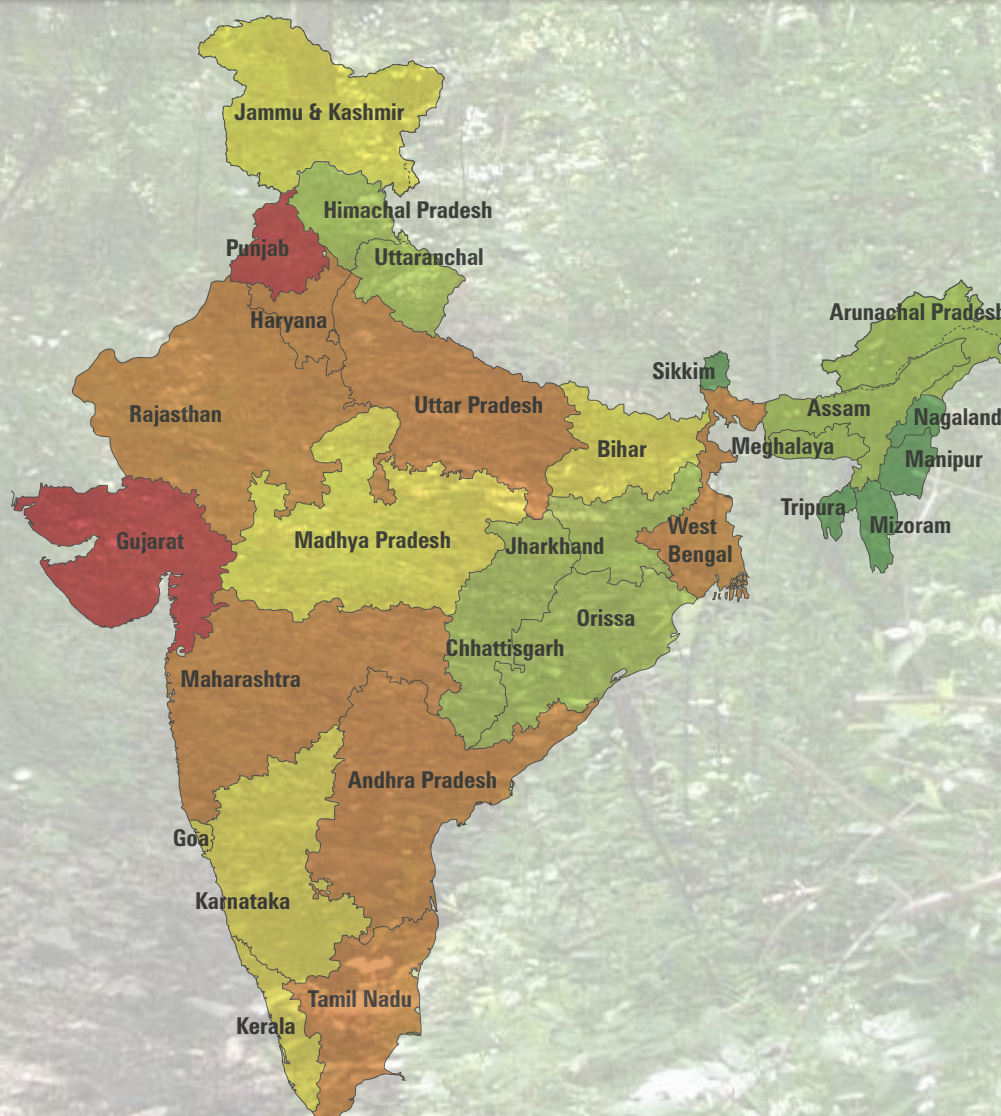


# ENVIRONMENTAL SUSTAINABILITY INDEX FOR INDIAN STATES

Informing Environmental Action

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# ENVIRONMENTAL SUSTAINABILITY INDEX FOR INDIAN STATES

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A policy Tool to Measure the environmental Sustainability  
of the 28 States of India

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## EXECUTIVE SUMMARY

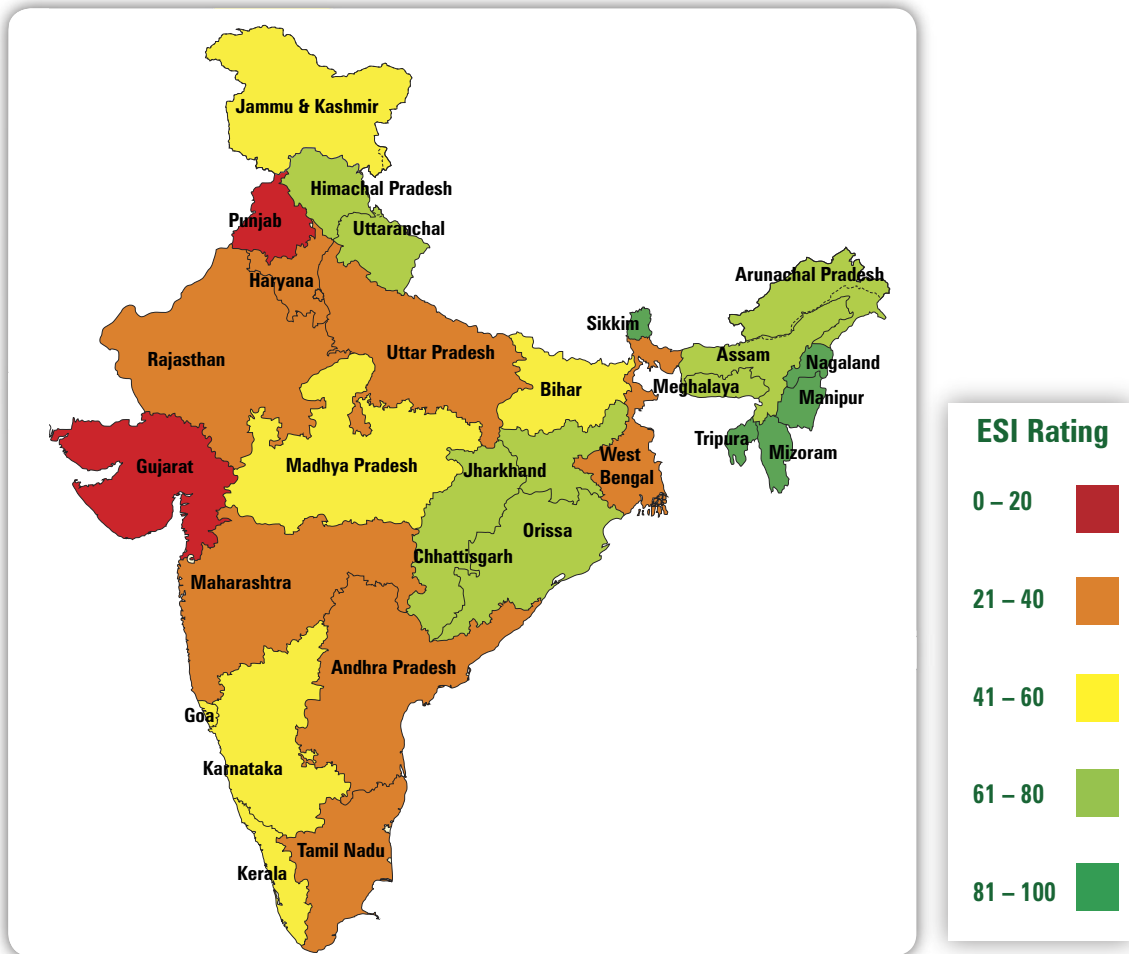
The Environmental sustainability index tracks the environment performance of 28 states of India and projects the ability of the states to protect their environment in the coming years. Collating secondary data from published and credible sources, ESI measures the state of environment along multiple dimensions, aggregates it into a single index that is interpretable and comparable across all the states. Sub-indices (Indicators and Policy Components) enable states to get a more nuanced picture of their performance. The rankings are relative and done on a scale of 0 to 100, allowing for states to see how well they are doing in comparison to other states.

The best performing state in the 2008 ranking is Manipur, followed by Sikkim and Tripura. The lowest ranking states are Punjab, Gujarat and Haryana. A state with higher ESI ranking means it has managed its natural resource stock judiciously; face less stress on its environment systems and less impact on human health. On the contrary, a state with lower ESI indicates that it has depleted its stock of natural resources and has accumulated waste and pollution which has created stress on ecosystem and human health. The ESI scores and ranks of all the 28 states are as follows:

States	ESI Scores	ESI Rank
Manipur	100.00	1
Sikkim	90.99	2
Tripura	85.81	3
Nagaland	82.08	4
Mizoram	81.58	5
Arunachal Pradesh	75.45	6
Chhattisgarh	74.09	7
Orissa	71.88	8
Uttaranchal	71.18	9
Assam	70.15	10
Meghalaya	66.79	11
Jharkhand	64.33	12
Himachal Pradesh	61.26	13
Karnataka	55.79	14

States	ESI Scores	ESI Rank
Kerala	53.71	15
Bihar	51.98	16
Jammu & Kashmir	48.73	17
Goa	45.16	18
Madhya Pradesh	43.01	19
Maharashtra	37.28	20
West Bengal	35.72	21
Tamil Nadu	33.75	22
Andhra Pradesh	32.55	23
Rajasthan	26.52	24
Haryana	25.59	25
Uttar Pradesh	21.40	26
Gujarat	10.46	27
Punjab	0.00	28

Most North-eastern states such as Manipur, Sikkim, Tripura, Nagaland and Mizoram are ranked higher and are on a sustainable trajectory than most other states. The next cluster is formed by Arunachal Pradesh, Chhattisgarh, Orissa, Uttaranchal, Assam, Meghalaya, Jharkhand and Himachal Pradesh; these states have ESI score in 60.01 to 80.00 range and show moderate sustainability. Six states (Karnataka, Kerala, Bihar, Jammu & Kashmir, Goa and Madhya Pradesh) are among the average performer with ESI scores between 40.01 -60.00; these states might face serious concerns in terms of sustainability. ESI Score below 40 projects alarming picture for majority of the states like Maharashtra, West Bengal, Tamil Nadu, Andhra Pradesh, Rajasthan, Haryana and Uttar Pradesh. Gujarat and Punjab (ESI scores of 10.46 and 0.00 respectively) are in the extremely alarming range.



The ESI for Indian States reveals that none of the state is on a sustainable trajectory; at the same time none of the states have performed very poor on all dimensions. Most states have done well in some areas and need to improve a lot in many other issues. Most of the larger states and high-growth states with concentration of industrial and agricultural activities are featured at the bottom of the ranking. The states which are relatively greener are going to face the challenge of integrating growth into sustainability; customized policies need to be drafted taking such concerns into account. ESI is designed to help the policymakers in:

- Understand a state's sustainability in terms of natural resource management, pollution load, vulnerability and institutional capacity
- Identify priority environmental issues and areas of action
- Create a baseline for cross-state and cross-sectoral performance comparisons and categorize states along multiple environmental indicators
- Identify best practices and successful policy models; evaluate adequacy and sufficiency of current policies
- Reinforce the economy-environment linkage and importance of integrated policy making

ESI is policy tool; it also is informative. It is designed to inform environmental action by quantifying environmental sustainability into simple interpretable index and facilitating benchmarking for cross-state comparison. It should complement Human Development Index and Per-capita Income, as a tool to map sustainable development along social, economic and ecological well-being. The ESI is not designed to provide an exhaustive picture of a state's environmental issues, but rather to help reveal trends and draw attention to phenomena that require further analysis and possible action.



# THE CONCEPT OF ENVIRONMENTAL SUSTAINABILITY INDEX (ESI) FOR INDIAN STATES

The Environmental Sustainability Index (ESI) is a ranking tool which maps the environment performance of 28 states of India and projects the ability of the states to protect their environment in the coming years. A state with higher ESI ranking means it has managed its natural resource stock judiciously; face less stress on its environment systems and less impact on human health. On the contrary, a state with lower ESI indicates that it has depleted its stock of natural resources and has accumulated waste and pollution which has created stress on ecosystem and human health. It is a relatively new concept and a pioneer effort with regard to Indian states.

Given the fact that most economic activities require extractive use of natural resources, rapid economic growth is often associated with unsustainable level of resource consumption and pollution leading to serious environmental challenges. Therefore ESI holds much more importance in the context of developing economies. Since economic growth gives an incomplete picture of a country or state's development, as it does not reflect the impacts on ecological and natural systems. Incorporating such impacts requires a different kind of framework—one that gauges a state's overall performance. From a sustainable development perspective it is essential to link ecological sustainability in relation to economic and social development. Hence the Environmental Sustainability Index (ESI) for Indian states is an effort to link environmental sustainability and development activities by measuring a state's performance over the years. Such exercises can serve as a background resource for policy planning and formulation and budgetary allocation and should be useful for decision-makers, especially at the state level.

The level of environmental degradation of a state varies with its development activities and environmental policies implemented. As the ESI is constructed on the basis of multiple environmental parameters, it should help in identifying the issues that deserve more attention and thus prioritizing policy interventions and investment for a particular state. It should also help to identify best practices from the better performing states. Thus the index should contribute to better understanding of the most significant issues a state faces, examples from states that have successfully addressed such issues and the consequences that will result from suboptimal environmental choices. The comparative nature of analysis will help in deciding benchmarks and creating peer pressure.

The index will give a comparative picture of the environmental conditions in each state in terms of water, air, soil, forest and other natural resources, thereby enabling governments to prioritize budgetary allocations in favour of areas where intervention is most urgently required. At the same time it will show the magnitude of pollution and depletion of resources, which should be a signal for Indian industries to pay more attention to their environmental footprints and should create competitive pressure for improved performance.

The ESI gives an indication of a state's general environmental conditions, which has implications for future regulations as well as investment opportunities and risks. The report accumulates information from a wide range of sectors related to the environment and ecology, and compresses this information into a simple and actionable format. The ESI should be informative for all individuals and institutions working in environment-related sectors.



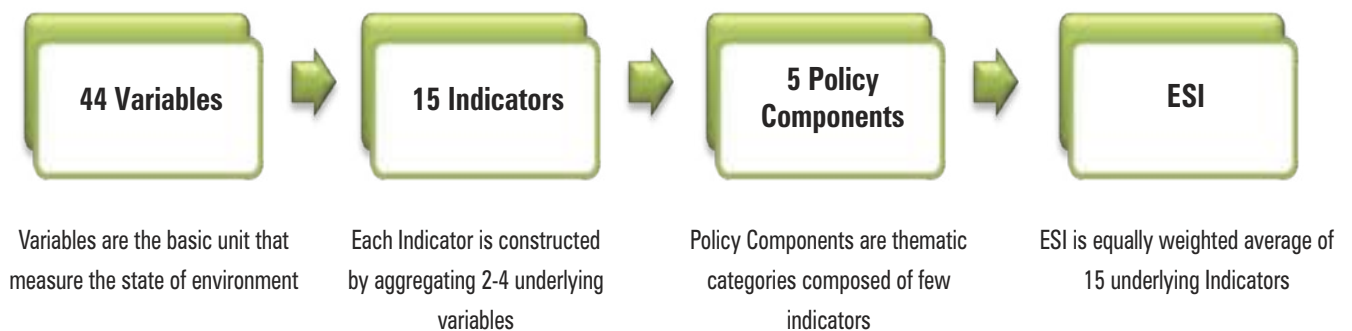
# HOW ESI IS CONSTRUCTED

## THE FRAMEWORK

Developing ESI involves conceptual clarity at both the theoretical and empirical levels. ESI is based on a well established and simple theoretical framework, employing statistical procedures to calculate the ESI scores. The following section elaborates on all the methods and procedures involved in developing the ESI for Indian States.

ESI is a composite index assembled from 15 indicators that are derived from 44 variables or datasets, which cover a wide range of issues such as population, air and water pollution, waste management, land use pattern, forest and other natural resources, air and water quality, environment degradation, impacts on health, energy management, GHG emission, and governance. The selection of these variables was based on its relevance, extensive literature review, the availability and reliability of data.

The ESI score is the equally weighted average of these 15 indicators. Each of the indicators is in turn an aggregate of 2 to 4 underlying variables. For example, to measure the indicator 'air quality' the underlying variables chosen are annual concentration levels of SO<sub>2</sub>, NO<sub>2</sub>, suspended particulate matter (SPM) and repairable suspended particulate matter (RSPM). Data are collected for each of these 4 variables across 28 states. The average of the underlying variables is taken as the indicator 'air quality' for a state. In this manner 15 such indicators are calculated, equally weighted and the average is taken as the ESI score of that particular state. Likewise the ESI scores for 28 states are calculated and the highest and lowest scores are calibrated to 100 and 0 respectively. The states are then ranked accordingly.



# ESI FRAMEWORK

Sl No.	44 Variables	Sl No.	15 Indicators	Sl No.	5 Policy Components
1	Population density	1	Population Pressure	1	Population Pressure
2	Population growth				
3	Total fertility rate				
4	% Change in forest area	2	Natural Resource Endowment	2	Environmental Stress
5	% of Forest land encroached				
6	Annual ground water draft				
7	NOx emission per capita	3	Air Pollution		
8	SO2 emission per capita				
9	CO2 emission per capita				
10	Number of motorized vehicles				
11	Untreated waste water discharged	4	Water Pollution		
12	Fertilizer consumption				
13	Pesticide consumption				
14	Per capita municipal solid waste	5	Waste Generation		
15	Per capita hazardous waste				
16	% of protected area to forest	6	Land Use	3	Environmental Systems
17	% of land under grazing to total land				
18	% of land under agriculture to total land				
19	Total replenishable ground water				
20	Average annual rainfall	7	Natural Resource Endowment		
21	% of Wetland area to total land				
22	% of state under forest cover				
23	Annual concentration of SO2 levels	8	Air Quality		
24	Annual concentration of NO2 levels				
25	Annual concentration of SPM levels				
26	Annual concentration of RSPM levels				
27	Biological Oxygen Demand	9	Water Quality		
28	Electrical Conductivity				
29	Total Suspended Solids				
30	% of degraded area	10	Disaster Management	4	Health Vulnerability
31	Area affected by flood and heavy rains				
32	% of total districts affected by drought				
33	Hazard prone area				
34	Incidence of acute respiratory diseases	11	Health Vulnerability		
35	Incidence of acute water diseases				
36	Per capita energy consumed	12	Energy Management	5	Environmental Governance
37	% of renewable energy in total energy				
38	Energy-GDP ratio				
39	Area under joint forest management	13	People's Initiative		
40	Presence of environmental NGOs				
41	% of defaulting industries	14	Government's Initiative		
42	Fund allocation by Union government				
43	Fund allocation by state government				
44	% Change in total GHG emissions	15	GHG emissions		

## 44 VARIABLES

1. Population density
2. Population growth
3. Total fertility rate
4. % Change in forest area
5. % of Forest land encroached
6. Change In ground water
7. NOx emission per capita
8. SO2 emission per capita
9. CO2 emission per capita
10. Number of motorized vehicles
11. untreated waste water discharge
12. Fertilizer consumption
13. Pesticide consumption
14. Municipal solid waste
15. Hazardous waste
16. Protected area
17. Wetland area
18. Grazing Land
19. Agricultural land
20. Replenishable ground water
21. Average annual rainfall
22. Forest cover
23. Annual concentration of SO2 levels
24. Annual concentration of NO2 levels
25. Annual concentration of SPM levels
26. Annual concentration of RSPM levels
27. Biological Oxygen Demand
28. Electrical Conductivity
29. Total Suspended Solids
30. Degraded & wastelands
31. Flood affected area
32. Arid/drought prone area
33. Hazard-prone districts
34. Incidence of acute respiratory diseases
35. Incidence of water borne diseases
36. Annual per capita power consumed
37. Renewable Energy as % of total Energy
38. Energy/GSDP ratio
39. Area under Joint Forest Management
40. Presence of Environmental NGOs
41. Defaulting and closed industries
42. State government's revenue expenditure on environment
43. Centre government's outlay-expenditure ratio on environment



## 15 INDICATORS

1. Population pressure
2. Natural resource depletion
3. Air pollution
4. Water pollution
5. Waste generation
6. Land use
7. Natural resources
8. Air quality
9. Water quality
10. Natural disaster
11. Health
12. Energy
13. People's initiatives
14. Government's initiatives
15. GHG Emission

## 5 POLICY COMPONENTS

1. Population Pressure
2. Environmental Stress
3. Environmental Systems
4. Impact on Human Health
5. Environmental Governance

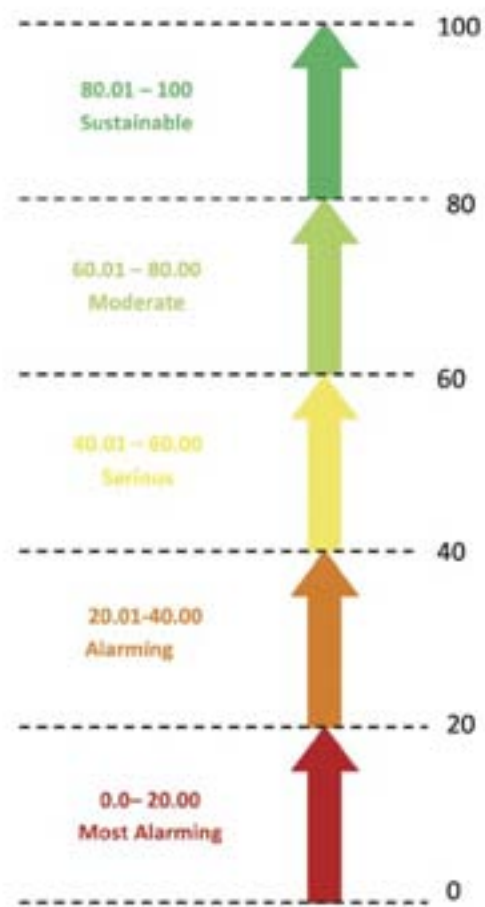
# INTERPRETATION OF ESI FOR INDIAN STATES

The ESI is an aggregate index of 15 underlying indicators, adjusted from 0 to 100. It is to be noted that higher the score, better is the state's performance on environmental dimensions. All the 28 states are ranked (from 1 to 28) based on this ESI scores; Rank 1 depicting the 'relatively most sustainable' and Rank 28 is the 'relatively least sustainable' state. Thus the state with rank 1 has score of 100 whereas the state which ranks 28 has a score of 0.

