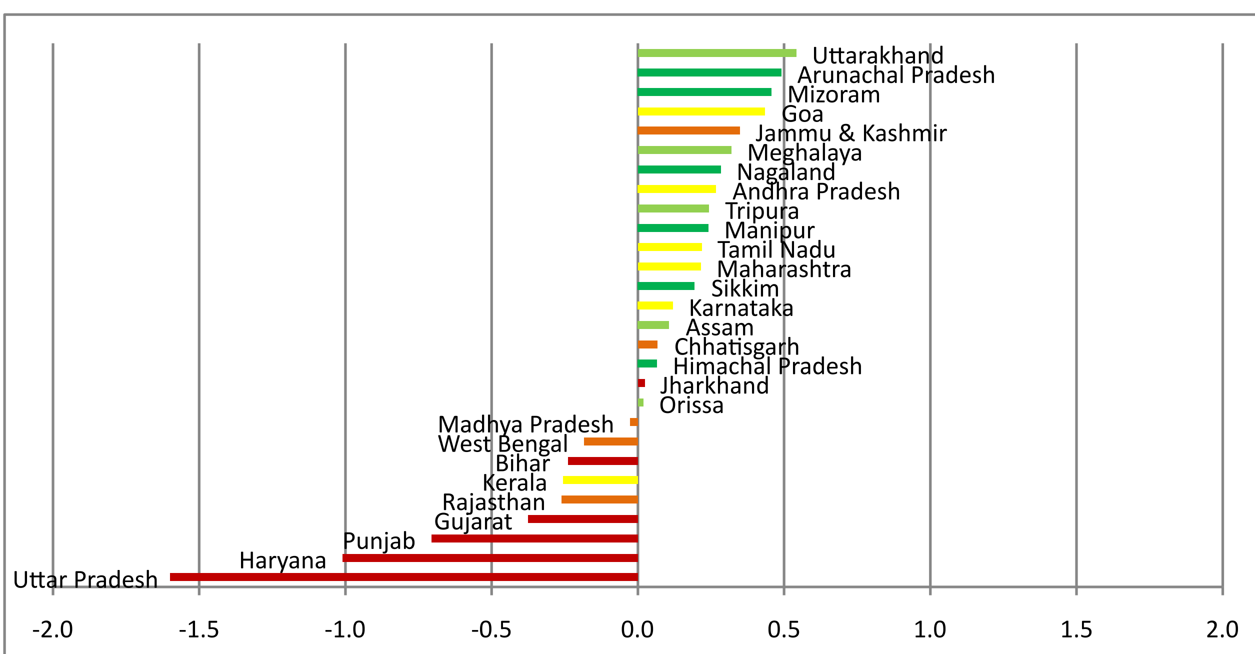
Figure 10 : State-wise standardised scores on Air Quality & Pollution



2.2.2 Water Quality & Availability

Unlike the Air Quality & Pollution sub-index, it is not merely the 'most' or 'more' sustainable states that perform well. Several of the 'moderately' sustainable states such as Goa, Andhra Pradesh, Tamil Nadu and Maharashtra and 'least' sustainable State such as Jammu & Kashmir score relatively well. States that have negative scores, largely fall in the 'least' sustainable category. An examination of the underlying indicators reveals that this is largely because of the contamination in the case of Uttar Pradesh (both BOD and COD), Haryana, Gujarat and Punjab (BOD); excessive ground water extraction in Punjab for irrigation use and low percentage of households being supplied by piped drinking water in Bihar.

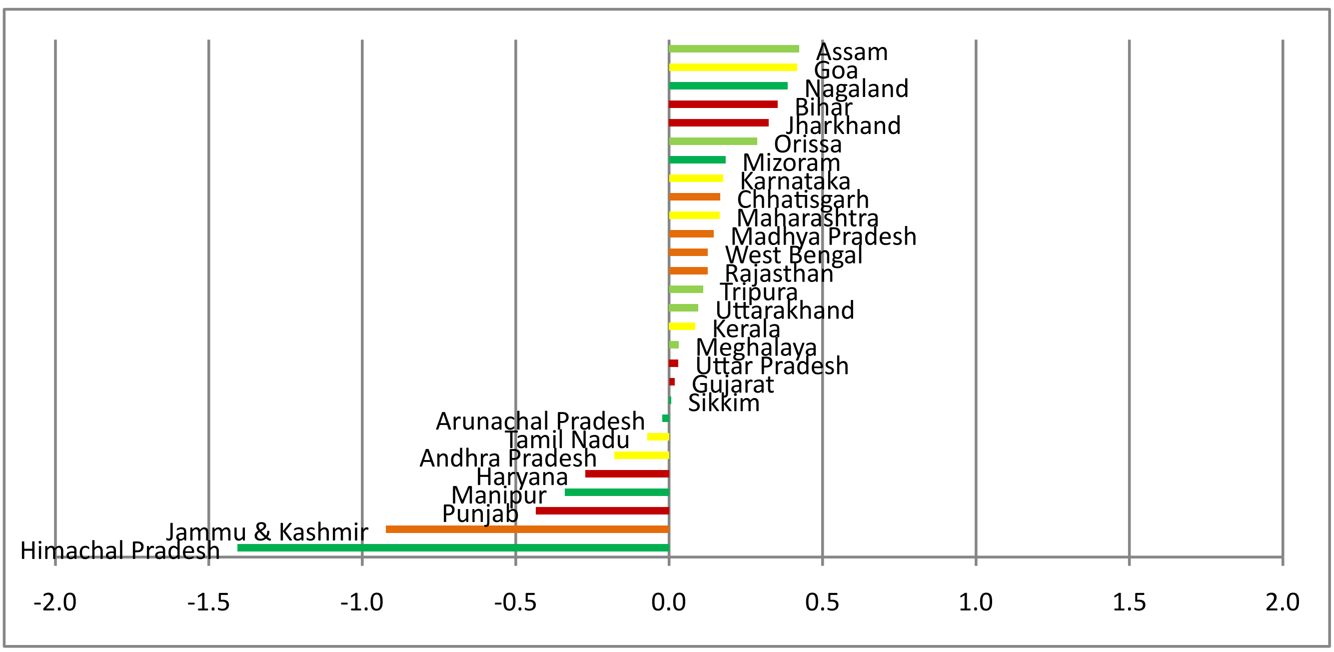
Figure 11 : State-wise standardized scores on Water Quality & Availability



2.2.3 Land Use & Agriculture

A majority of states are found on the positive side of the axis, although many of them have very small positive scores compared to the states on the negative side of the axis. Himachal Pradesh, a 'most' Sustainable State performs very poorly in a majority of the indicators constituting this sub-index, specifically Grazing land, Wasteland and Soil erosion. On the other hand, 'least' sustainable states like Bihar and Jharkhand are the better performers in this area, the former due to its good scores for indicators like Grazing land and soil erosion and the latter due to its better performance in the area of Pesticide and Fertilizer Consumption. In Punjab and Haryana, usage of fertilizers and pesticides is much higher than in other states, a fact that together with their high incidence of soil erosion results in their poor score in this sub-index.

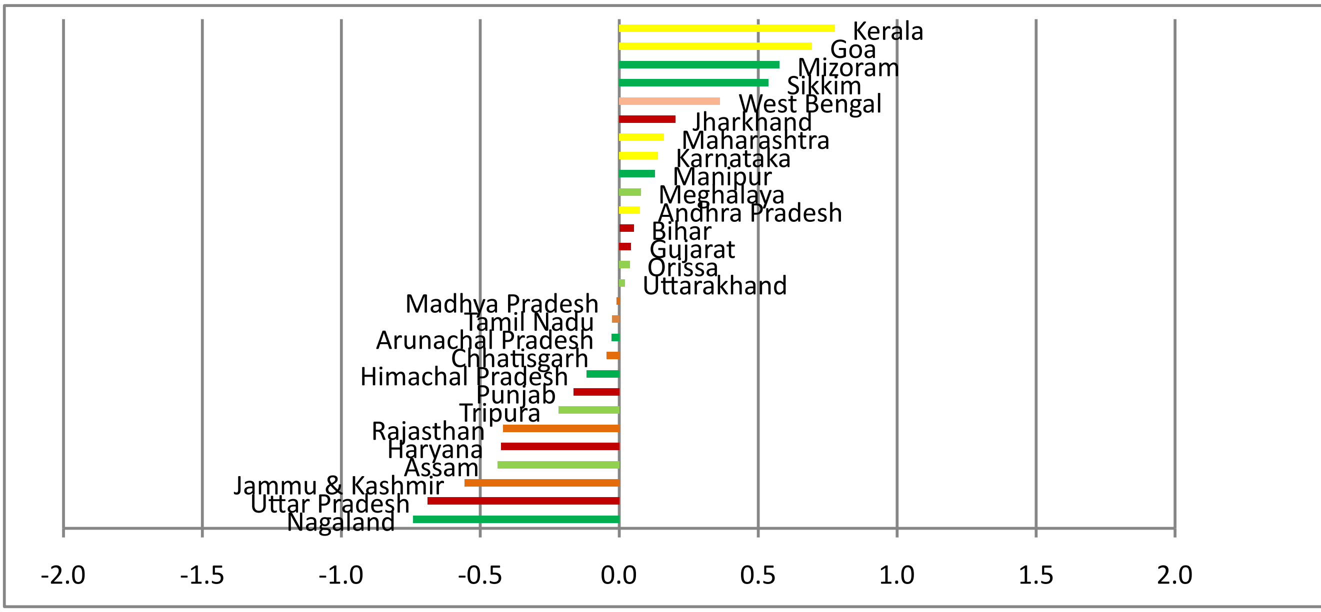
Figure 12 : State-wise standardised scores on Land Use & Agriculture



2.2.4 Forests & Biodiversity

While high initial endowments of forests (measured by forest cover) boosts the score of a State significantly, flow variables such as change in forest cover and area under JFM and PANs indicate policy responses to protect initial conditions. Kerala for example performs the best, and this can be attributed to the State's initiatives with regards to CAMPA and protection of wetlands. Out of the total land set aside for afforestation under CAMPA, 86.01% has been afforested. 6.04% of the land is under wetlands indicative of the state's concern in conserving biodiversity. Interestingly, although Nagaland has a high initial endowment of forest cover (81.21%), it is placed last, with negative scores on every indicator that captures State efforts to protect forests and biodiversity. Similarly, with other 'most' and 'more' sustainable states such as Arunachal Pradesh and Himachal Pradesh with large areas under forests.

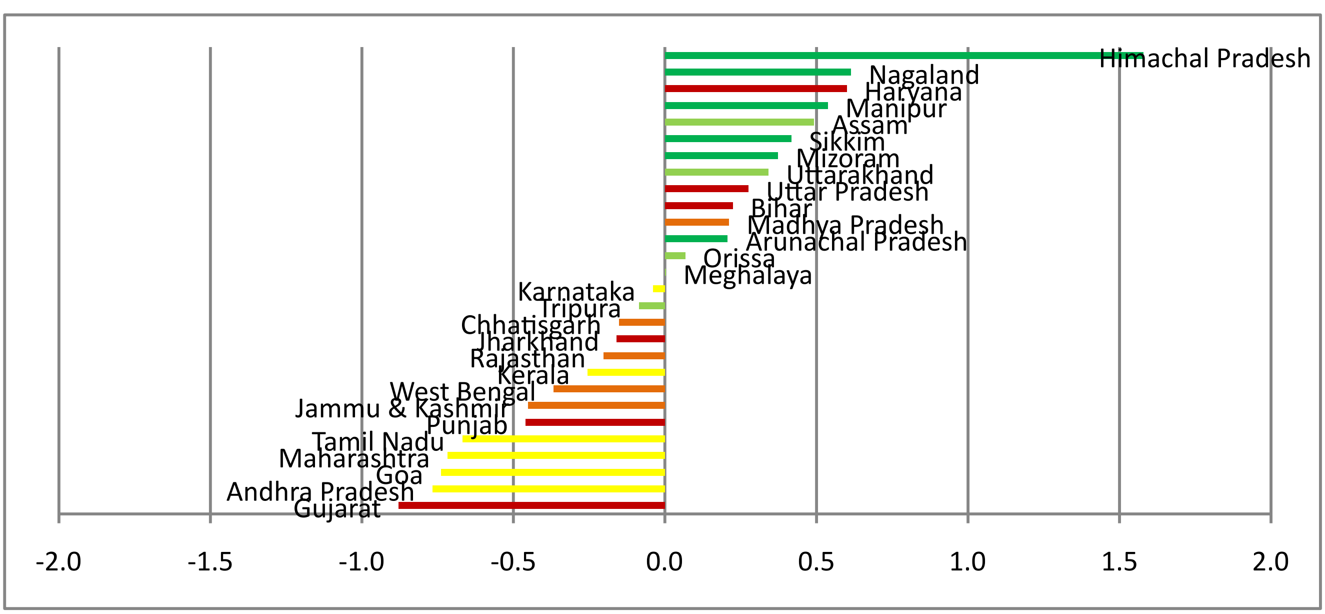
Figure 13 : State-wise standardized scores on Forests & Biodiversity



2.2.5 Waste Generation and Management

Waste generation and treatment reflect the lifestyle and consumption patterns of a society. More waste generated alludes to higher extraction rate and thus less sustainability. States that fall within the first two percentiles perform very well in Waste Management. An exception is noted in the case of Haryana which is a 'least' Sustainable state. This is because the state exhibits the lowest Gap in Sewage Treatment (48.96%). The worst performing are states which have a high per capita income and contribution to the nation's GDP, i.e. Tamil Nadu, Maharashtra, Gujarat. Tamil Nadu has the highest MSW generation, with 85% of that waste remaining untreated. It is accompanied by Andhra Pradesh and Goa.