It is essential to note that ESI is a relative measurement among the 28 states across select environmental indicators aimed at facilitating inter-state and across-indicator comparisons. Thus a score of 100 does not necessarily mean that the state has achieved highest level sustainability, it rather indicates that among the 28 states this particular state has performed the best.

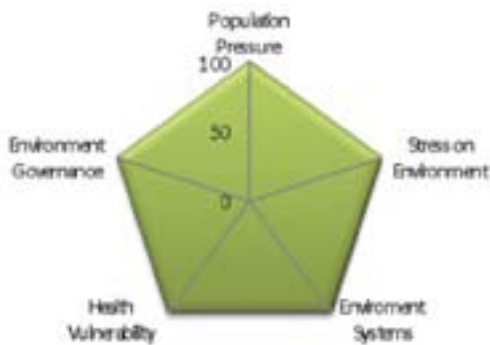
ESI is also a multidimensional index, composed of 15 indicators and 5 important policy categories. There are states doing well in some aspects in spite of low overall score, states with high overall score yet below-average sub-scores.

This multidimensional approach to calculating the ESI helps in capturing various aspects of environmental sustainability in a single index and presents a quantifiable and quick overview of a qualitative and complex issue.



## The 5 Policy Component Scores

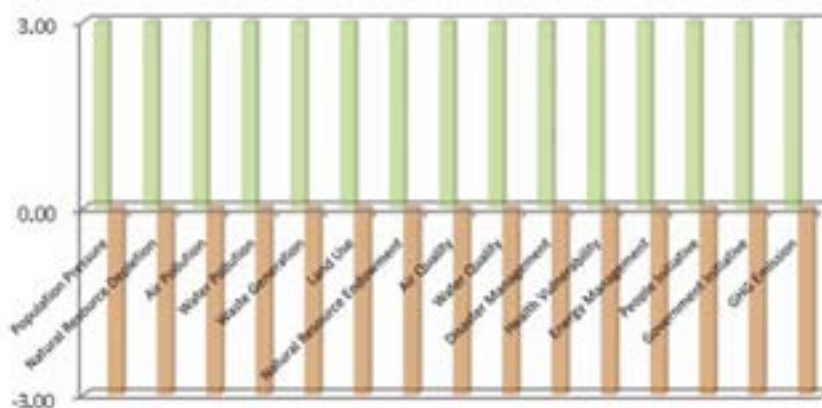
Each states relative performance in 5 main policy components (such as pressure on the ecosystem, Environmental stress, Environmental system, Human vulnerability and Environmental governance) are measured. The 5 Policy scores are equally weighted in scale of 0 (worst) to 100 (best), on a comparative scale for 28 states. Thus if a state scores 0 in policy component “population pressure’ it means it has the lowest score for population pressure which means maximum pressure on the ecosystem. A State’s score of 100 in ‘environment system’ means it has the best air and water quality, most favourable land use and favourable natural resource endowment. The ideal state will have 100 scores in all the 5 components and the least desirable is to have scores close to 0 in all the 5 components.



When all the 5 components are shown a spider graph, values farther from the centre indicate better performance and more shadow area covered means good performance by the state in all 5 dimensions. Thus this 5 scores show the relative break-up of good and bad performance for each state.

## The 15 Indicator Scores

The 15 indicators are the main building blocks of the ESI which shows relative performance of a state in each of these 15 areas of equal weight. Plotted in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer bars going in upward direction is desirable and indicates good performances.



The indicator profile identifies the areas of strength and weakness for a state. A state might have high overall scores yet very low scores for some indicators and vice-versa. Also for some states the bars are close to 0 indicating balanced performance across indicators and for some states the values vary greatly which means the good or poor ESI score is driven by few indicators.

## KEY FINDINGS: MAPPING SUSTAINABILITY IN STATES

The ESI score for all the states when compared shows that most states have moderate scores. Manipur tops the list followed by Sikkim and Tripura. Uttar Pradesh, Gujarat and Haryana features at the bottom of the ranking. The ranks are scores of all the states are shown in the following table.

States	ESI Scores	ESI Rank
Manipur	100.00	1
Sikkim	90.99	2
Tripura	85.81	3
Nagaland	82.08	4
Mizoram	81.58	5
Arunachal Pradesh	75.45	6
Chhattisgarh	74.09	7
Orissa	71.88	8
Uttaranchal	71.18	9
Assam	70.15	10
Meghalaya	66.79	11
Jharkhand	64.33	12
Himachal Pradesh	61.26	13
Karnataka	55.79	14
Kerala	53.71	15
Bihar	51.98	16
Jammu & Kashmir	48.73	17
Goa	45.16	18
Madhya Pradesh	43.01	19
Maharashtra	37.28	20
West Bengal	35.72	21
Tamil Nadu	33.75	22
Andhra Pradesh	32.55	23
Rajasthan	26.52	24
Haryana	25.59	25
Uttar Pradesh	21.40	26
Gujarat	10.46	27
Punjab	0.00	28

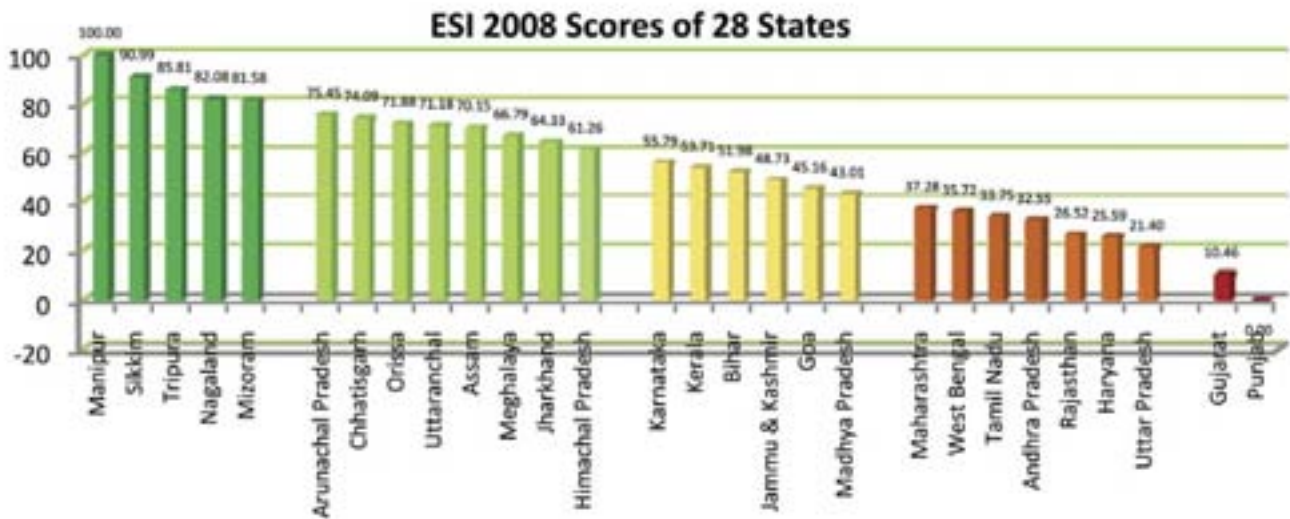
Most North-eastern states such as Manipur, Sikkim, Tripura, Nagaland and Mizoram are ranked higher and are on a sustainable trajectory than most other states.

The next cluster is formed by Arunachal Pradesh, Chhattisgarh, Orissa, Uttaranchal, Assam, Meghalaya, Jharkhand and Himachal Pradesh; these states have ESI score in 60.01 to 80.00 range and show moderate sustainability.

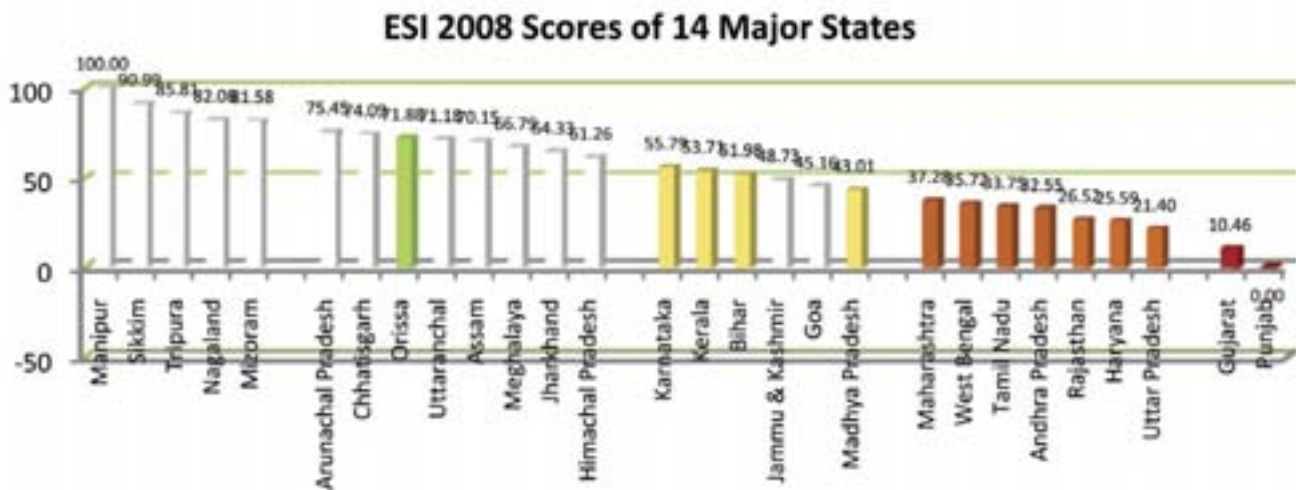
6 states (Karnataka, Kerala, Bihar, Jammu & Kashmir, Goa and Madhya Pradesh) are among the average performer with ESI scores between 40.01 - 60.00; these states might face serious concerns in terms of sustainability.

ESI Score below 40 projects alarming picture for majority of the states like Maharashtra, West Bengal, Tamil Nadu, Andhra Pradesh, Rajasthan, Haryana and Uttar Pradesh. Gujarat and Punjab (ESI scores of 10.46 and 0.00 respectively) are in the extremely alarming range.

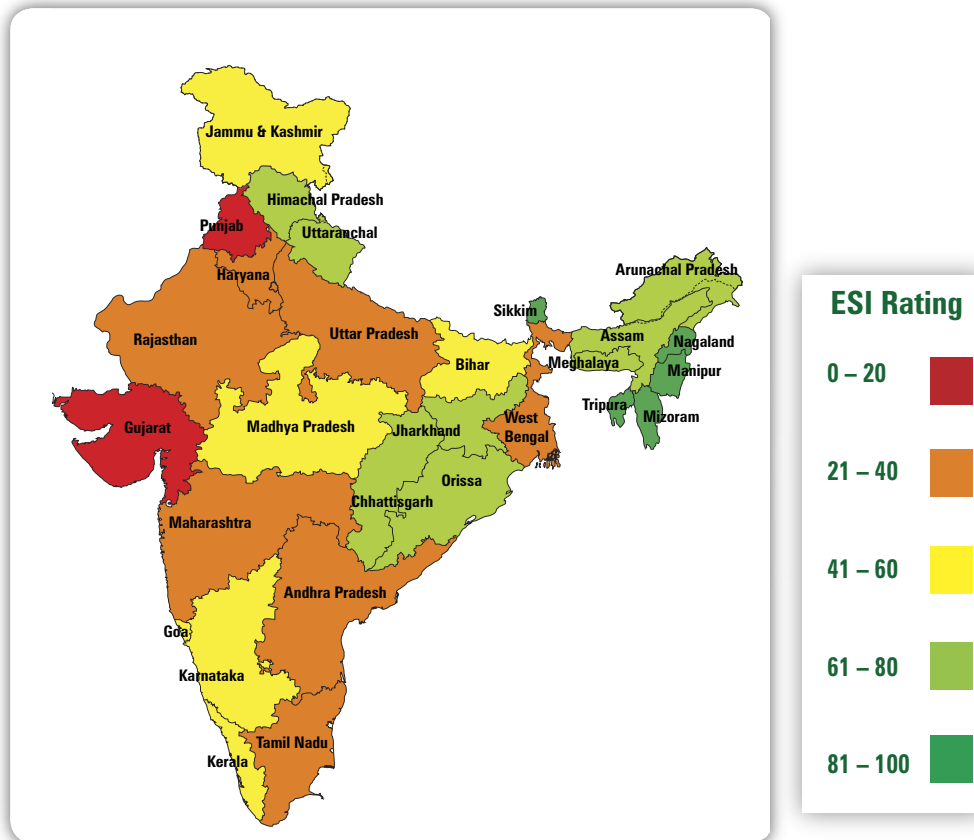




Though the ESI scores and ranks compare all the states, the heterogeneity and variations among states should be considered. For example, comparing Manipur and Gujarat is difficult, since there is a huge difference between them in terms of industrial activities, population and geography. Taking this into account, the 14 most important states, which together account for 90 % of India's GDP and 88 % of its total population, have been chosen for more specific comparisons. The 14 states are again grouped into 3 categories: low income states, middle income states and high income states. Though the categorization has been done based on income, the states in each sub-group are more or less similar in terms of socio-economic development, thus making comparison easier and more meaningful. Table 6 presents the three sub-groups, each state's contribution to India's overall GDP and population, per capita SGDP, ESI ranks and respective ESI peer ranks.



In the ranking table, each state is treated as one entity hence assumes equal importance. However in reality, the states vary in geographical areas and therefore the performance of larger states has relatively more significance while interpreting the sustainability picture of India as a whole. For example: 7 states in the alarming category (ESI score 20-40) capture almost half of the country's geographical area. Whereas 5 states in the sustainable category occupy only 2% of India's geographical area.

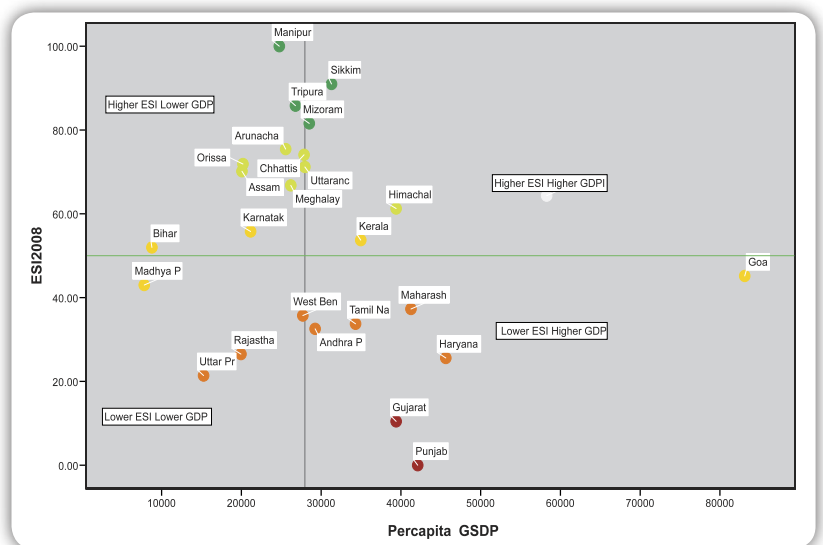


It can be seen that large part of the country is either on an unsustainable path or is already facing alarming level of environmental stress. The relatively sustainable parts are clustered around the north-eastern, eastern and Himalayan region; which are also the states in fragile ecosystem and less developed. This poses serious questions on long term sustainability since the environment in these states is likely to degrade with increasing economic activity.

Interestingly the ESI 2008 revealed that most states with high per capita SGDP have not performed well on the environmental front. It was observed that the high per capita SGDP rankings states like Haryana, Maharashtra, Punjab and Gujarat all perform poorly in the ESI ranking.

Taking the median per capita GSDP along horizontal axis and ESI performance along vertical axis all the states<sup>1</sup> are placed in 4 quadrants such as: Higher ESI - Lower GDP, Higher ESI - Higher GDP, Lower ESI - Higher GDP, Lower ESI - Lower GDP.

States like Punjab, Gujarat, and Haryana which have higher than median per capita income have fared low in ESI. These states have exhausted much of its resources and the pollution load on ecosystem is also high. On the hand, states like Orissa, Bihar, Assam and

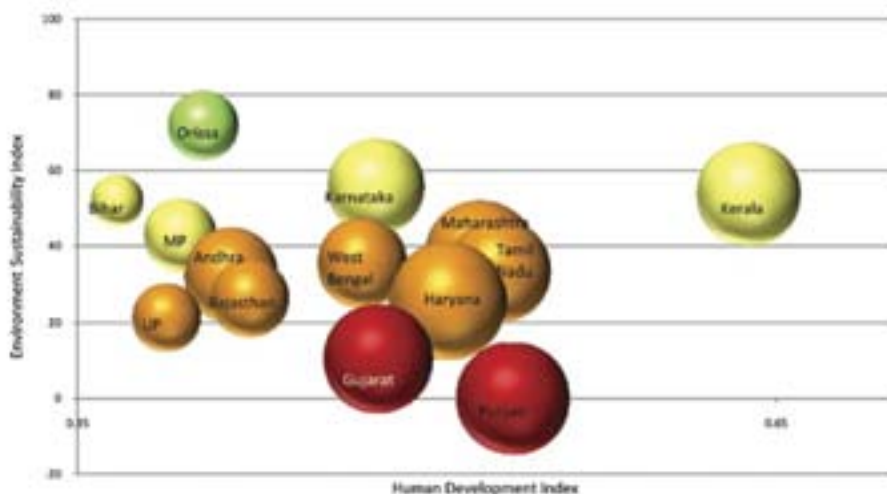


1 Except Jammu & Kashmir and Nagaland, since the GSDP/capita (2006) is not available for these two states



Karnataka have demonstrated better environmental performance despite the lower per-capita GDP. As these state's economies grow, controlling pollution and conserving resources is going to be an important challenge. The greatest challenge is for the Low ESI - Low GDP states such as Uttar Pradesh, Madhya Pradesh and Rajasthan. It is desirable to have more states in Higher ESI - Higher GDP, at present only 2 states (Kerala and Himachal) are in this segment. A deeper and better understanding of the past and current actions and policies in these two states may provide useful insights. It is noteworthy that all the high income states have low ESI scores. This raises a number of critical questions regarding the linkages between the environment, economy and poverty and points to the challenges for maintaining growth vis-à-vis sustainability.

Sustainable development takes into account the economic, social and environmental aspects of development. GDP (Gross Domestic Product) and HDI (Human Development Index) are the commonly accepted measure of economic growth and social wellbeing respectively. The ESI will serve as a measure of the environmental aspects which is missing at present. Combining these 3 indicators such as the per capita SGDP, the HDI and the ESI can throw light on how sustainable a state is growing or is likely to grow.



The performance of the 14 major states along per capita SGDP, the HDI and the ESI is mapped in the following graph. The sizes of the bubbles represent the amount of per-capita income in respective states; thus bigger bubbles mean richer states. The Vertical axis shows the ESI, higher the state is located more sustainable it is. The horizontal axis is for the HDI, thus a state which is located towards right has better human development than the states located close to centre of origin. States which scores well on all the 3 parameters such as GDP, HDI and ESI will have higher per capita GDP (bigger bubble sizes) are greener (located higher) with more human development (located towards right), are the most sustainably growing states.

## BEYOND THE SUMMARY STATE PROFILES

The ESI scores and ranks of each state is only a summary picture of environmental sustainability of the state. While a single score or rank is useful as a summary; the real policy and action value is driven by the underlying policy categories and indicators used to construct the ESI for Indian states. Hence each state's performance was studied in detail along these building blocks of ESI and the environmental profiles were prepared.

When each state profile is analyzed, the identification of factors which contribute to good/poor environmental performance becomes easier. For example in case of Tamil Nadu the low scores in GHG emission, air pollution and waste generation has lowered its overall score despite few positive indicators; which elucidates the priority areas of action and policy focus. Population pressure in Bihar and Uttar Pradesh is so high that the negative scores in this indicator have pulled down its overall scores. Bihar's good scores on energy management, health, water quality and GHG emission helps in neutralizing the low scores in population pressure, land use, air quality and people's initiative and places it around the middle of the ranking.

It is to be noted that none of the states have scored positive and high on all indicators. The highest ranked state Manipur has comfortable scores in most of the sub-indices, but it is not without problems. It scores much below the average in disaster management and population pressure indicating there are areas where it needs improvement. Punjab ranks lowest when overall score is compared, but not in all the indicators. In fact it ranks highest in disaster management, and has better than average scores in 5 indicators out of 15; which indicates every state has unique environmental dynamics.

In-depth analysis of the individual policy categories and the indicators yields interesting insights on each state's performance in much more detail.

The sub-scores and indicators measure the magnitude of pollution and depletion of resources and give a comparative picture of the environmental conditions in each state in terms of water, air, soil, forest and other natural resources.

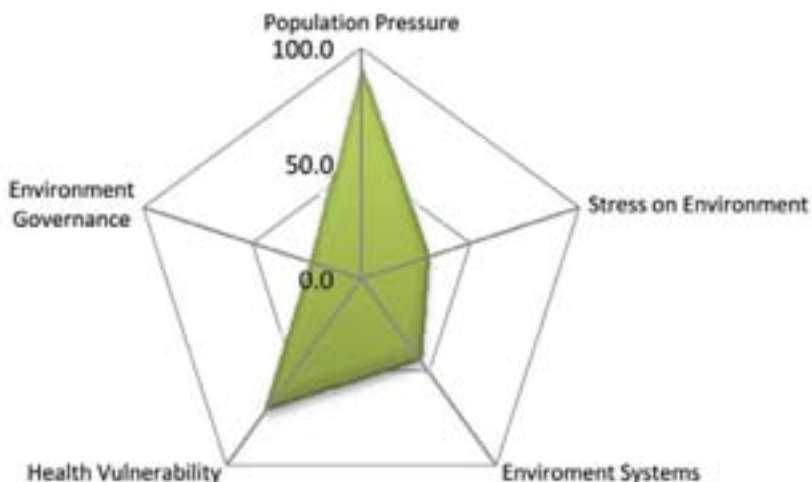
Consequently, it can help in hereby identifying the most significant issues faced by the states and enabling governments to prioritize policy and budgetary allocations in favour of areas where intervention is most urgently required.

## ANDHRA PRADESH

ESI Score: 32.55

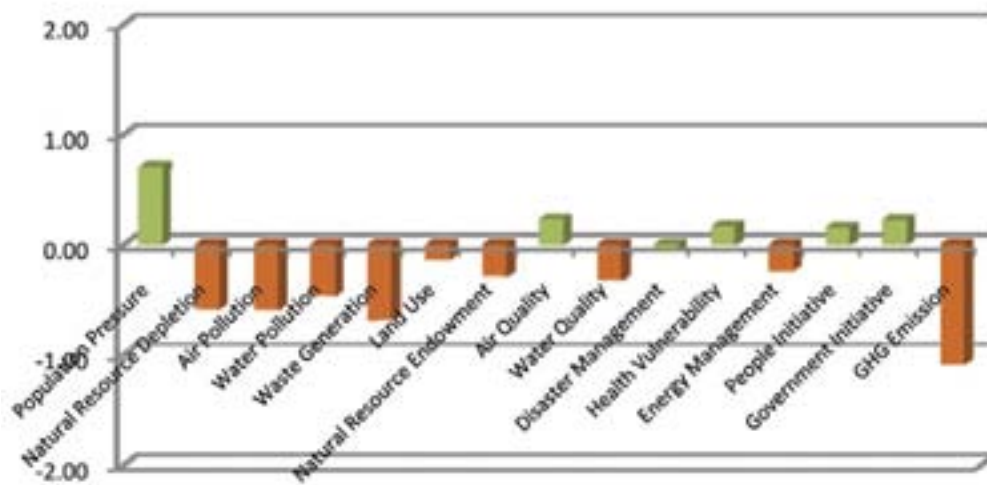
ESI Rank: 23

GSDP/capita: Rs. 28722 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

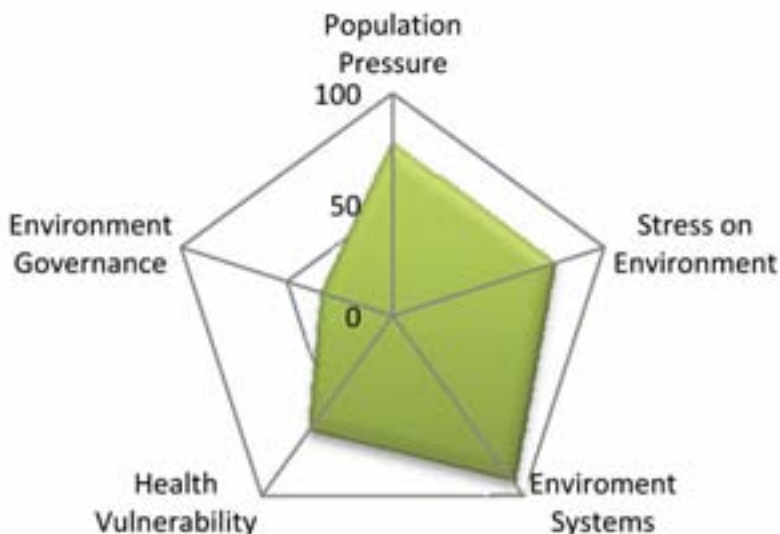
Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.70	Land Use	-0.13	Health Vulnerability	0.16
Natural Resource Depletion	-0.58	Natural Resource Endowment	-0.29	Energy Management	-0.23
Air Pollution	-0.59	Air Quality	0.23	People Initiative	0.15
Water Pollution	-0.46	Water Quality	-0.32	Government Initiative	0.23
Waste Generation	-0.68	Disaster Management	-0.06	GHG Emission	-1.08

## ARUNACHAL PRADESH

ESI Score: 75.45

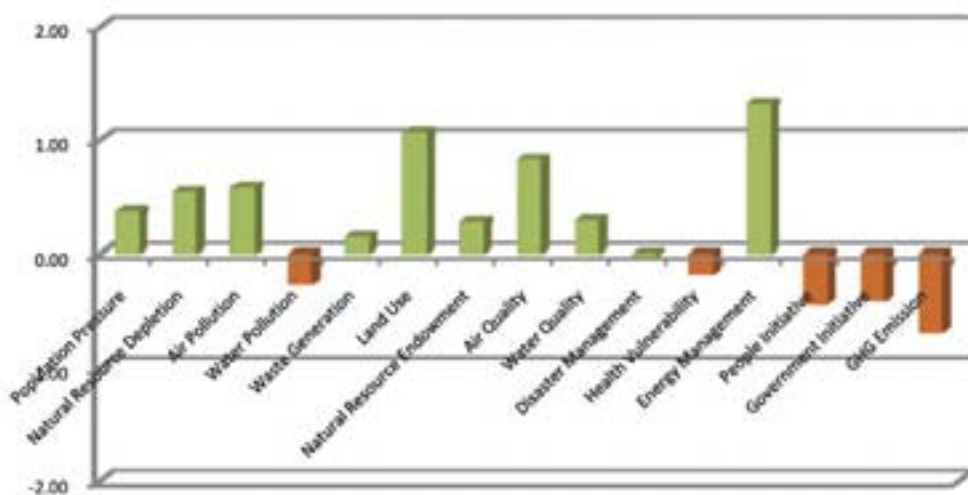
ESI Rank: 6

GSDP/capita: Rs. 24892 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators

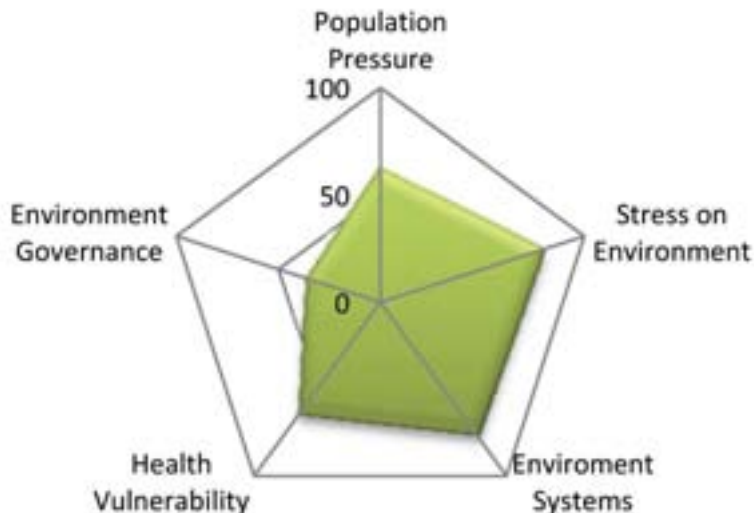


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.37	Land Use	1.07	Health Vulnerability	-0.18
Natural Resource Depletion	0.54	Natural Resource Endowment	0.28	Energy Management	1.32
Air Pollution	0.58	Air Quality	0.83	People Initiative	-0.43
Water Pollution	-0.26	Water Quality	0.29	Government Initiative	-0.41
Waste Generation	0.15	Disaster Management	-0.02	GHG Emission	-0.68

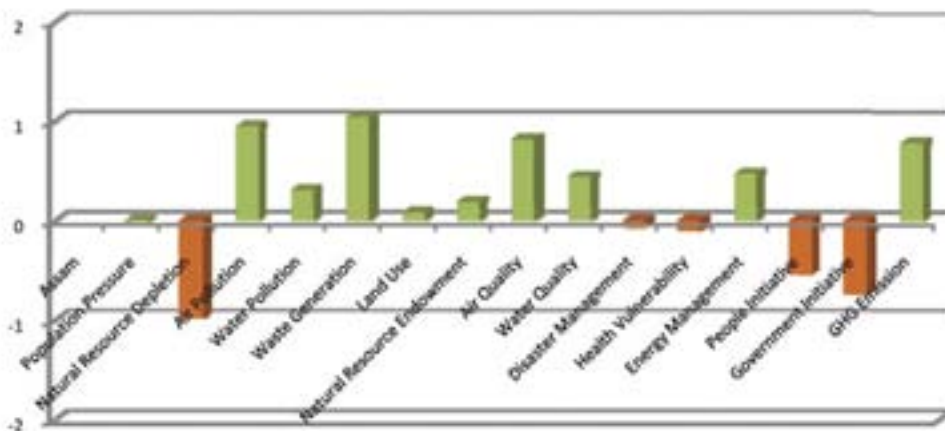
# ASSAM

ESI Score: 70.15  
 ESI Rank: 10  
 GSDP/capita: Rs. 19227 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

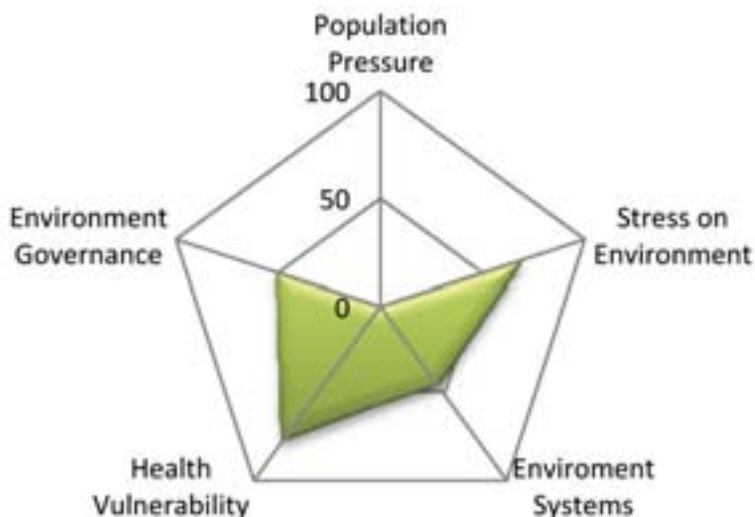


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.02	Land Use	0.08	Health Vulnerability	-0.10
Natural Resource Depletion	-0.98	Natural Resource Endowment	0.19	Energy Management	0.47
Air Pollution	0.95	Air Quality	0.82	People Initiative	-0.53
Water Pollution	0.31	Water Quality	0.44	Government Initiative	-0.73
Waste Generation	1.04	Disaster Management	-0.06	GHG Emission	0.79

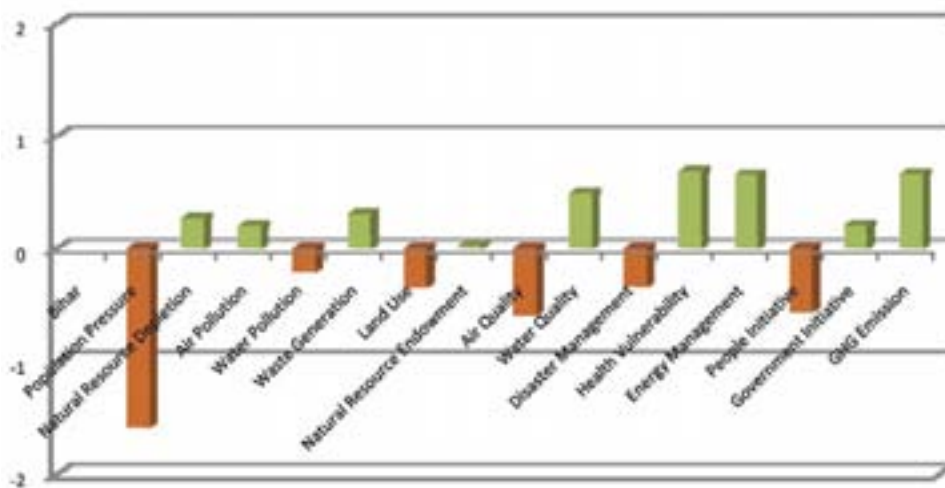
# BIHAR

ESI Score: 51.98  
 ESI Rank: 16  
 GSDP/capita: Rs. 8493 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-1.58	Land Use	-0.33	Health Vulnerability	0.69
Natural Resource Depletion	0.27	Natural Resource Endowment	0.02	Energy Management	0.66
Air Pollution	0.20	Air Quality	-0.58	People Initiative	-0.55
Water Pollution	-0.19	Water Quality	0.49	Government Initiative	0.21
Waste Generation	0.30	Disaster Management	-0.33	GHG Emission	0.66

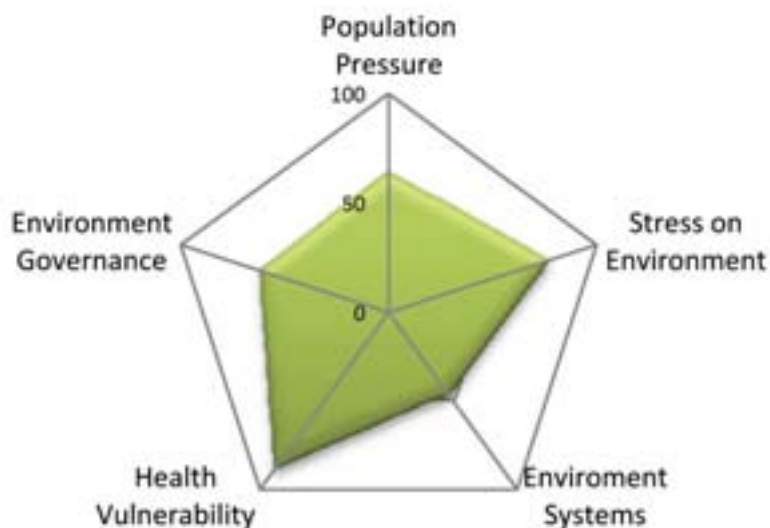


## CHATTISGARH

ESI Score: 74.09

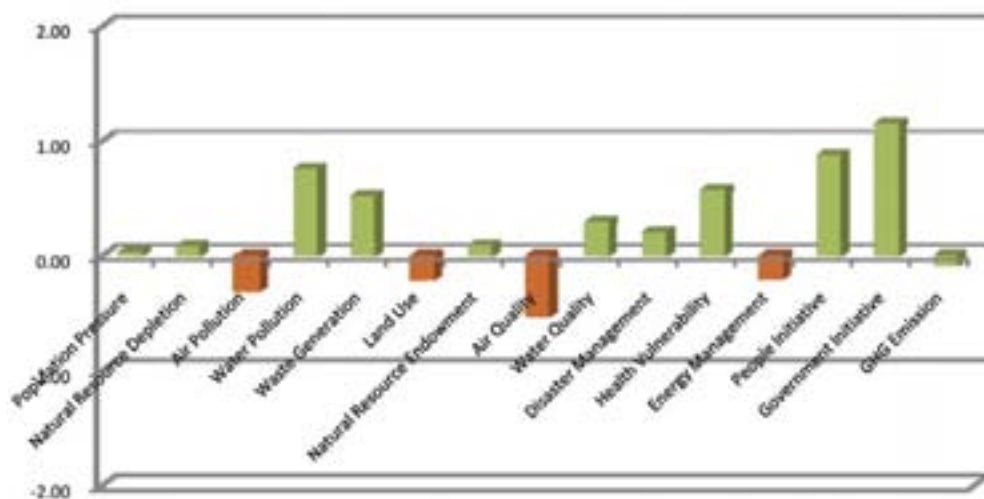
ESI Rank: 7

GSDP/capita: Rs. 21958 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators