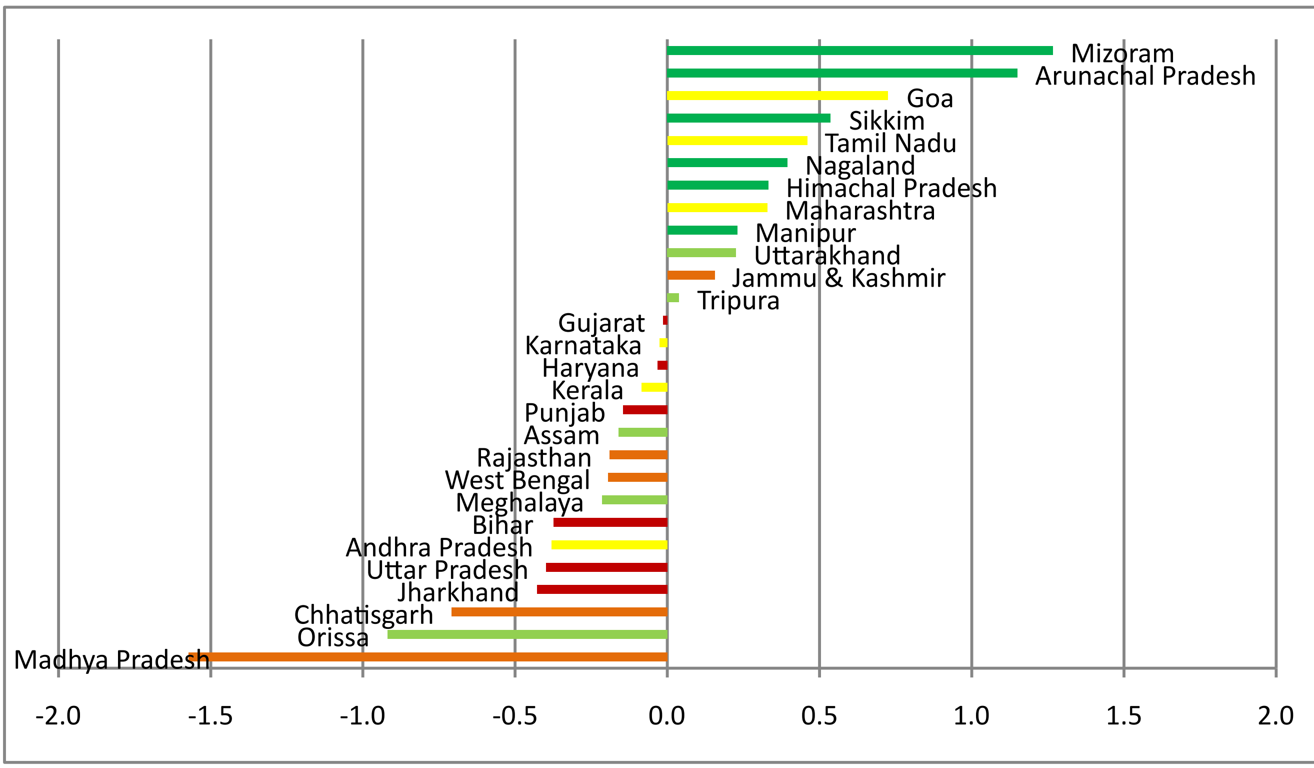
Figure 14 : State-wise standardized scores on Waste Generation and Management



2.2.6 Energy Management

All the 'most' sustainable states score very high on this index. Interestingly Tamil Nadu a 'moderately' sustainable State score well, given its high installation of renewable energy. The worst performing states include Jharkhand, Chhattisgarh, Odisha and Madhya Pradesh, exhibiting lowest energy efficiency. Moreover, Jharkhand and Odisha have fewer installations to tap renewable energy sources.

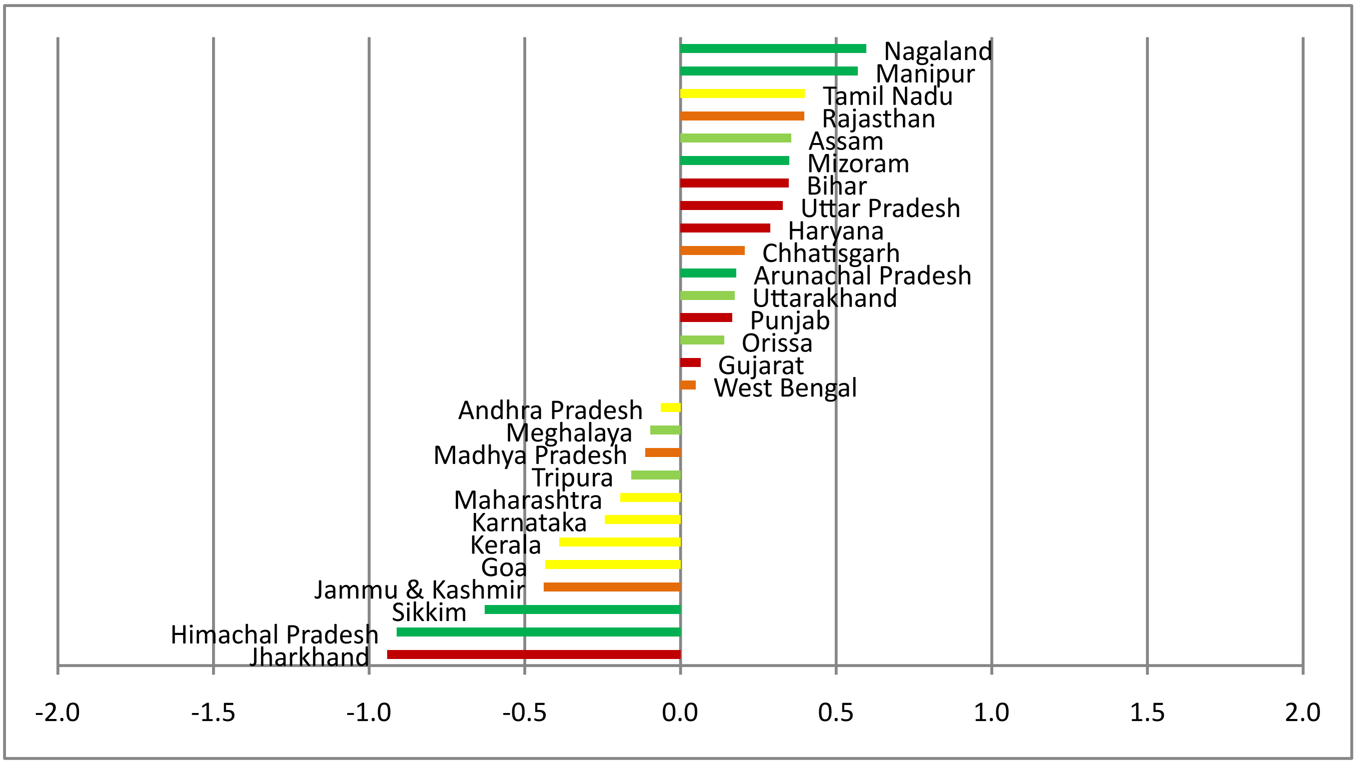
Figure 15 : State-wise standardized scores on Energy Management