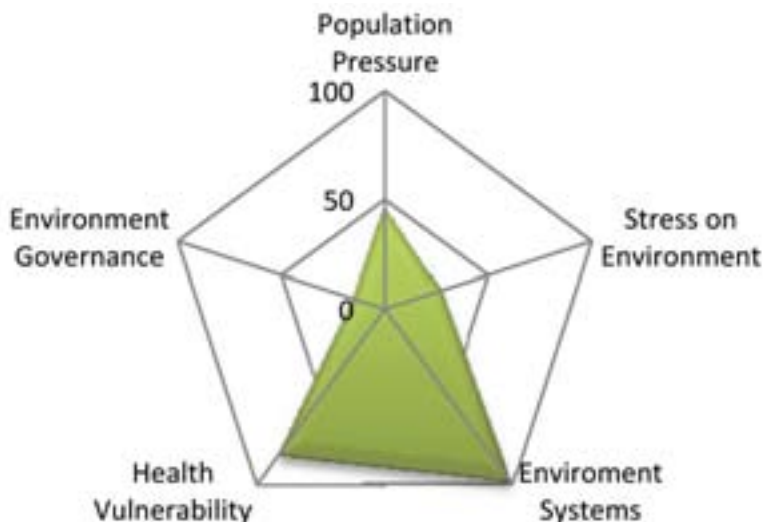


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.03	Land Use	-0.21	Health Vulnerability	0.57
Natural Resource Depletion	0.08	Natural Resource Endowment	0.09	Energy Management	-0.20
Air Pollution	-0.31	Air Quality	-0.53	People Initiative	0.87
Water Pollution	0.76	Water Quality	0.29	Government Initiative	1.15
Waste Generation	0.52	Disaster Management	0.21	GHG Emission	-0.09

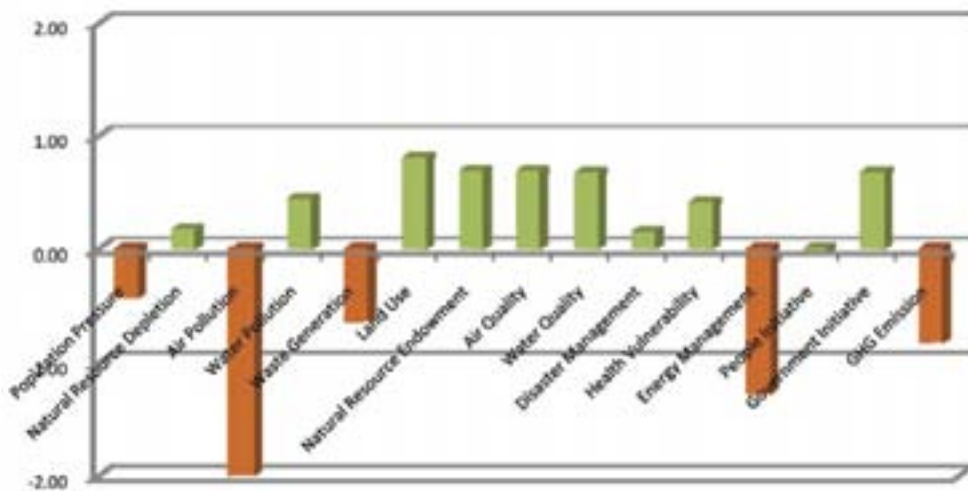
GOA

ESI Score: 45.16  
 ESI Rank: 18  
 GSDP/capita: Rs. 76167 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators



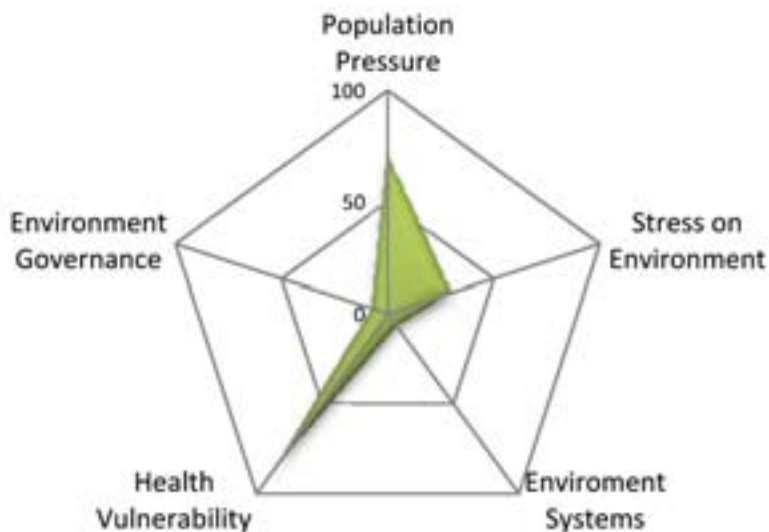
How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.42	Land Use	0.81	Health Vulnerability	0.41
Natural Resource Depletion	0.17	Natural Resource Endowment	0.69	Energy Management	-1.28
Air Pollution	-2.60	Air Quality	0.69	People Initiative	-0.05
Water Pollution	0.44	Water Quality	0.67	Government Initiative	0.68
Waste Generation	-0.63	Disaster Management	0.15	GHG Emission	-0.82



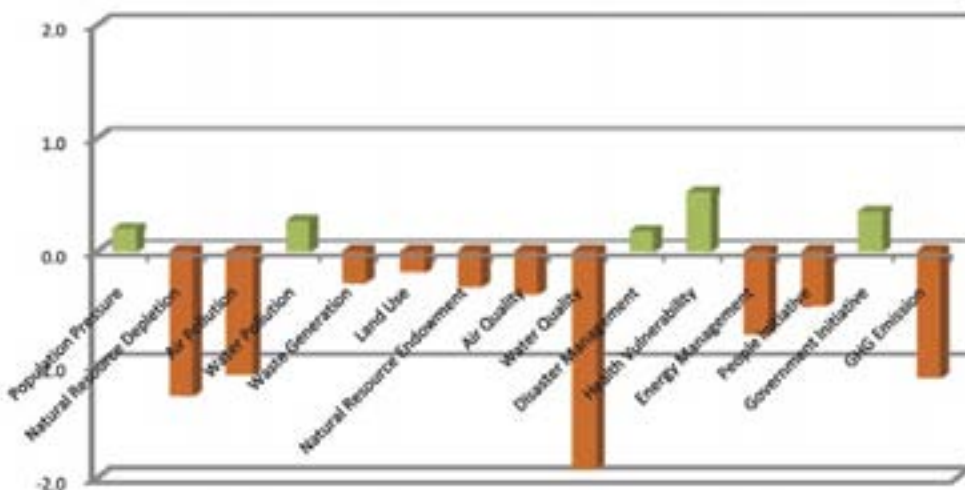
# GUJARAT

ESI Score: 10.46  
 ESI Rank: 27  
 GSDP/capita: Rs. 38408



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.20	Land Use	-0.19	Health Vulnerability	0.52
Natural Resource Depletion	-1.27	Natural Resource Endowment	-0.31	Energy Management	-0.74
Air Pollution	-1.10	Air Quality	-0.37	People Initiative	-0.48
Water Pollution	0.26	Water Quality	-1.92	Government Initiative	0.35
Waste Generation	-0.27	Disaster Management	0.18	GHG Emission	-1.12

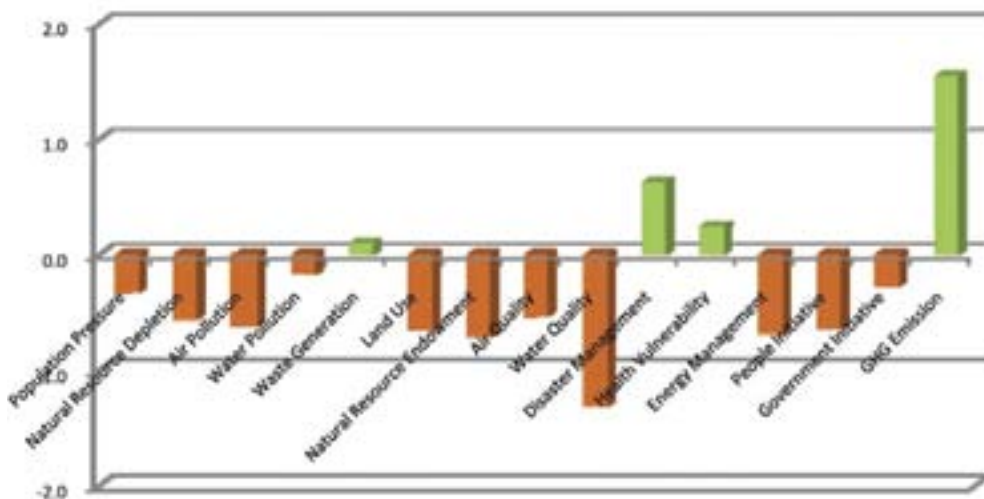
# HARYANA

ESI Score: 25.59  
 ESI Rank: 25  
 GSDP/capita: Rs. 44752 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

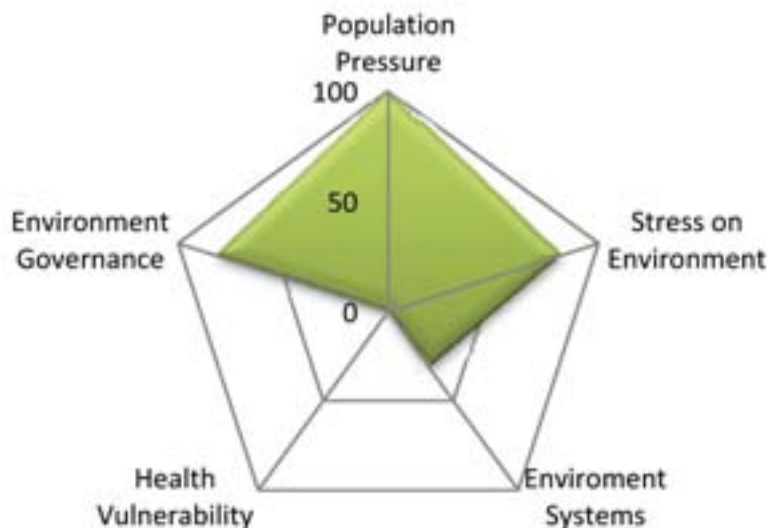


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.33	Land Use	-0.66	Health Vulnerability	0.25
Natural Resource Depletion	-0.56	Natural Resource Endowment	-0.71	Energy Management	-0.69
Air Pollution	-0.61	Air Quality	-0.53	People Initiative	-0.64
Water Pollution	-0.17	Water Quality	-1.32	Government Initiative	-0.28
Waste Generation	0.10	Disaster Management	0.62	GHG Emission	1.54

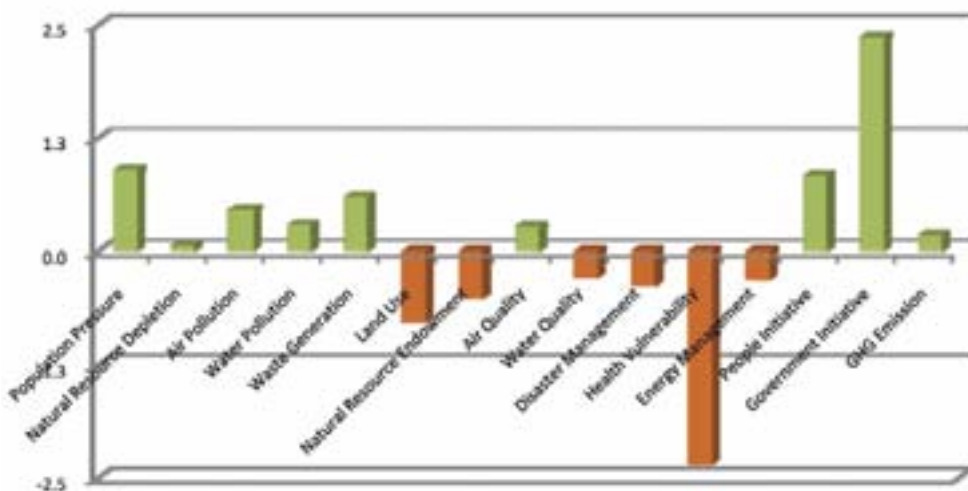
## HIMACHAL PRADESH

ESI Score: 61.26  
 ESI Rank: 13  
 GSDP/capita: Rs. 38832 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators

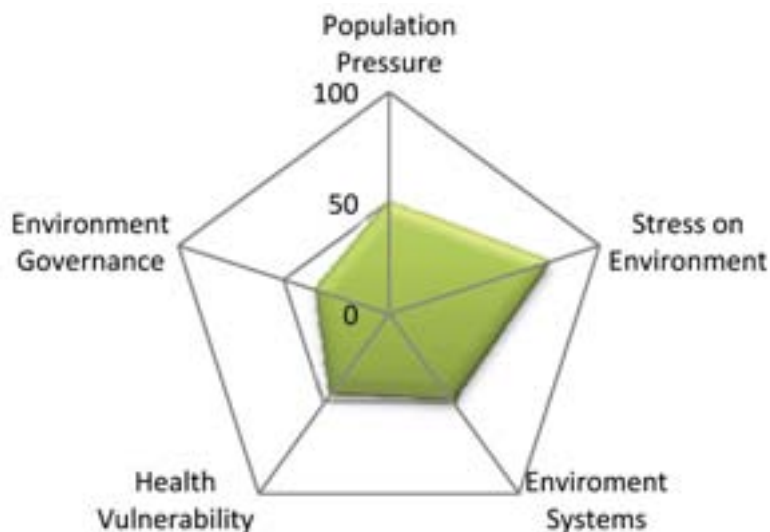


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.90	Land Use	-0.78	Health Vulnerability	-2.35
Natural Resource Depletion	0.06	Natural Resource Endowment	-0.51	Energy Management	-0.31
Air Pollution	0.45	Air Quality	0.27	People Initiative	0.83
Water Pollution	0.28	Water Quality	-0.28	Government Initiative	2.37
Waste Generation	0.59	Disaster Management	-0.37	GHG Emission	0.17

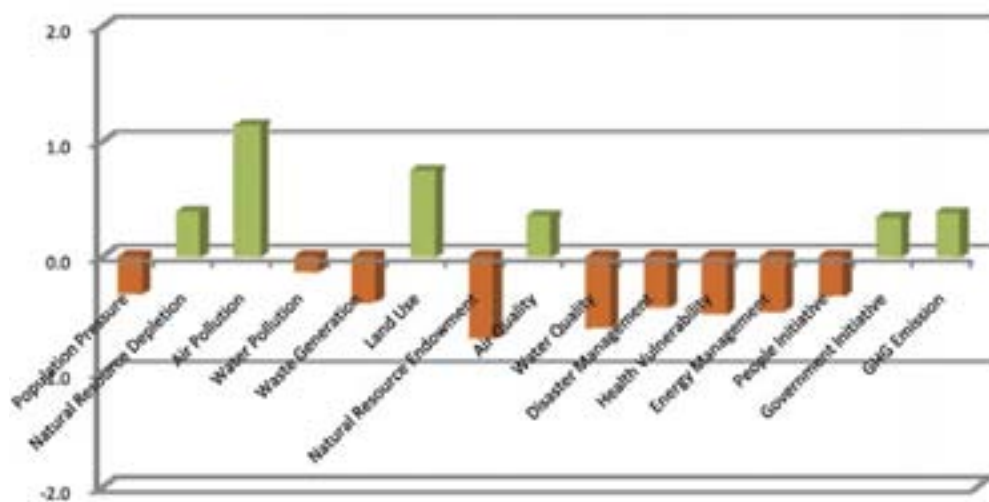
### JAMMU AND KASHMIR

ESI Score: 48.73  
 ESI Rank: 17  
 GSDP/capita: Not Available



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

#### Performance across 15 indicators

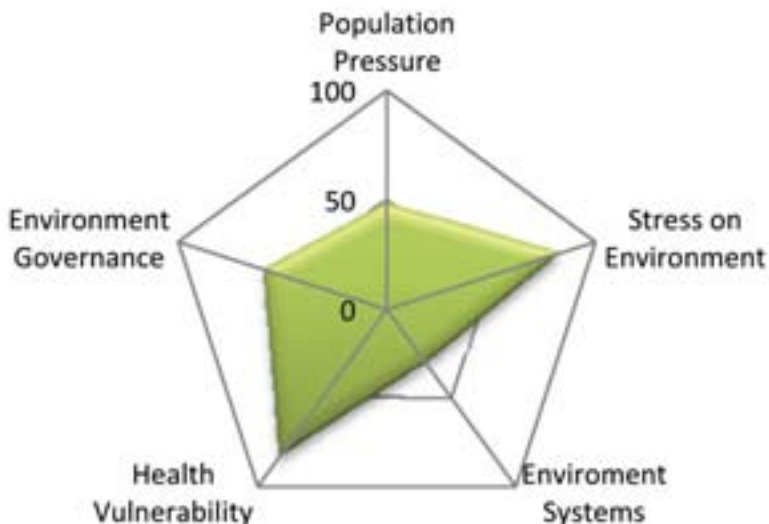


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.32	Land Use	0.75	Health Vulnerability	-0.50
Natural Resource Depletion	0.38	Natural Resource Endowment	-0.71	Energy Management	-0.47
Air Pollution	1.14	Air Quality	0.35	People Initiative	-0.34
Water Pollution	-0.12	Water Quality	-0.61	Government Initiative	0.34
Waste Generation	-0.39	Disaster Management	-0.44	GHG Emission	0.38

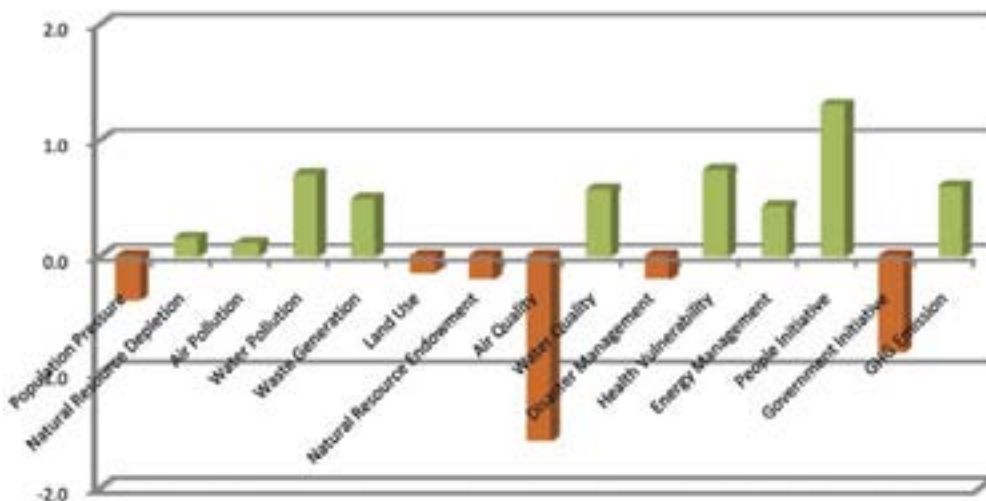
## JHARKHAND

ESI Score: 64.33  
 ESI Rank: 12  
 GSDP/capita: Rs. 20976 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators

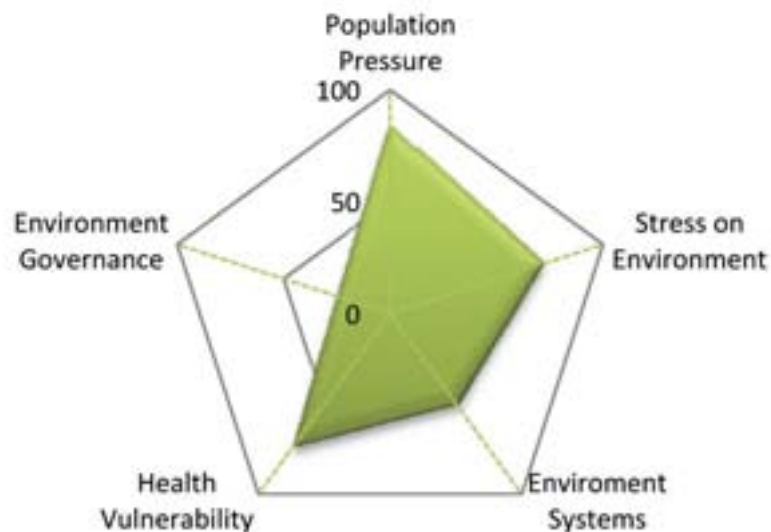


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.37	Land Use	-0.14	Health Vulnerability	0.74
Natural Resource Depletion	0.16	Natural Resource Endowment	-0.20	Energy Management	0.43
Air Pollution	0.10	Air Quality	-1.59	People Initiative	1.30
Water Pollution	0.70	Water Quality	0.57	Government Initiative	-0.82
Waste Generation	0.49	Disaster Management	-0.20	GHG Emission	0.60

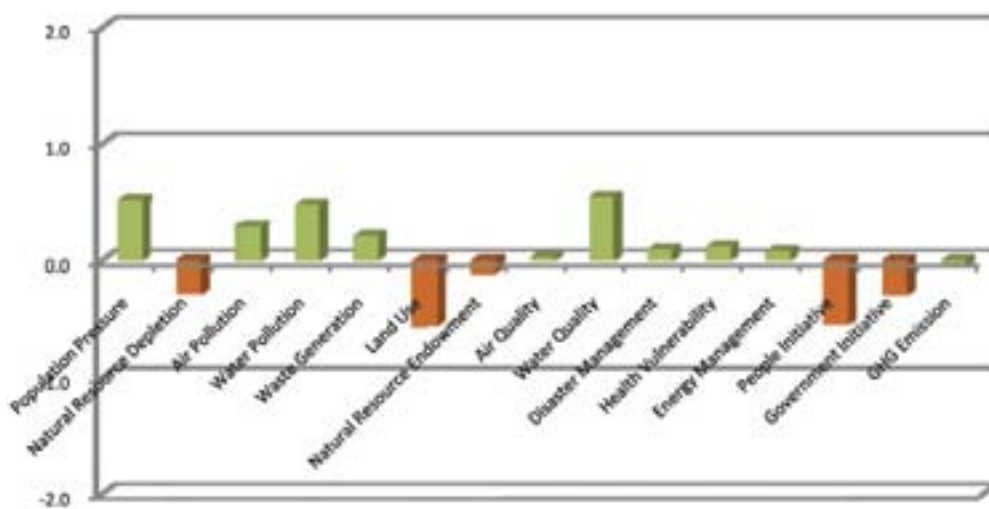
## KARNATAKA

ESI Score: 55.79  
 ESI Rank: 14  
 GSDP/capita: Rs. 29746 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



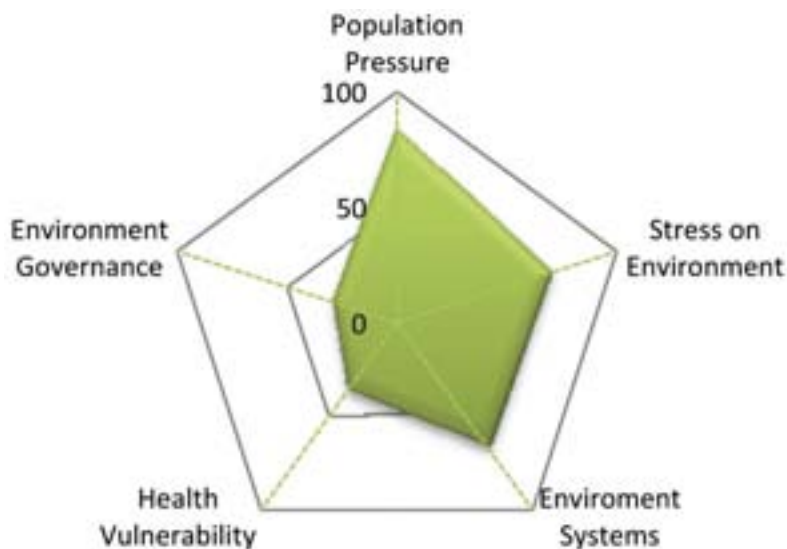
How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.52	Land Use	-0.55	Health Vulnerability	0.11
Natural Resource Depletion	-0.28	Natural Resource Endowment	-0.10	Energy Management	0.08
Air Pollution	0.29	Air Quality	0.02	People Initiative	-0.54
Water Pollution	0.47	Water Quality	0.54	Government Initiative	-0.29
Waste Generation	0.20	Disaster Management	0.09	GHG Emission	-0.05



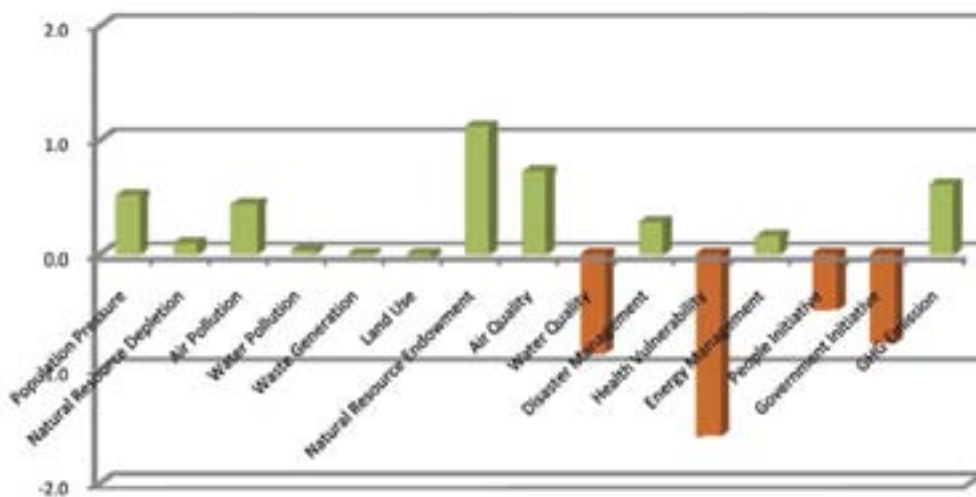
# KERALA

ESI Score: 53.71  
 ESI Rank: 15  
 GSDP/capita: Rs. 36919 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

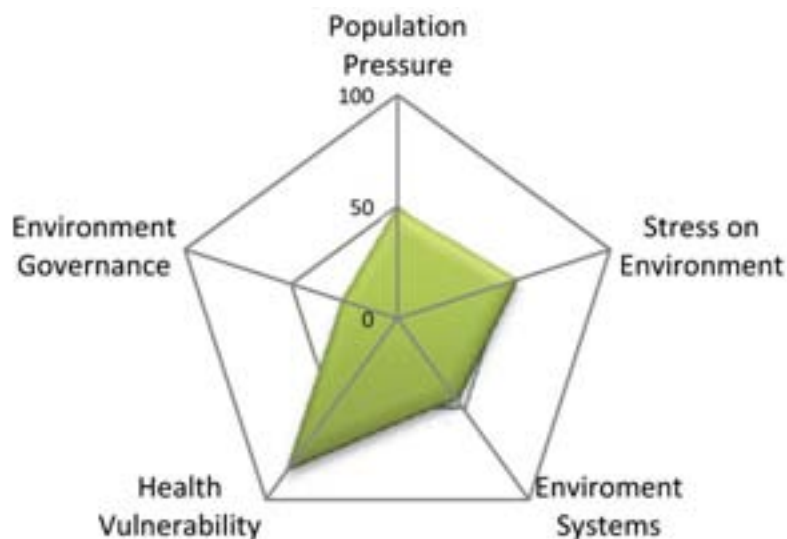


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.51	Land Use	-0.04	Health Vulnerability	-1.58
Natural Resource Depletion	0.10	Natural Resource Endowment	1.11	Energy Management	0.15
Air Pollution	0.44	Air Quality	0.72	People Initiative	-0.47
Water Pollution	0.02	Water Quality	-0.85	Government Initiative	-0.77
Waste Generation	-0.01	Disaster Management	0.27	GHG Emission	0.60

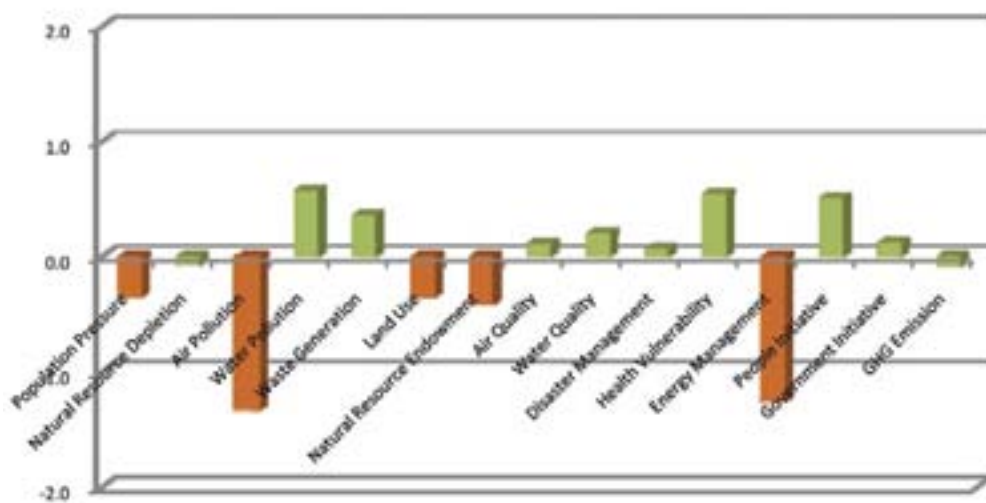
MADHYA PRADESH

ESI Score: 43.01  
 ESI Rank: 19  
 GSDP/capita: Rs. 16790 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators



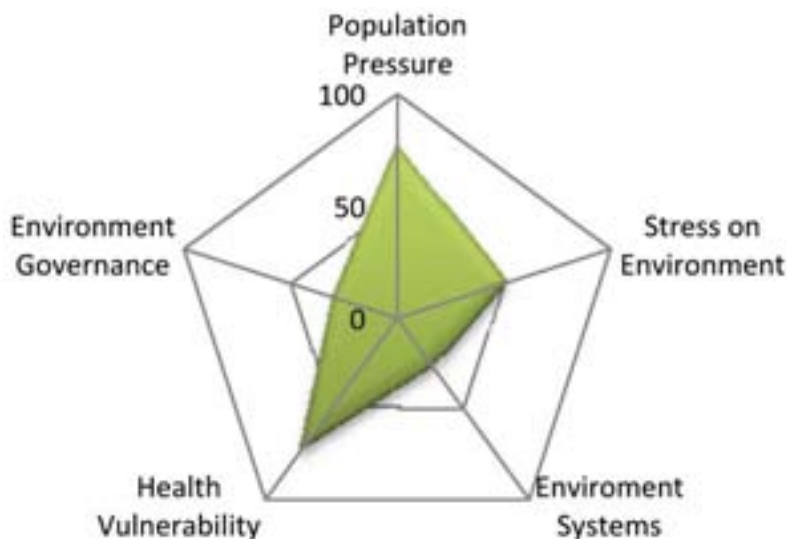
How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.35	Land Use	-0.35	Health Vulnerability	0.54
Natural Resource Depletion	-0.08	Natural Resource Endowment	-0.42	Energy Management	-1.27
Air Pollution	-1.33	Air Quality	0.12	People Initiative	0.51
Water Pollution	0.57	Water Quality	0.20	Government Initiative	0.12
Waste Generation	0.36	Disaster Management	0.07	GHG Emission	-0.09



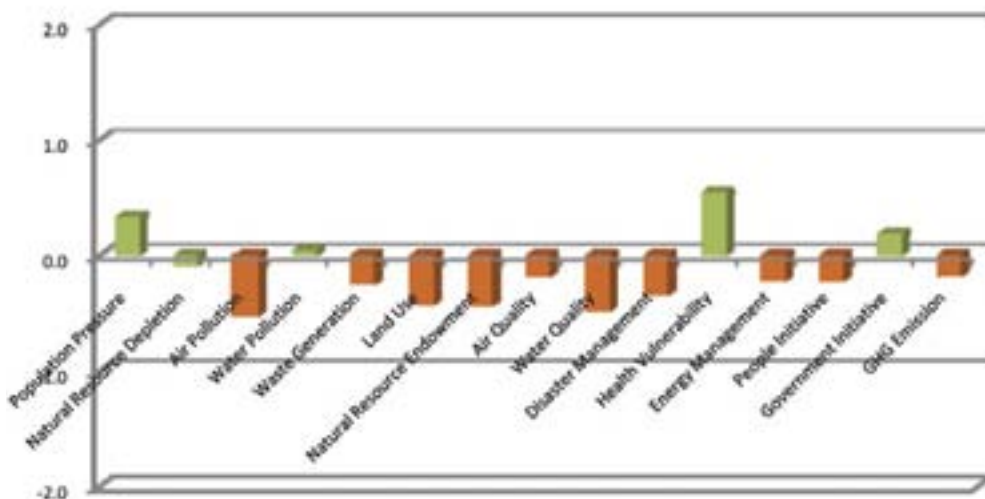
MAHARASHTRA

ESI Score: 37.28  
 ESI Rank: 20  
 GSDP/capita: Rs. 40453 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.34	Land Use	-0.43	Health Vulnerability	0.55
Natural Resource Depletion	-0.09	Natural Resource Endowment	-0.44	Energy Management	-0.22
Air Pollution	-0.53	Air Quality	-0.18	People Initiative	-0.22
Water Pollution	0.04	Water Quality	-0.48	Government Initiative	0.19
Waste Generation	-0.25	Disaster Management	-0.34	GHG Emission	-0.18

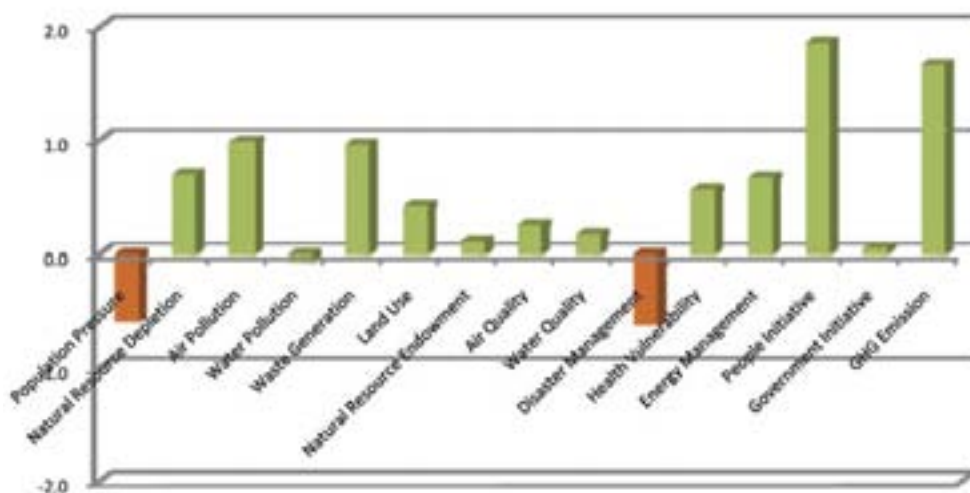
# MANIPUR

ESI Score: 100.00  
 ESI Rank: 1  
 GSDP/capita: Rs. 21751 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

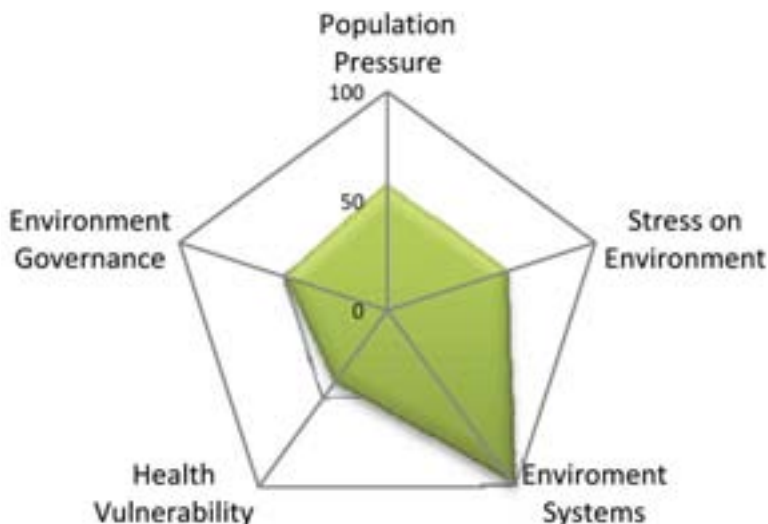


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.59	Land Use	0.42	Health Vulnerability	0.56
Natural Resource Depletion	0.69	Natural Resource Endowment	0.11	Energy Management	0.67
Air Pollution	0.99	Air Quality	0.25	People Initiative	1.86
Water Pollution	-0.07	Water Quality	0.17	Government Initiative	0.04
Waste Generation	0.96	Disaster Management	-0.63	GHG Emission	1.67