2.2.7 Impact on Human Health & Disaster

States performing well in this sub-index, are drawn from across the five percentiles. While in 'most' sustainable states such as Nagaland, Manipur and Mizoram the incidence of people affected by respiratory and water-borne disease is low, this is coupled with small tracts of land being flood and drought prone. A similar situation is seen in a 'moderately' sustainable State, Tamil Nadu, except that 22.52% of the land is drought prone. Uttar Pradesh, a 'least' sustainable State has low levels of both flood and drought prone areas. With regards to the poor performers, we find that Himachal Pradesh and Sikkim, both with high ESI scores, suffer because of a high incidence of respiratory disease and water-borne disease respectively.

Figure 16 : State wise standardized scores on Impact on Human & Ecosystem

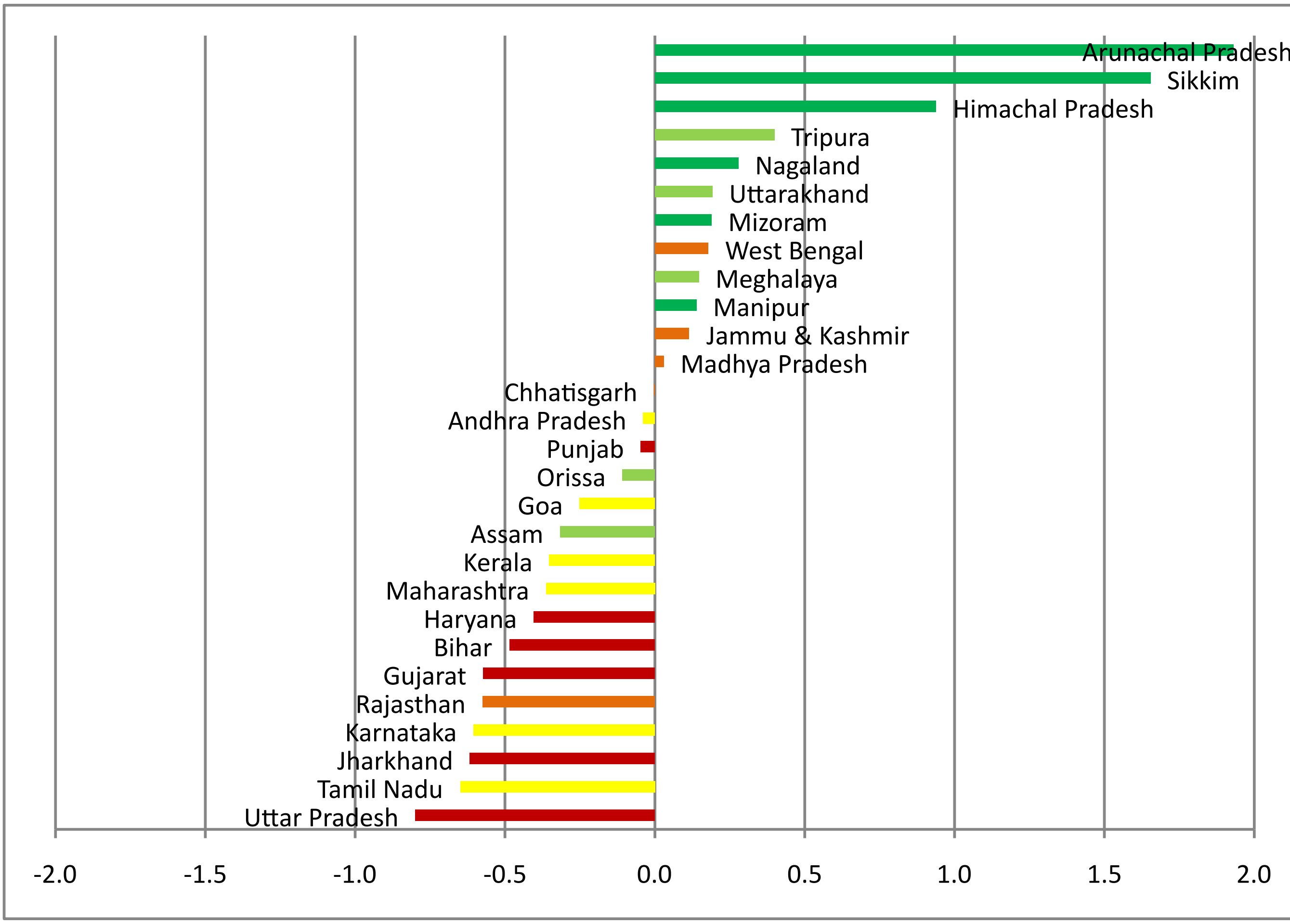


2.2.8 Environmental Budget[1]

Except West Bengal and Jammu & Kashmir most states with higher ESI score reveal higher allocations to environment in their budgets. Population abatement, conservation, clean energy production expenditure contributes to Environmental Budget sub-index. States like Arunachal and Sikkim have the highest expenditure on environment as a percentage of net state GDP whereas states like Uttar Pradesh and Tamil Nadu fare very badly in the area of expenditure on renewable energy as percentage of net GDP of the state.

1 Although one of the indices is Population Pressure on Ecosystem, not much is being elucidated on this, as population-related variables are difficult to change in the short-term, and a State can do its best to manage the other aspects of the environment to compensate.