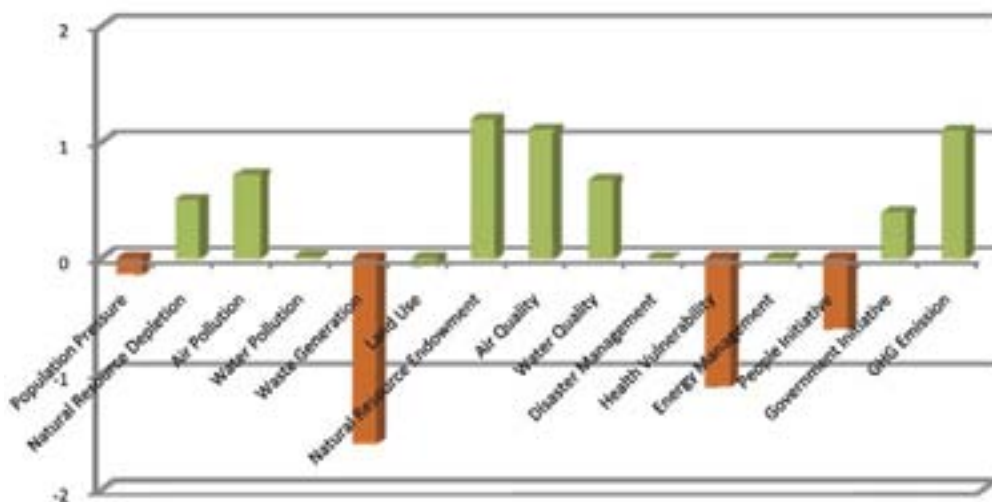
MEGHALAYA

ESI Score: 66.79  
 ESI Rank: 11  
 GSDP/capita: Rs. 25513 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators

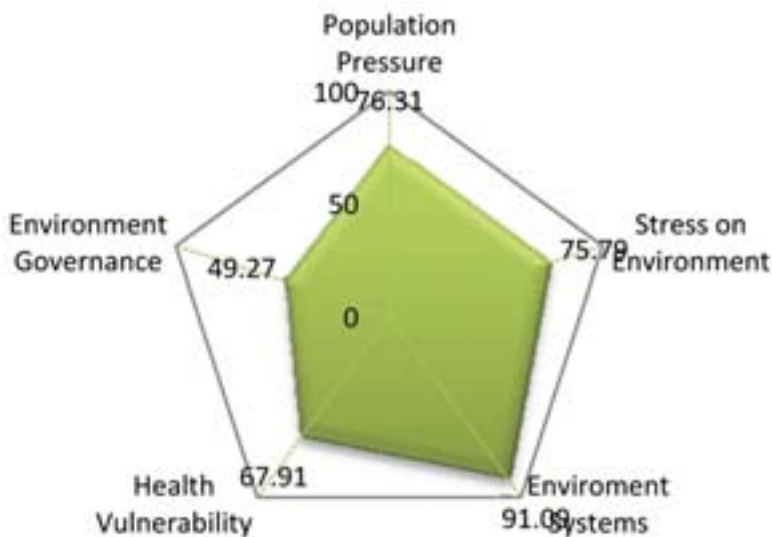


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.14	Land Use	-0.07	Health Vulnerability	-1.11
Natural Resource Depletion	0.50	Natural Resource Endowment	1.19	Energy Management	-0.02
Air Pollution	0.72	Air Quality	1.11	People Initiative	-0.61
Water Pollution	0.01	Water Quality	0.67	Government Initiative	0.39
Waste Generation	-1.59	Disaster Management	0.00	GHG Emission	1.10

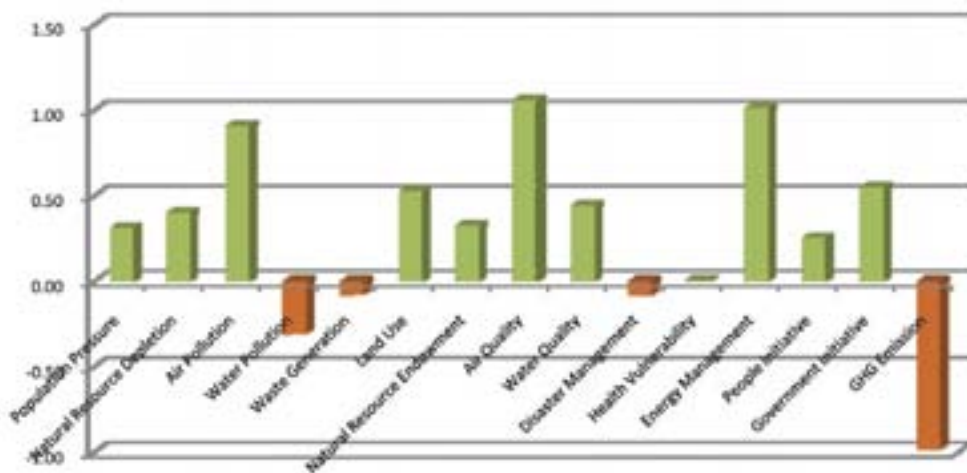
# MIZORAM

ESI Score: 81.58  
 ESI Rank: 5  
 GSDP/capita: Rs. 27520 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

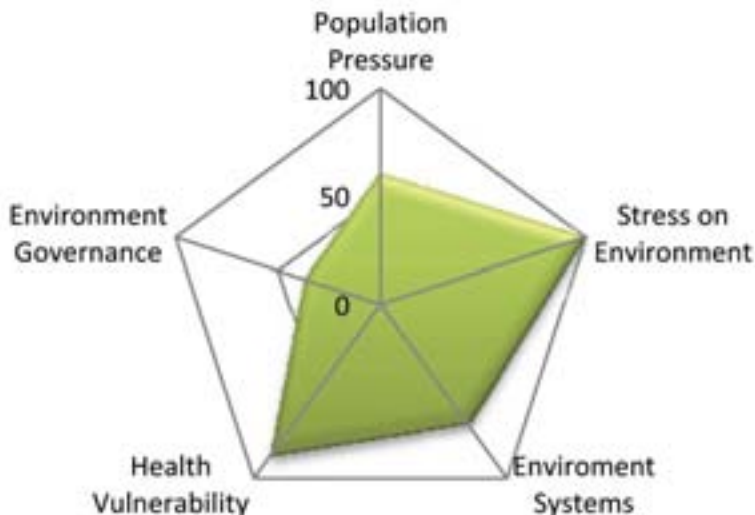


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.31	Land Use	0.52	Health Vulnerability	0.01
Natural Resource Depletion	0.40	Natural Resource Endowment	0.33	Energy Management	1.01
Air Pollution	0.91	Air Quality	1.06	People Initiative	0.25
Water Pollution	-0.31	Water Quality	0.45	Government Initiative	0.55
Waste Generation	-0.07	Disaster Management	-0.08	GHG Emission	-0.98

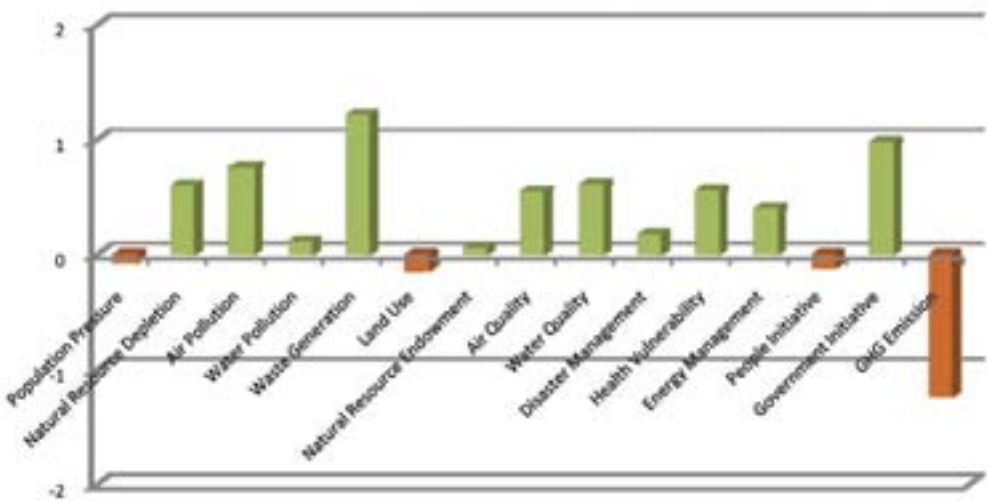
## NAGALAND

ESI Score: 82.08  
 ESI Rank: 4  
 GSDP/capita: Not Available



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

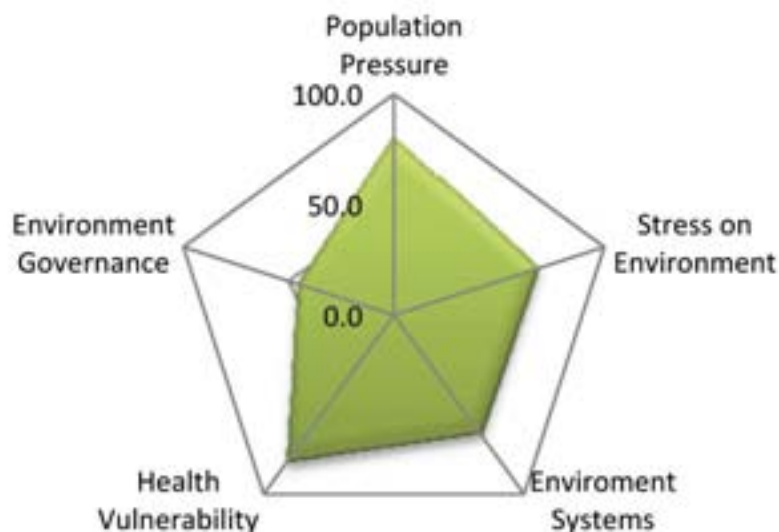
Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.08	Land Use	-0.15	Health Vulnerability	0.56
Natural Resource Depletion	0.59	Natural Resource Endowment	0.06	Energy Management	0.40
Air Pollution	0.76	Air Quality	0.55	People Initiative	-0.11
Water Pollution	0.12	Water Quality	0.61	Government Initiative	0.98
Waste Generation	1.21	Disaster Management	0.17	GHG Emission	-1.24

## ORISSA

ESI Score: 71.88

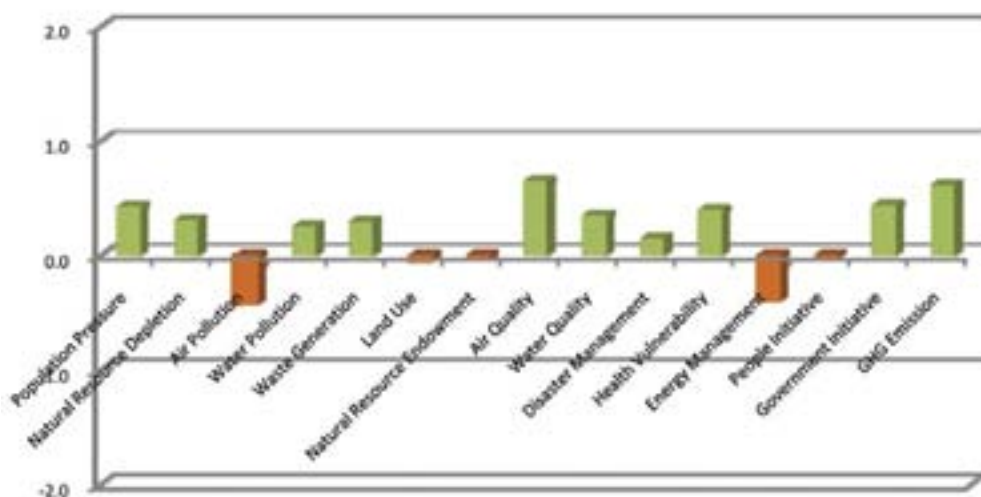
ESI Rank: 8

GSDP/capita: Rs. 19684 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



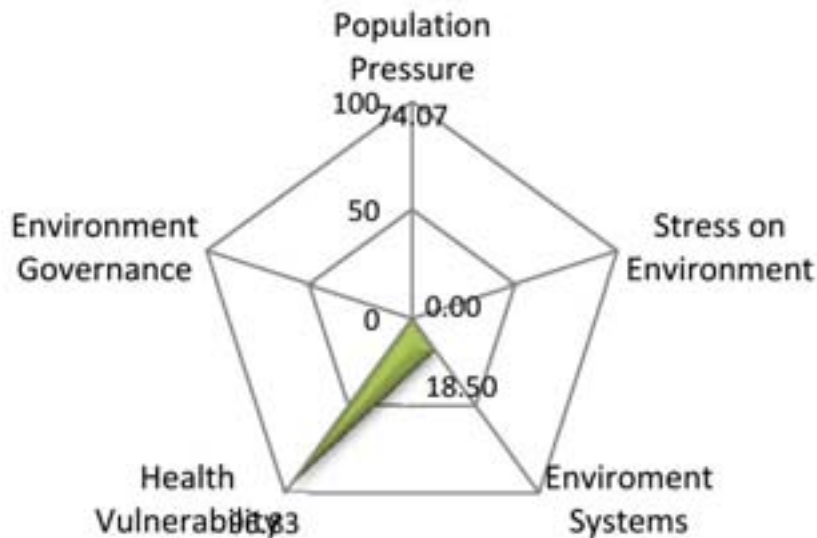
How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.43	Land Use	-0.06	Health Vulnerability	0.39
Natural Resource Depletion	0.31	Natural Resource Endowment	-0.05	Energy Management	-0.40
Air Pollution	-0.43	Air Quality	0.65	People Initiative	-0.02
Water Pollution	0.25	Water Quality	0.35	Government Initiative	0.43
Waste Generation	0.30	Disaster Management	0.15	GHG Emission	0.61



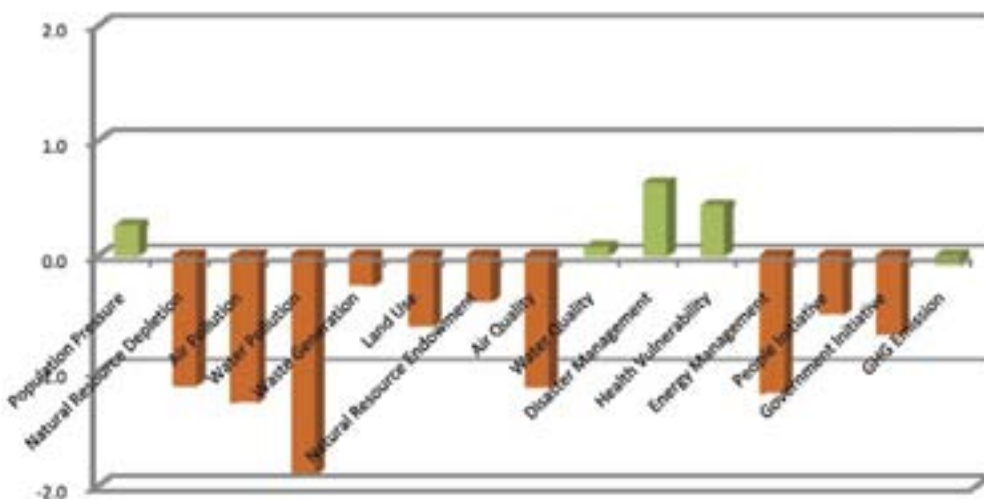
PUNJAB

ESI Score: 0.00  
 ESI Rank: 28  
 GSDP/capita: Rs. 41268 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators

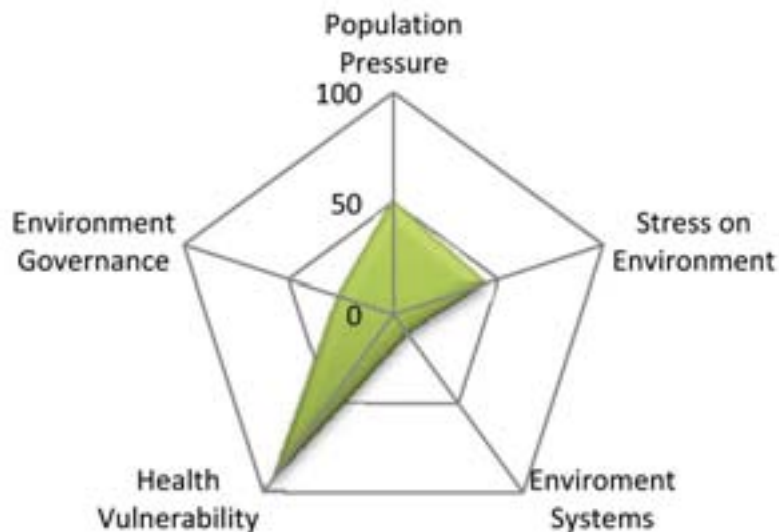


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.26	Land Use	-0.62	Health Vulnerability	0.43
Natural Resource Depletion	-1.13	Natural Resource Endowment	-0.40	Energy Management	-1.19
Air Pollution	-1.28	Air Quality	-1.15	People Initiative	-0.51
Water Pollution	-1.90	Water Quality	0.07	Government Initiative	-0.68
Waste Generation	-0.26	Disaster Management	0.62	GHG Emission	-0.09

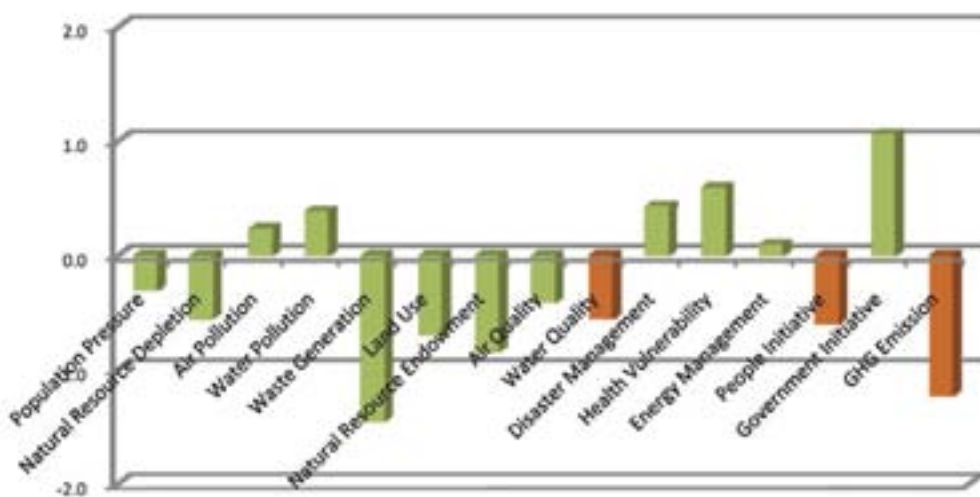
## RAJASTHAN

ESI Score: 26.52  
 ESI Rank: 24  
 GSDP/capita: Rs. 19218 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



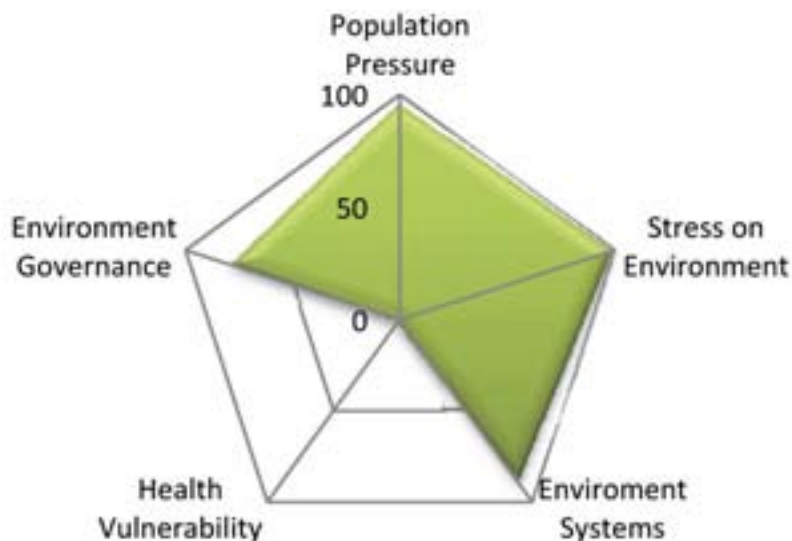
How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.31	Land Use	-0.69	Health Vulnerability	0.59
Natural Resource Depletion	-0.55	Natural Resource Endowment	-0.84	Energy Management	0.10
Air Pollution	0.23	Air Quality	-0.42	People Initiative	-0.60
Water Pollution	0.39	Water Quality	-0.56	Government Initiative	1.06
Waste Generation	-1.45	Disaster Management	0.43	GHG Emission	-1.23



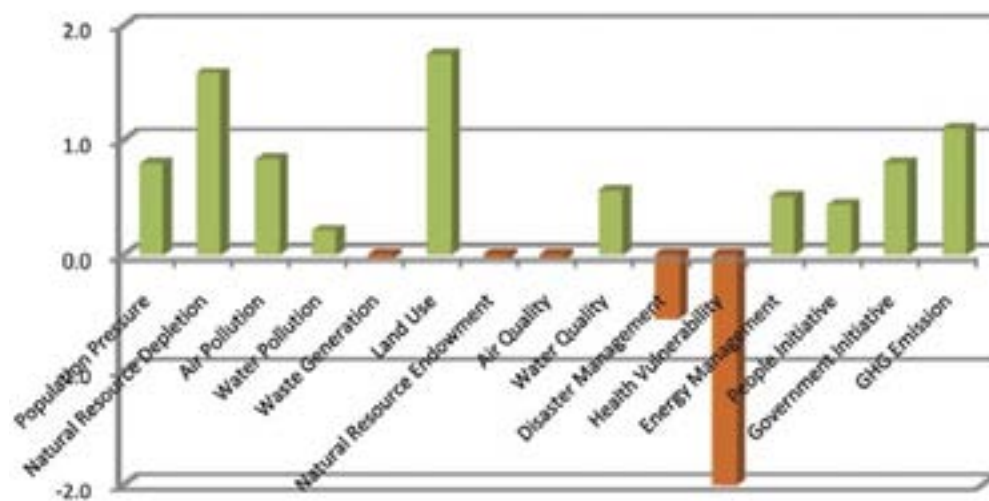
SIKKIM

ESI Score: 90.99  
 ESI Rank: 2  
 GSDP/capita: Rs. 30354 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators

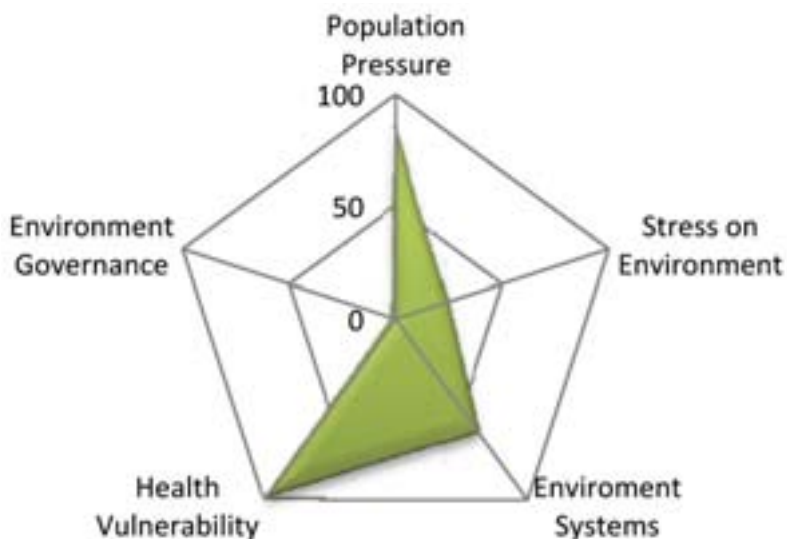


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.79	Land Use	1.75	Health Vulnerability	-2.11
Natural Resource Depletion	1.58	Natural Resource Endowment	-0.03	Energy Management	0.50
Air Pollution	0.83	Air Quality	-0.04	People Initiative	0.43
Water Pollution	0.20	Water Quality	0.55	Government Initiative	0.80
Waste Generation	-0.03	Disaster Management	-0.54	GHG Emission	1.10

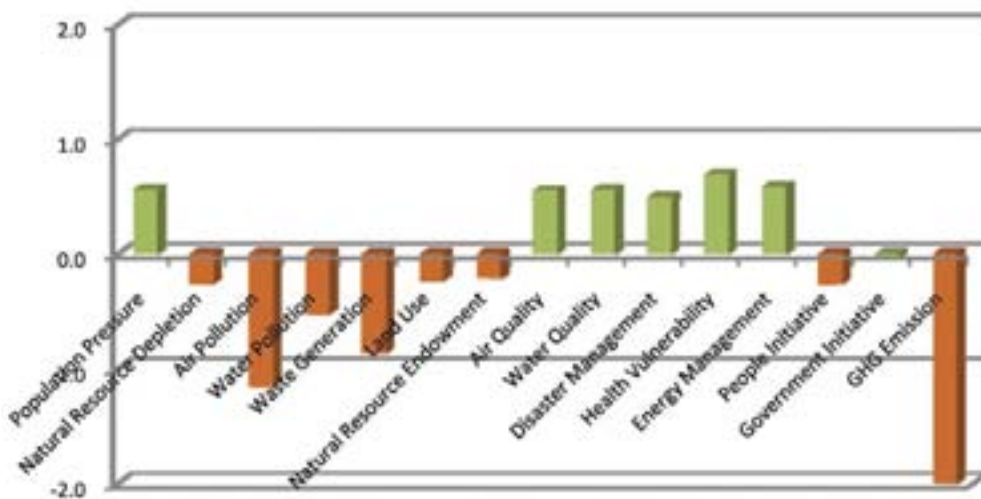
TAMIL NADU

ESI Score: 33.75  
 ESI Rank: 22  
 GSDP/capita: Rs. 33666 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

Performance across 15 indicators

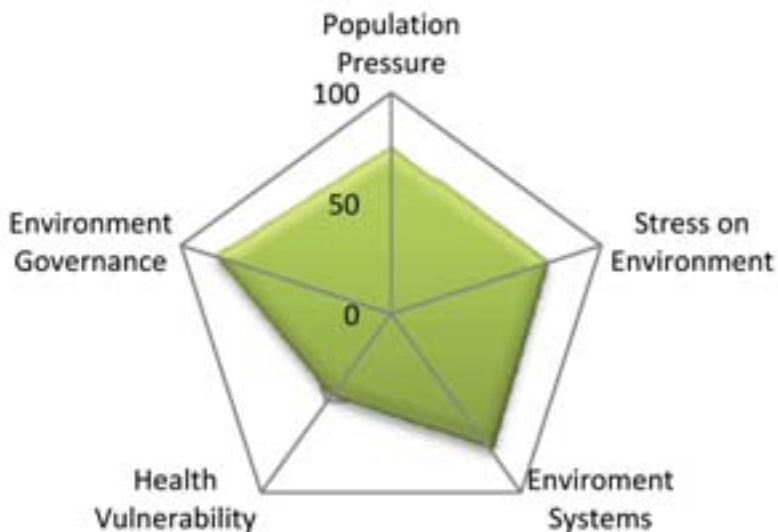


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.6	Land Use	-0.2	Health Vulnerability	0.7
Natural Resource Depletion	-0.3	Natural Resource Endowment	-0.2	Energy Management	0.6
Air Pollution	-1.2	Air Quality	0.6	People Initiative	-0.3
Water Pollution	-0.5	Water Quality	0.6	Government Initiative	0.0
Waste Generation	-0.9	Disaster Management	0.5	GHG Emission	-2.7

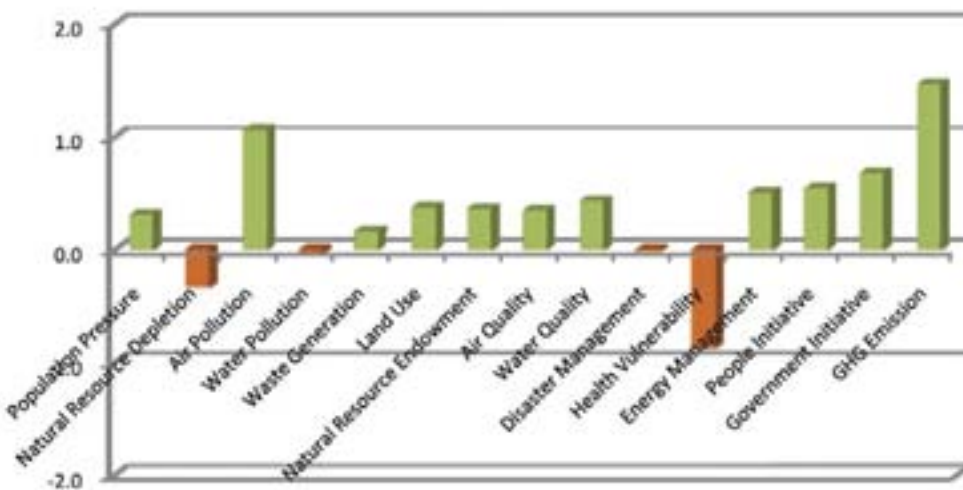
# TRIPURA

ESI Score: 85.81  
 ESI Rank: 3  
 GSDP/capita: Rs. 25994 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

## Performance across 15 indicators

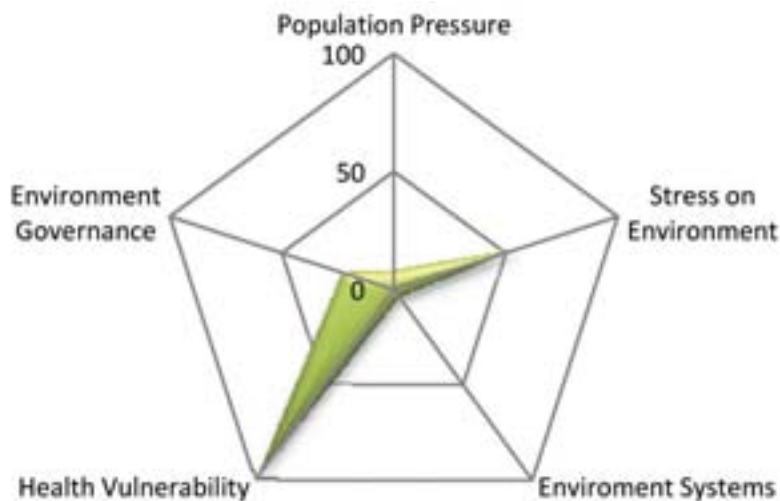


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.31	Land Use	0.37	Health Vulnerability	-0.87
Natural Resource Depletion	-0.34	Natural Resource Endowment	0.36	Energy Management	0.51
Air Pollution	1.06	Air Quality	0.35	People Initiative	0.54
Water Pollution	-0.03	Water Quality	0.43	Government Initiative	0.68
Waste Generation	0.16	Disaster Management	-0.02	GHG Emission	1.47

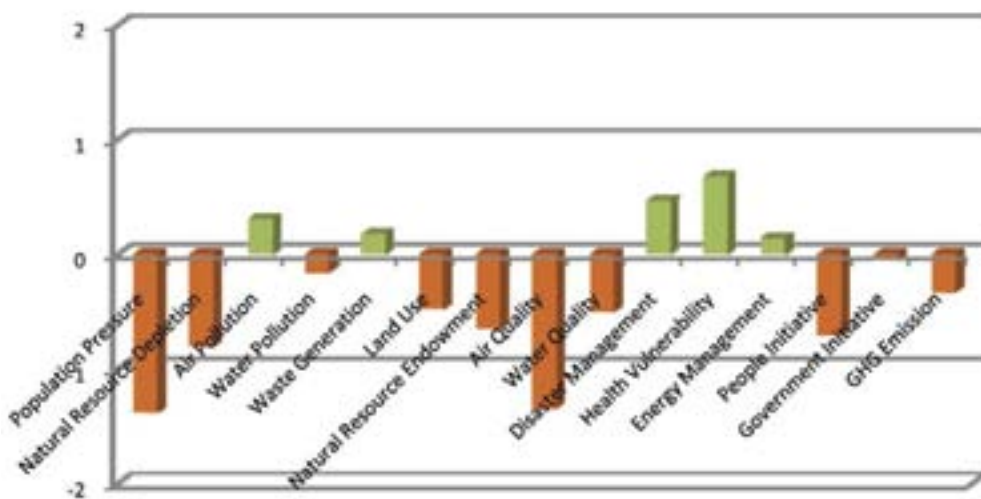
## UTTAR PRAESH

ESI Score: 21.40  
 ESI Rank: 26  
 GSDP/capita: Rs. 14656 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

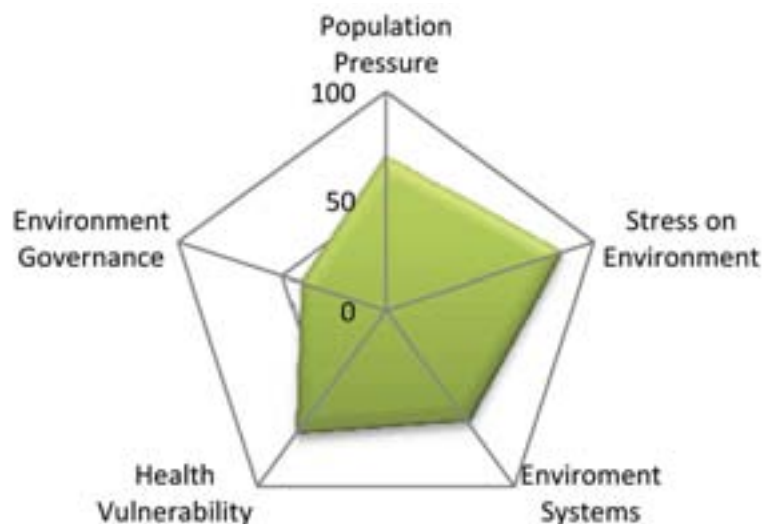
Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-1.38	Land Use	-0.48	Health Vulnerability	0.67
Natural Resource Depletion	-0.80	Natural Resource Endowment	-0.65	Energy Management	0.14
Air Pollution	0.31	Air Quality	-1.34	People Initiative	-0.71
Water Pollution	-0.15	Water Quality	-0.49	Government Initiative	-0.05
Waste Generation	0.17	Disaster Management	0.47	GHG Emission	-0.33

## UTTARANCHAL

ESI Score: 71.18

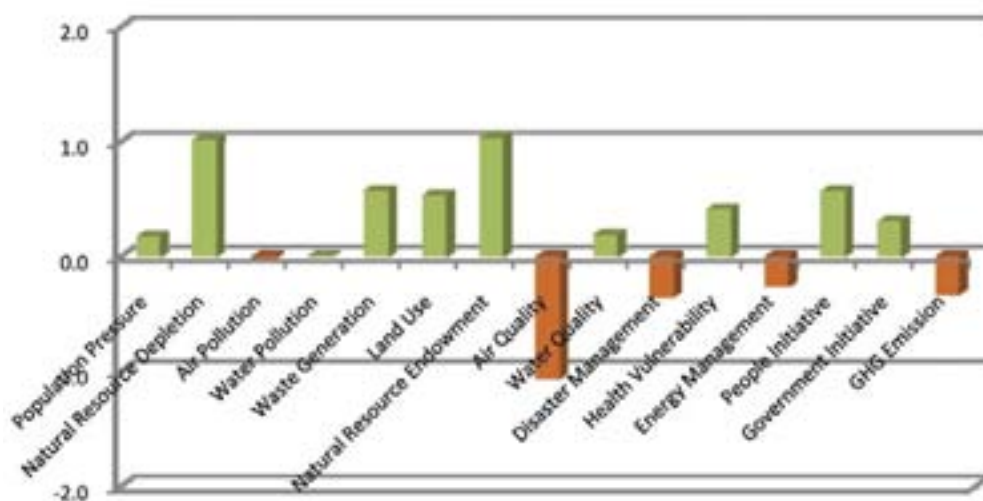
ESI Rank: 9

GSDP/capita: Rs. 27141 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators

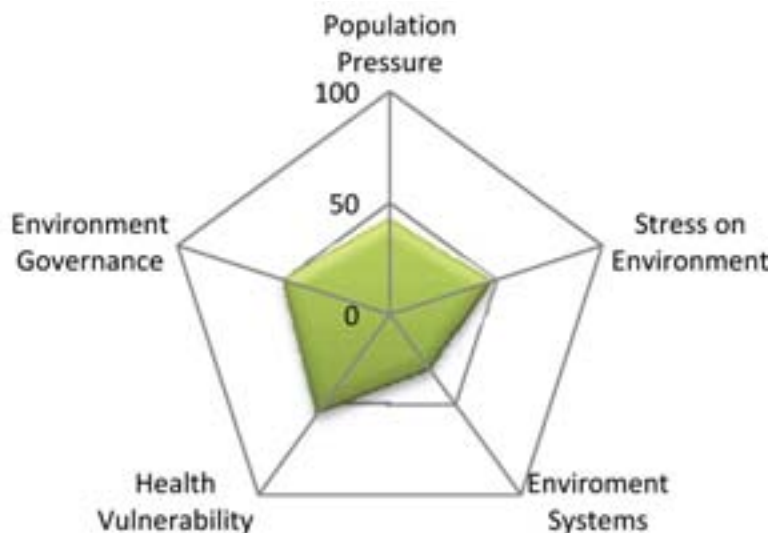


How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	0.17	Land Use	0.53	Health Vulnerability	0.41
Natural Resource Depletion	1.02	Natural Resource Endowment	1.04	Energy Management	-0.26
Air Pollution	-0.01	Air Quality	-1.06	People Initiative	0.57
Water Pollution	0.01	Water Quality	0.19	Government Initiative	0.30
Waste Generation	0.58	Disaster Management	-0.35	GHG Emission	-0.33

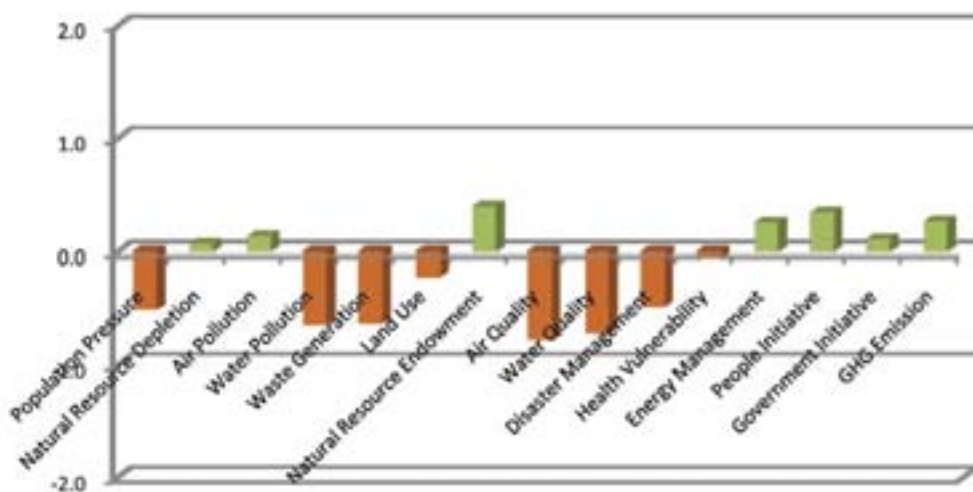
## WEST BENGAL

ESI Score: 35.72  
 ESI Rank: 21  
 GSDP/capita: Rs. 26863 per year



How to Interpret: Values farther from the centre indicates better performance; Values are calibrated in a scale of 0 (worst) to 100 (best). More the area occupied by the chart in the spider indicates better performance by the state in all components.