Figure 17 : State wise standardized scores on Environmental Budget



CHAPTER 3

Comparison across Peer Group States

Due to the high degree of variation across the twenty-eight states (total land area, population, per capita income and socio-economic heterogeneity), more meaningful conclusions about environmental sustainability can be drawn by grouping similar states into peer groups. States are classified into six groups, based on their per capita GDP and contribution to the nation's GDP[1]. The choice of using GDP-related data for grouping states is actuated by the argument that (a) per capita income influences and determines environmental policy decisions. The Environmental Kuznets Curve (EKC) shows that as income increases, demand for environmental quality and hence policies taken for the same by stakeholders increases; and (b) contribution to national GDP highlights a State's natural, human and economic resources and hence accounts for inter-State differences.

Taking the mean per capita income of the country as a benchmark, States are divided into *high* or *low* per capita income states. With regards to states' contribution to India's overall GDP, three categories were created – *high* (5-15%), *medium* (1-5%) and *low* contributors (less than 1%). Based on this categorisation, a matrix was formed, with six peer groups. These are: (a) High per capita income-High GDP contribution (b) Low per capita income-High GDP contribution, (c) High per capita income-Medium GDP contribution, (d) Low per capita income-Medium GDP contribution, (e) High per capita income-Low GDP contribution, and (f) Low per capita income-Low GDP contribution.

Table 3 : Peer Grouping of states according to Economic Profiles

	High Contribution to country's GDP (5-15%)	Medium Contribution to country's GDP (1-5%)	Low Contribution to country's GDP (less than 1%)
High per capita income (greater than INR 38,169)	*PEER GROUP I*	*PEER GROUP II*	*PEER GROUP III*
	Maharashtra Andhra Pradesh Tamil Nadu Gujarat Karnataka	Kerala Haryana Punjab	Himachal Pradesh Goa
Low per capita income (less than INR 38,169)	*PEER GROUP IV*	*PEER GROUP V*	*PEER GROUP VI*
	Uttar Pradesh West Bengal	Rajasthan Madhya Pradesh Bihar Odisha Chhattisgarh Assam Jharkhand	Uttarakhand Jammu & Kashmir Tripura Meghalaya Nagaland Manipur Arunachal Pradesh Mizoram Sikkim

1 State-wise per capita income in INR/annum at current prices (2008-09) and State-wise Gross Domestic Product at current prices (2008-09) as a percentage of India's overall GDP (2008-09) was considered.

3.1 Movements across years: ESI 2011 and ESI 2009

Being a relative index, ESI measures state level sustainability by capturing the variation within 28 states at any given point of time. Hence each year's ESI is a standalone measure of sustainability that is not comparable in a time series format. However, some pattern of state level sustainability can be established by reviewing the grouping of states in 2009 & 2011. In both the years, states with abundant natural resources and less economic activity are the most sustainable states whereas the least sustainable are the ones where the degree and intensity of economic activities, coupled with higher population and limited natural resources lead to unsustainable anthropogenic impacts on the environment. While this is the dominant observation, there is some reshuffling between states in the 5 sustainability groups. States that have moved up the sustainability ladder are: Himachal Pradesh, Assam, Odisha, Maharashtra, Andhra Pradesh and Rajasthan. States which shifted down the ladder include: Chhattisgarh, West Bengal, Jharkhand, Kerala and Uttarakhand. The largest shift was seen in the case of West Bengal, which moved from the More Sustainable category to the Less Sustainable Category.

Table 4 : State groups based on Overall ESI in 2011 and 2009

ESI Groups	States in ESI 2011	States in ESI 2009
Most Sustainable States (80-100 percentile)	Mizoram Arunachal Pradesh Sikkim Nagaland Manipur Himachal Pradesh	Mizoram Arunachal Pradesh Sikkim Nagaland Manipur Uttarakhand
More Sustainable States (between 60-80 percentile)	Meghalaya Tripura Uttarakhand Assam Odisha	Meghalaya Tripura Himachal Pradesh Kerala West Bengal
Moderately Sustainable States (between 40-60 percentile)	Kerala Tamil Nadu Goa Karnataka Andhra Pradesh Maharashtra	Assam Chhattisgarh Goa Karnataka Odisha Tamil Nadu
Less Sustainable States (between 20-40 percentile)	Chhattisgarh Jammu & Kashmir West Bengal Madhya Pradesh Rajasthan	Andhra Pradesh Jammu & Kashmir Jharkhand Madhya Pradesh Maharashtra
Least Sustainable States (between 0-20 percentile)	Bihar Gujarat Haryana Punjab Uttar Pradesh Jharkhand	Bihar Gujarat Haryana Punjab Uttar Pradesh Rajasthan

While the framework employed remains the same, the differences in ESI scores of states in 2009 and 2011 are a product of changes in data and the number of indicators under the sub-indices.

i. Changes in the datasets

ESI 2011 utilises data which has been updated post the last ESI report in 2009. Newer sources of data are available for some indicators under Land Use & Agriculture, Forests & Biodiversity; Waste Generation & Management, Energy Management, Population Pressure on Ecosystem and Environmental Budget.

ii. Changes in indicators

Two indicators, viz., Land under cultivation (as a percentage of the total land area of the State) and Wasteland (as a percentage of the total land area of the State) were added to the Land Use & Agriculture sub-index; taking the total number of indicators under this index from five in 2009 to seven in 2011. Also, the Joint Forest Management (JFM) indicator under the Forests & Biodiversity sub-index was calculated differently. While last year, JFM was viewed as a percentage of the total land area of the State, this year it was considered as a percentage of the total forest area of the State

3.2 Snapshot of ESI

Table 5 provides a holistic picture incorporating State sustainability, core areas of concern (if any) within the DPSIR framework and their corresponding economic profiles. Population data are also included.

Table 5 : ESI Snapshot

Economic Profile	States/ESI Category	Population Details	DPSIR details
Peer Group I	**Moderately Sustainable** Andhra Pradesh Karnataka Maharashtra Tamil Nadu **Least Sustainable** Gujarat	Significantly higher than the country's average population	**Pressure** ▪ All states have negative scores, indicating massive anthropogenic pressures on the environment. ▪ Gujarat has the worst score followed by Tamil Nadu, in the case of the former largely due to problems with management of hazardous waste, and the latter municipal solid waste. ▪ Andhra Pradesh and Karnataka exhibit excessive fertiliser use, while Maharashtra has a high density of motor vehicle usage, contributing to poor air quality **State** ▪ Andhra Pradesh, Karnataka and Tamil Nadu have positive scores, indicating less observable changes to the environment. ▪ Positive scores are due to higher scores on water quality indicators (BOD, COD and supply of piped drinking water) ▪ Gujarat and Maharashtra have negative scores, former because of poor water quality and the latter air quality and percentage of land under forest cover **Impact** ▪ Andhra Pradesh, Karnataka and Maharashtra exhibit negative impacts on ecological systems, primarily because of large tracts of area being drought prone and subject to soil erosion. **Response** ▪ Maharashtra exhibits the best response strategies to ameliorate the environment, viz., promotion use of non-LPG fuel, area under CAMPA and JFM. ▪ Gujarat is second best, largely because of its efforts with regards to sewage management.

Economic Profile	States/ESI Category	Population Details	DPSIR details
Peer Group II	**Moderately Sustainable** Kerala **Least Sustainable** Haryana Punjab	Lower than the country's average population	**Pressure** ▪ Punjab scores the worst, because intensive agriculture has worsened conditions of groundwater availability and soil conditions because of fertiliser and pesticide use. ▪ Similar situation is seen with Haryana, albeit to a lesser degree **State** ▪ Both Haryana and Punjab have poor air and water quality. ▪ Kerala scores positively; save a negative score on supply of piped drinking water, all other indicators are positive. **Impact** ▪ Interestingly, Kerala has negative impacts on ecological and human systems, with a large percentage of land prone to floods and salinity, acidity and water logging problems. Also, average incidence of acute respiratory disease is high. ▪ Both Haryana and Punjab exhibit a miniscule positive score **Response** ▪ Only Kerala displays positive efforts to mitigate and improve environmental conditions, through strategies for CAMPA and wetland protection
Peer Group III	**Most Sustainable** Himachal Pradesh **Moderately Sustainable** Goa	Significantly lower than the country's average population	**Pressure** ▪ Both Goa and Himachal Pradesh have negative scores. Goa has a high motor vehicle usage and municipal and hazardous waste generation. Himachal Pradesh has a large percentage of land under grazing **State** ▪ Himachal Pradesh has a negative score, given the proportion of land declared as wasteland **Impact** ▪ Both states face impacts on ecological and human systems, with the magnitude being more in Himachal Pradesh. ▪ Himachal Pradesh faces high average incidence of both respiratory and water borne disease **Response** ▪ Both states show evidence of government support for environmental protection. ▪ Strategies for protected area management, JFM, CAMPA are seen. Additionally, in Goa, efforts have been made to propagate use of on-LPG fuel, and in Himachal Pradesh the actual expenditure on the environment far exceeds that of outlay.

<table>
<tr><th>Economic Profile</th><th>States/ESI Category</th><th>Population Details</th><th>DPSIR details</th></tr>
<tr><td>Peer Group IV</td><td>Less Sustainable
West Bengal

Least Sustainable
Uttar Pradesh</td><td>The population of both the states are significantly higher than the national average.</td><td>Pressure
Uttar Pradesh mainly suffers from poor irrigation facilities and high fertilizer consumption which sum up to a negative score whilst West Bengal suffers high pesticide and fertilizers consumption along with poor MSW management
State
The state of environment in Uttar Pradesh is showing a negative score due to a series of reasons namely poor Air Quality, Drinking water Quality and scanty forest cover whereas the performance of West Bengal has been derailed only due to poor Air Quality
Impact
Both the states score a small positive score in terms of impact primarily due to low incidence of air and waterborne diseases in Uttar Pradesh and low level of soil disturbances and disaster frequency in West Bengal
Response
Uttar Pradesh shows poor response factor mainly due to inadequate conservation initiatives while West Bengal performs better due to a larger environmental outlay and protected areas</td></tr>
<tr><td>Peer Group V</td><td>More Sustainable
Assam
Odisha

Less Sustainable
Chhattisgarh
Rajasthan
Madhya Pradesh

Least Sustainable
Bihar
Jharkhand</td><td>The population of Rajasthan, Bihar and Madhya Pradesh are considerably higher than the national average while the rest of them are below it.</td><td>Pressure
All the states score positive in pressure excepting Rajasthan which suffers poor Ground Water drafts. Assam performs the best due to efficient MSW management and low vehicular population
State
All the states excluding Assam and Odisha illustrate a negative state of environment. This is mainly due to poor Air and Water Quality whereas the same factors add to the positive scores of the outlier states
Impact
All the states barring Jharkhand and Madhya Pradesh demonstrate positive impacts. This is predominantly due to both the states have large areas prone to floods and droughts. The other states reveal lesser incidence of air and waterborne diseases which is positive for them
Response
All of the 7 states score negative with Assam, Madhya Pradesh and Rajasthan performing the worst amongst them. This is chiefly due to poor environment conservation initiatives in the case of Assam and Rajasthan while it is low energy efficiency in Madhya Pradesh</td></tr>
</table>

Economic Profile	States/ESI Category	Population Details	DPSIR details
Peer Group VI	**Most sustainable** Arunachal Pradesh Nagaland, Manipur, Mizoram, Sikkim, **More sustainable** Meghalaya, Tripura, Uttarakhand **Less Sustainable** Jammu& Kashmir	Significantly lower than country's average population	**Pressure** ▪ All states, except Jammu & Kashmir exhibit lower anthropogenic pressures on the environment. **State** ▪ Manipur and Sikkim (among the north-eastern states) and Jammu & Kashmir have negative scores, because of proportion of land declared as wasteland and low levels of replenishable ground water. **Impact** ▪ Jammu & Kashmir, Meghalaya, Sikkim and Tripura have negative scores owing to high incidence of respiratory and/or water borne disease **Response** ▪ North-eastern states except Arunachal Pradesh and Sikkim display lesser number of interventions for environmental protection ▪ Arunachal Pradesh takes the lead here, especially with regards to environment budget

4 Conclusion

ESI is a diagnostic tool that informs and empowers various stakeholders including government and policy makers, concerned citizens, researchers and activists about state level sustainability issues. In addition to assisting evidence based policy making, the tool identifies environmental issues and concerns that require immediate attention and action. By monitoring and measuring sustainability indicators at the state level, the tool assists states to realize their own potential in protecting their environment in the future.

Each state's environmental resources, capabilities and hence challenges differ from others. Furthermore, India's federal system provides the states with considerable jurisdiction and autonomy to formulate and implement policies that improve environmental quality and sustainability at the state level. Hence ESI as a tool recognizes states as a chief change agent for environmental policy outcomes. The overall ESI score summarizes the sustainability trajectory of the state while the sub-index scores provide a sectoral overview of the various components of sustainability. Each of these sectoral dimensions is important for a state's sustainability and its performance varies widely across these areas.

A holistic picture incorporating state sustainability (ESI score), core areas of concern within the DPSIR framework, economic profiles (State GDP and state contribution to India's GDP), and population details provides the edifice for facilitating 'learning' among various states in the same peer group. For example, although Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat, and Maharashtra, have high State GDP, contributions to national GDP, and demographic pressures, the latter two states can prove to be a model for the former three, in terms of responsive strategies to protect the environment, particularly with regards to promotion of use of LPG fuel (Maharashtra) and initiatives to better solid waste management (Gujarat). Likewise, with regards to the peer group encompassing North-Eastern states, Jammu & Kashmir and Uttarakhand, which have similar historical endowments, there is much to be learnt from the initiatives of Arunachal Pradesh and Sikkim. Furthermore, studies probing linkages between various indicators classified under the DPSIR framework can also be undertaken. These studies would identify and establish relationship between environmental pressures and there impacts on various aspects of sustainability; thereby assisting evidence based policy making process.

However, it must be remembered that ESI is a quantitative tool and provides an overview of sustainability and does not incorporate state-specific characteristics (environmental and others). Consequently, it highlights areas where a State performs well and issues and concerns which need immediate action; after which further probing and analysis is required. Thus ESI should be considered as a base for deeper analysis of successful sectoral policies, adopted at the state level, to enhance knowledge about policy initiatives and sustainability outcomes. With regards to peer group learning, the potential of one State to emulate policies, initiatives and experiences of another in order to see improvements in a particular natural resource sector, requires an analysis that is in-depth and qualitative in nature. Moreover, there is a lag time between initiatives taken and tangible on-the-ground outcomes and therefore, while a number of states have taken innovative steps, it may not reflect in their scores.

Consequently, a deeper analysis of successful sectoral policies is initiated to enhance knowledge about policy initiatives and outcomes at state level. One case study is developed for each of the peer group, namely, High per capita income-High GDP contribution, Low per capita income-High GDP contribution, High per capita income-Medium GDP contribution, Low per capita income-Medium GDP contribution, High per capita income-Low GDP contribution, and Low per capita income-Low GDP contribution. A major environmental issue plaguing the peer group is taken as the theme of the case study. Comparison of sub-indices score for the same issue points to the state which has relatively managed the issue successfully. Thus the case studies ascertain and highlight the efforts taken by the state – in terms of policies and implementation strategies, so as to make a learning case for states with similar growth trajectories.

ANNEX 1

Indicators	*Description*	*Data Sources*
AIR QUALITY and POLLUTION		
Annual average Sulphur Dioxide (SO_2) concentration	Amount of SO_2 levels measured in micrograms per cubic meter	Central Pollution Control Board, National Ambient Air Quality Monitoring, 2007.
Annual average Nitrogen Dioxide (NO2) concentration	Amount of NO_2 levels measured in micrograms per cubic meter	Central Pollution Control Board, National Ambient Air Quality Monitoring, 2007.
Annual average Suspended Particulate Matter (SPM) concentration	Amount SPM levels measured in micrograms per cubic meter	Central Pollution Control Board, National Ambient Air Quality Monitoring, 2007.
Annual average Respirable Suspended Particulate Matter (RSPM) concentration	Amount of RSPM levels measured in micrograms per cubic meter	Central Pollution Control Board, National Ambient Air Quality Monitoring, 2007.
Density of motor vehicle usage	Number of motor vehicles used per thousand persons. A proxy indicator of transport sector contribution to air pollution	Department of Road Transport and Highways, Government of India (GoI), 2004.
Note: Air Pollutants (SO_2, NO_2, SPM and RSPM) are measured using sensors installed by the Central and State Pollution Control Boards in select industrial clusters, largely located in urban or semi-urban areas. Hence, the data represents the air quality in these areas and is not indicative of the State's air quality at large.		
WATER QUALITY and AVAILABILITY		
Replenishable ground water	Flow account indicating a dynamic resource which is replenished periodically by precipitation, irrigation return flow, canal seepage, tank seepage, influent seepage etc, annually, per cubic square kilometer of land area.	Ground Water Resources of India Report, Ministry of Water Resources,2004
Mean Biochemical Oxygen Demand (BOD)	Amount of dissolved oxygen consumed by the decomposition of carbonaceous and nitrogenous matter in water, in milligrams per litre.	Water Quality Status Year Book, Central Pollution Control Board,2007.
Mean total coliform	Indicates presence of pathogenic bacteria in water sources (includes total as well as fecal coliform) in most probable numbers per 100 milli litres.	Water Quality Status Year Book, Central Pollution Control Board,2007.

Irrigated land	Land under irrigation as percentage of the net geographical area	Lok Sabha Starred Question No. 487, dated on 28.04.2008.
Annual groundwater extraction	Ground water depleted annually as percentage of net ground water available annually in billion cubic metres.	Ground Water Resources of India Report, Ministry Of Water Resources, 2004.
Piped drinking water	Number of households per State, out of the total households with access to piped drinking water	National Family and Health Survey 3, 2001.
LAND USE and AGRICULTURE		
Grazing land	Grazing land as percentage of the total land area of the State	Ministry of Agriculture, Govt. of India (GoI), 2004. (accessed: www.indiastats.com)
Land under cultivation	Cultivable land as percentage of the total land area of the State	Rajya Sabha Unstarred Question No. 4005, dated 11.05.2007.
Salinity, Acidity, Water logged land	Land degraded by salinity, acidity and water logging as percentage of the total land area of the State	National Bureau of Soil Survey & Land Use Planning, Ministry of Agriculture & Cooperation, 2005.
Wasteland	Wasteland as percentage of the total land area of the State	Wastelands Atlas of India, Ministry of Rural Development, 2005.
Fertilizer consumption intensity	Fertilizer consumption per hectare of cultivable land measured in kilogram per hectare	Lok Sabha Unstarred Question No. 2414, dated 13.03.2006.
Pesticide consumption intensity	Pesticide consumption per hectare of cultivable land measured in kilogram per hectare	Lok Sabha Unstarred Question No. 4161, dated 15.12.2009.
Soil Erosion	Land affected by soil erosion as percentage of the total land area of the State	National Bureau of Soil Survey & Land Use Planning, Ministry of Agriculture & Cooperation, 2005.
FORESTS and BIODIVERSITY[1]		
Forest Cover	Land area under forest cover as percentage of total geographical area of the State	State of Forest Report, 2009, FSI.
Change in Forest Cover	Percentage change in forest cover from 2005-07	State of Forest Report, 2009, FSI.

1 Protected Area and Wetland are taken are proxies for Biodiversity

Protected area	Protected area as percentage of total geographical area of the State	State of Forest Report, 2009, FSI.
Compensatory Afforestation	Area under Compensatory Afforestation Fund & Management Planning Authority (CAMPA) as percentage of stipulated area as on 21.04.2008	Lok Sabha Unstarred Question No.4230.
Wetland	Wetland area as percentage of total geographical area of the State	Rajya Sabha Starred Question No. 418.
Joint Forest Management (JFM)	JFM as percentage of total forest area of the State	State of Forest Report, 2009, FSI.
WASTE GENERATION and MANAGEMENT		
Municipal Solid Waste (MSW)	Annual per capita MSW generated in kilogram per capita per annum	Central Pollution Control Board, 2005.
Hazardous Waste	Annual per capita hazardous waste generated in kilogram per capita per annum	Inventory of Hazardous Waste, Central Pollution Control Board, 2008-09.
Gap in sewage treatment	Gap in Sewage Treatment as percentage of sewage generated	Central Pollution Control Board, 2006.
Note: Bio-medical waste has not been included due to non-availability of relevant data across all 28 states.		
ENERGY MANGEMENT		
Non-Efficient fuel use	Percentage of households in a State using non LPG fuel (Fire wood, crop residue, cowdung cake, coal, lignite, charcoal and kerosene)	Census of India,2001
Renewable Energy	Renewable energy as percentage of total energy installed in megawatts in a State	Central Electricity Commission Monthly Report, As on January 2010
Energy Efficiency	Energy utilized to produce 1 unit of GSDP	Rajya Sabha Unstarred Question No. 1186, dated 11.12.2008.
IMPACT on HUMAN HEALTH and DISASTER		
Respiratory disease incidence	Average incidence of acute respiratory disease cases per thousand of population	Ministry of Health and Family Welfare, 2004.

Water borne disease incidence	Average incidence of water borne disease cases per thousand of population	Rajya Sabha parliamentary session, 2003.
Flood affected area	Area reported as flood prone as percentage of total geographical area of the State by the 10th Plan Working Group	Rajya Sabha Unstarred Question No. 1783, dated 19.03.2002.
Drought prone area	Number of affected districts as percentage of total number of districts of the State.	Lok Sabha parliamentary session, 2004-05.
Disaster Deaths	Total number of deaths in a State due to natural disasters as percentage	www.indiastat.com
POPULATION PRESSURE on ECOSYSTEM		
Total Fertility Rate	Average number of living children that a woman is expected to have in her reproductive life, per State	National Family and Health survey 3, 2001.
Population density	Number of persons per square kilometer per State	Census of India (2010)
Population growth	Percentage change in the number of individuals in population annually	Census of India (2010)
ENVIRONMENTAL BUDGET		
Renewable Energy Expenditure	Expenditure on Renewable Energy initiatives as percentage of net GDP of the State	Lok Sabha Unstarred Question 3499 dated April 16,2010
Environmental Budget	Expenditure on environment as a percentage of net state GDP, per State	Planning Commission, Eleventh Five Year Plan
Expenditure-Outlay Gap	Actual expenditure as percentage of agreed outlay for the environment, per State	Rajya Sabha Starred Question No. 23, dated 13.08.2007

ANNEX 2

State	Contribution to India's GDP (%)	Per Capita Income (INR) (current prices (2007-08)
Maharashtra	14.04	54,867
Uttar Pradesh	8.35	18,214
Andhra Pradesh	7.65	40,902
West Bengal	7.18	36,322
Tamil Nadu	6.88	45,058
Gujarat	6.84	59,570
Karnataka	5.49	40,998
Rajasthan	4.09	27,001
Kerala	3.85	49,316
Haryana	3.70	68,914
Madhya Pradesh	3.48	21,648
Punjab	3.36	52,879
Bihar	2.89	13,663
Odisha	2.71	29,464
Chhattisgarh	1.93	34,483
Assam	1.61	23,993
Jharkhand	1.53	21,465
Uttarakhand	0.82	36,675
Himachal Pradesh	0.75	44,538
Jammu & Kashmir	0.70	25,425
Goa	0.40	116,966
Tripura	0.24	30,350
Meghalaya	0.19	33,674
Nagaland	0.14	20,840
Manipur	0.13	21,062
Arunachal Pradesh	0.09	33,302
Mizoram	0.08	29,576
Sikkim	0.05	37,553
India's mean GSDP		38,169

ANNEX 3

List of indicators considered	
Annual average SO2 concentration	Soil erosion
Annual average NO2 concentration	Annual GW draft as % of annual net GW available
Annual average SPM concentration	Population density
Annual average RSPM concentration	Population growth CAGR
No of motor vehicles used/million population	Total fertility rate
Ozone concentration	Migration
Fuel wood consumption per capita	Urbanization rate
% of household using biomass/kerosene fuel	Rate of industrial growth
Per capita freshwater availability	Access to safe drinking water
annual replenishable GW per Sq Km of area	Access to private sanitation
Average annual rainfall	Infant mortality rate
Mean Biological Oxygen Demand	Average incidence of acute respiratory diseases
Mean fecal coliform	Average incidence of water borne diseases
Mean Total Suspended Solids	Biodiversity species diversity
% Change in Forest Area	Threatened species as % of total species
% forest area encroached	Wetland as % of total geographic area
Protected area as % of total geographical area	% of flood affected area to total geographic area
Compensatory reforestation	% of drought prone area to total geographical area
% change in Grazing land	% of district declared as hazard-prone
% change in Agriculture land	Disaster loss (life, economic value)
% of land affected by desertification, salinization &Acidification	Energy use per capita (g oil Equivalent)

List of indicators considered	
% of degraded/wastelands to total geographical area	Annual per capita power consumed
% of untreated wastewater to total wastewaterDischarged	Renewable Energy as % of Total Energy Installed Capacity
Fertilizer consumption kg/ha of gross cropped area	Energy used to produce 1 unit of GSDP
Pesticide consumption kg/ha net sown area	Renewable Purchase Obligation Standard
Annual per capita municipal solid waste generated	Investment made in RE & energy efficiency sector
Annual Per capita Hazardous waste generated	Area under JFM as % of total geographical area of the state
% of municipal solid waste recycled	No. of NGOs working on Environment
% of sewage treated before disposal	No. of Public Interest Litigations filed
Use of ozone depleting substance	Industries defaulting and closed as % of total 17C Industries
Coal consumption per capita	% of projects denied of Environment clearance
Per capita water consumption	Share of environmental budget as % of state GDP
Water use in industry & agri per unit of GDP	Actual expenditure as % of agreed outlay forecology & environment
Cropping intensity	Govt. expenditure on Renewables & other sustainability programs
Fishing intensity	% of revenues as fines/fees, pollution/ carbon/eco tax collected from polluters
Timber harvest rate	Number of CDM projects as % of total CDM projects in India
Depletion of minerals as % of proven reserve	Per capita GHG emission

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