### Performance across 15 indicators



How to Interpret: Values are in a scale of -3 (worst) to +3 (best) and 0 means average. The bars going upwards shows better than average (of all 28 states) performance and the bars going downwards shows less than the average (of all 28 states). More number of longer upward bars is desirable and indicates good performances.

Indicator	Value	Indicator	Value	Indicator	Value
Population Pressure	-0.50	Land Use	-0.21	Health Vulnerability	-0.06
Natural Resource Depletion	0.06	Natural Resource Endowment	0.39	Energy Management	0.25
Air Pollution	0.12	Air Quality	-0.77	People Initiative	0.34
Water Pollution	-0.64	Water Quality	-0.71	Government Initiative	0.10
Waste Generation	-0.63	Disaster Management	-0.48	GHG Emission	0.26



## INTER-STATE COMPARISONS ACROSS INDICATORS

While the state ESI profiles demonstrate the uniqueness of each state's environmental dynamics; the cross-state comparison elucidates the distribution of positive and negative performances and identifies the leaders and the laggards. For example: Assam and Orissa have comparable ESI scores of 71.88 and 70.15 respectively. When studied in detail, it can be seen that Orissa's scores are better distributed along all indicators than Assam where few extreme positive and negative values have influenced the rankings. Similarly Tamil Nadu (22nd rank) and Andhra Pradesh (23rd rank) are similar in overall score yet show considerable difference across policy categories.

The graphs below present state-wise performance in the 15 indicators in standardized z-scores ranging from -3 to 3; greater distance from the centre means better performance. For example, in Indicator 1, Bihar and Uttar Pradesh scores are very close to the centre indicating a very high population pressure which is a negative sign. Greener bars (0 to +3) indicate better than average performance whereas states with less than average (-3 to 0) performance are shown in orange.

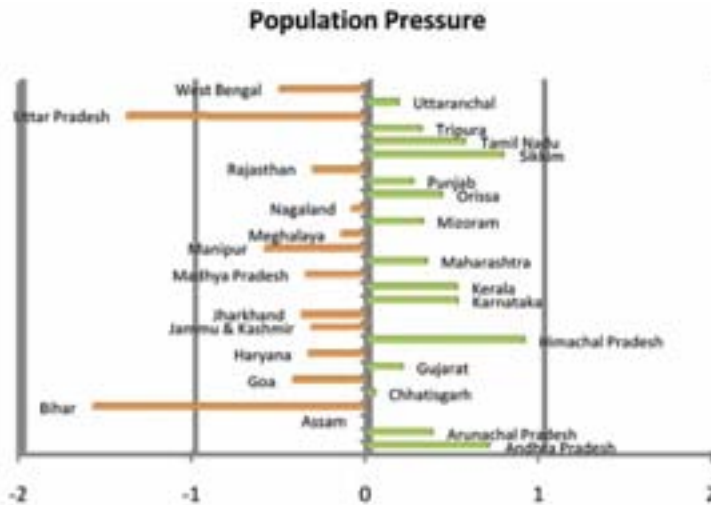
### INDICATOR 1: POPULATION PRESSURE

**Underlying Variables:** Population density, Population growth, Total fertility rate

Population density has an impact on per capita natural resource availability and environmental conditions. High population density is often associated with poverty and unsustainable use of resources. Since the natural resources in an ecosystem and its carrying capacities are finite, increased population means more extractive resource use. Population density shows the level of direct pressure on resources; population growth and fertility rate indicate the pattern of change and affect the volume of demands on natural resources and implications for environmental degradation. Hence lower the population pressure, better chances of achieving sustainability.

Environmental Sustainability Index is a comparison tool meant to relatively review the environmental performance of the 28 states.

There is no absolute standards used for assigning ranks and each state is ranked against each other on a relative scale. Such comparisons emphasize the fact that no state dominates on all indicators therefore promoting creative competition and each state has something to learn from the other states.



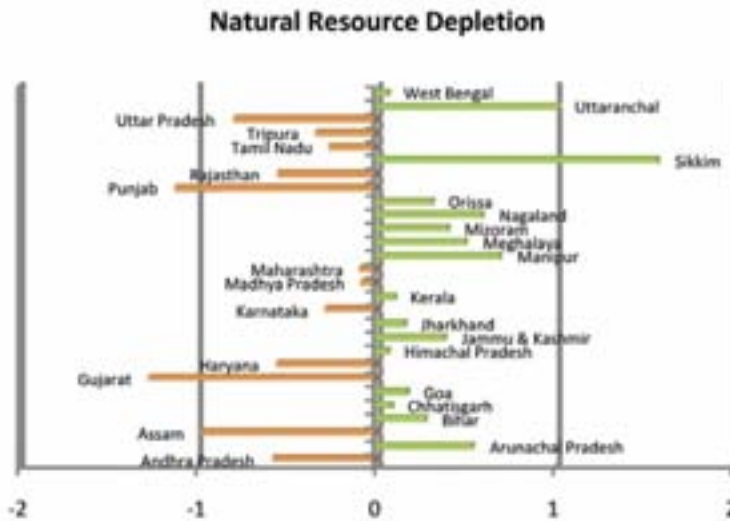
Best among 28 states  
Himachal Pradesh & Sikkim

Least among 28 states  
Bihar & Uttar Pradesh

**INDICATOR 2: NATURAL RESOURCE DEPLETION**

Underlying Variables: % Change in forest area, % of Forest land encroached, Annual ground water draft as % of annual net groundwater available

Due to severe degradation or loss of forest, their capacity to function as regulators for the environment is lost, thereby increasing floods, soil erosion, and change in soil fertility, less rainfall etc. leading to the loss of plant and animal life. Moreover, forest are important resources in terms of timber, NTFP, medicinal plants etc. Because of loss of forests, the sustainability of resources from forest is also lost. The encroached forest land signals human interference and potential loss of forest and biodiversity and also the lack of efficient implementation and regulation to protect forest resource. States with least depletion are more sustainable.



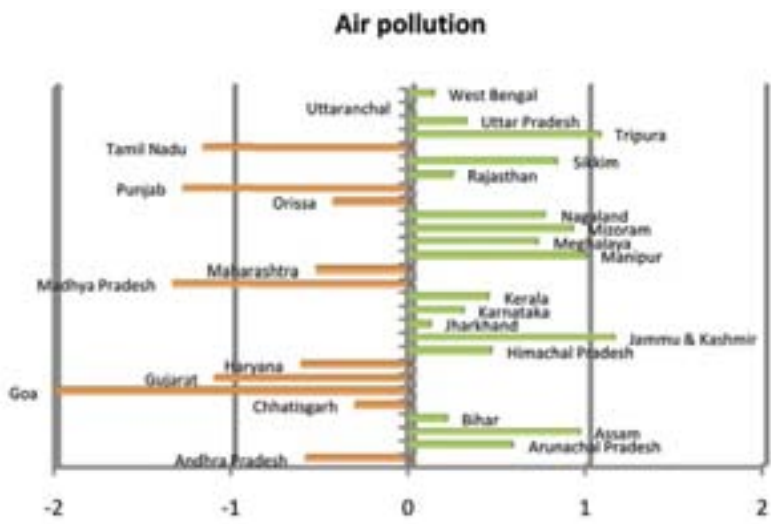
Best among 28 states  
Sikkim & Uttarakhand

Least among 28 states  
Gujarat & Punjab

**INDICATOR 3: AIR POLLUTION**

Underlying Variables: Nox emission per capita, So2 emission per capita, Co2 emission per capita, Number of motorized vehicles used per million people

Air pollution is one of the most important indicators of clean environment. Nox, SO2, CO2 emissions create harmful particulate matter, ground-level ozone (smog) and acid rain and project the pollution load sate is going to face. The number of motor vehicles is a good indicator of air pollution from transport sector, which is a large proportion of the total air pollution.



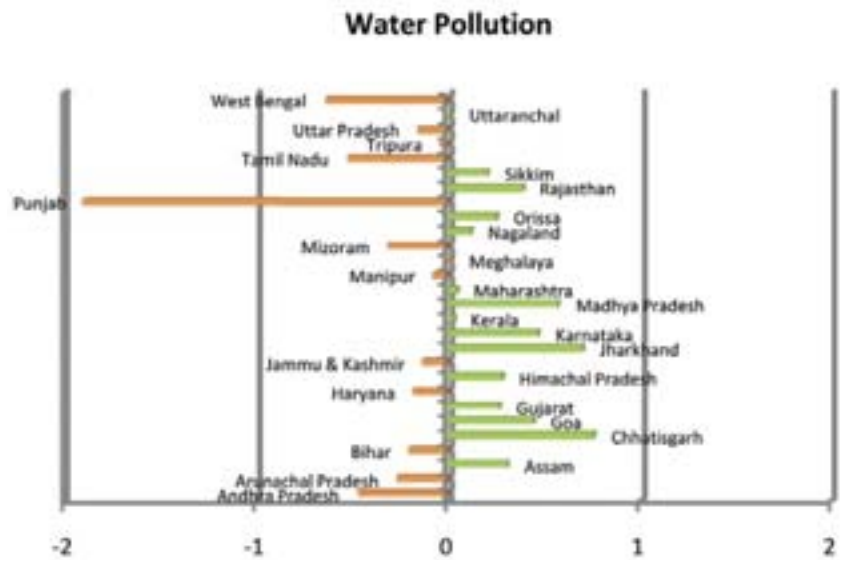
Best among 28 states  
Jammu & Kashmir, Tripura

Least among 28 states  
Goa & Madhya Pradesh

**INDICATOR 4: WATER POLLUTION**

Underlying Variables: % of untreated waste water discharged, Fertilizer and Pesticide consumption per hectare of agricultural land

Through untreated waste water toxic substances enter water bodies deteriorating its utility. Excessive use of fertilizers has negative impact on soil, water, humans and wildlife. Pesticides are highly poisonous substances, through drainage and seepage it enters the ecosystems and food chain. Continued water pollution has serious implication for availability of usable water and sustaining human life.



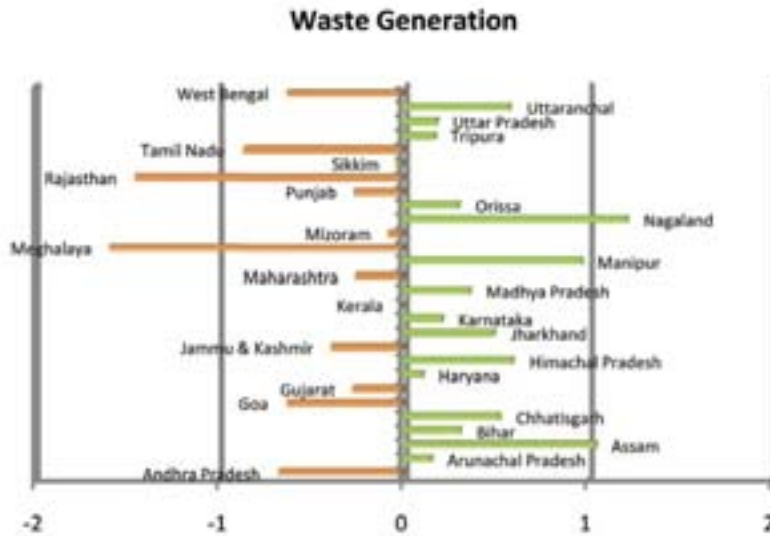
Best among 28 states  
Chhattisgarh & Jharkhand

Least among 28 states  
Punjab & West Bengal

**INDICATOR 5: WASTE GENERATION**

Underlying Variables: Per capita Municipal solid waste generated, Per capita hazardous waste generated

Waste generation is important to consider since it shows the lifestyle and consumption patter of a society. More waste generated means higher ecosystem service extraction rate and thus less sustainability. States which generate less per-capita waste are more likely to manage their environment well.



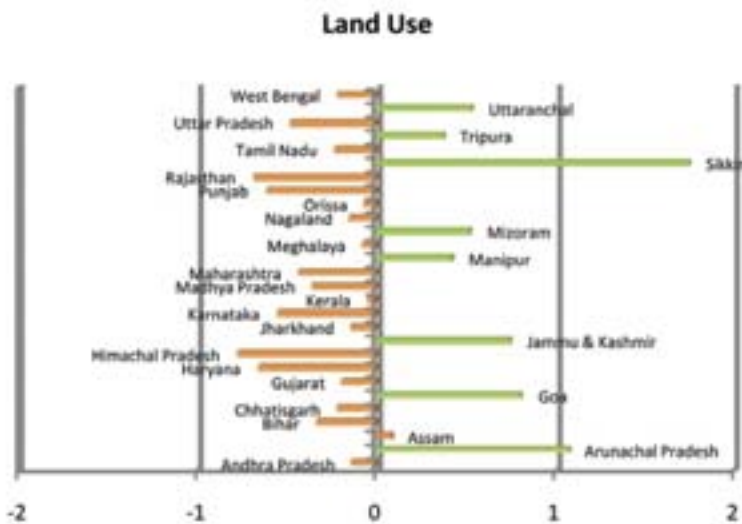
Best among 28 states  
Nagaland & Assam

Least among 28 states  
Meghalaya & Rajasthan

**INDICATOR 6: LAND USE**

Underlying Variables: % of protected area, % of grazing and % of agriculture land

Land use practices determine the long term ecosystem vitality of a state. Agricultural and grazing land puts pressure on ecosystem and makes it fragile and unsustainable. Protected areas are a measure of the degree to which natural environment has been maintained and conserved.



Best among 28 states  
Sikkim & Arunachal Pradesh

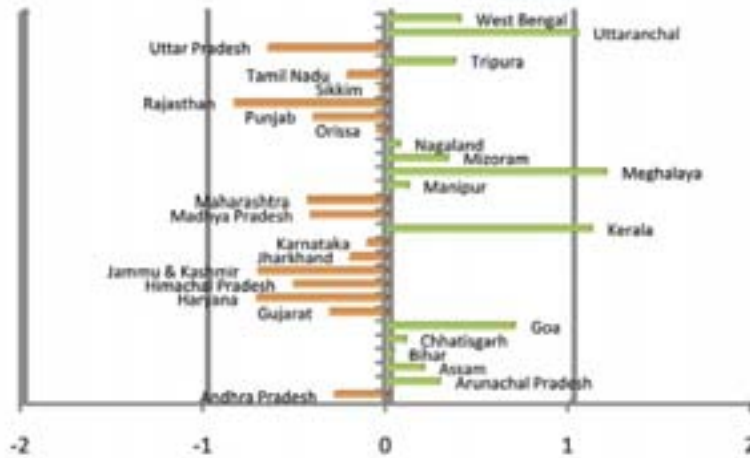
Least among 28 states  
Himachal Pradesh & Rajasthan

**INDICATOR 7: NATURAL RESOURCE ENDOWMENT**

Underlying Variables: annual replenishable ground water, average annual rainfall, wetland as % of total geographic area and forest cover as % of total geographical area

Greater endowment of natural resources such as forest, water and biodiversity equips the state to grow more sustainably. Ground water and Rainfall are important water resources and wetland is a good proxy of biodiversity. Forest cover is a good indicator of availability of natural resources like timber, NTFP, biodiversity etc. Forests also act as regulators of environment by preventing soil erosion, bringing rainfall and giving shelter to biodiversity.

### Natural Resource Endowment



Best among 28 states  
Meghalaya & Kerala

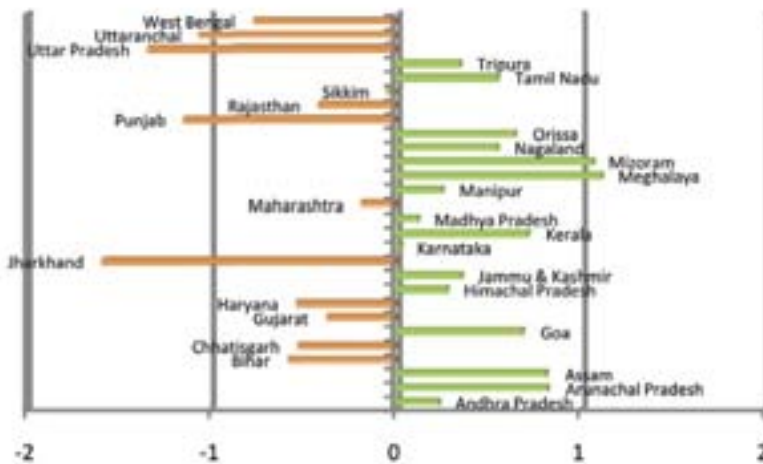
Least among 28 states  
Rajasthan & Haryana

### INDICATOR 8: AIR QUALITY

Underlying Variables: Annual concentration of SO2 levels, Annual concentration of NO2 levels, Annual concentration of SPM levels, Annual concentration of RSPM levels

Atmospheric concentration of SO2, NO2 and particulate matters measure the quality of air of a particular place at a given time. Higher concentration negatively affects both human and ecosystem health causing serious respiratory diseases. The presence of particulate matter reduces visibility. The deposition of particulate matter can change composition of soil and surface water and affects the ecosystem

### Air quality



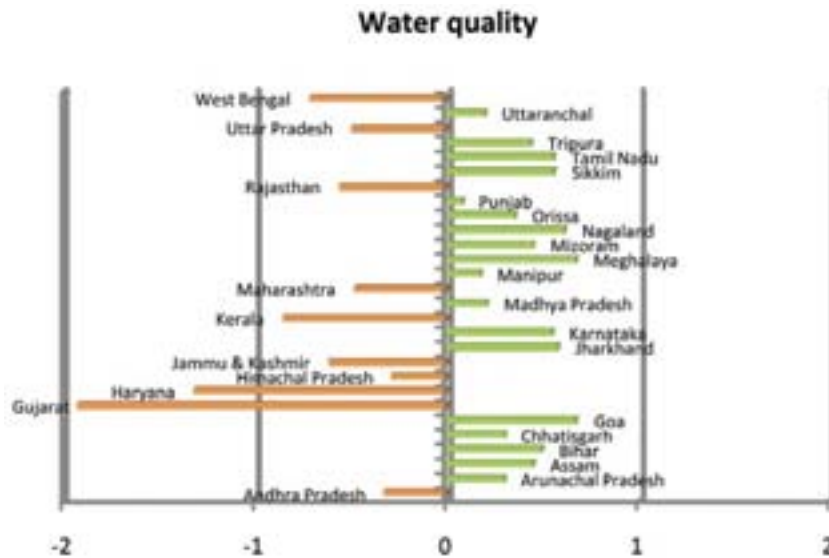
Best among 28 states  
Meghalaya & Mizoram

Least among 28 states  
Jharkhand & Uttar Pradesh

### INDICATOR 9: WATER QUALITY

Underlying Variables: Biological oxygen demand, Electrical conductivity, Total suspended solids

Water quality is another important constituent of environment systems. Biological oxygen demand, electrical conductivity and total soluble solids are considered for ESI among the many parameter used to measure the quality of water. High levels of Electrical conductivity correspond to high concentrations of metals. Large number of suspended solids affects the aquatic life due to unavailability of light. They also make water unfit for drinking. BOD affects the amount of dissolved oxygen in the river and the streams, higher BOD leads to rapid depletion of oxygen which in turn creates more stress.



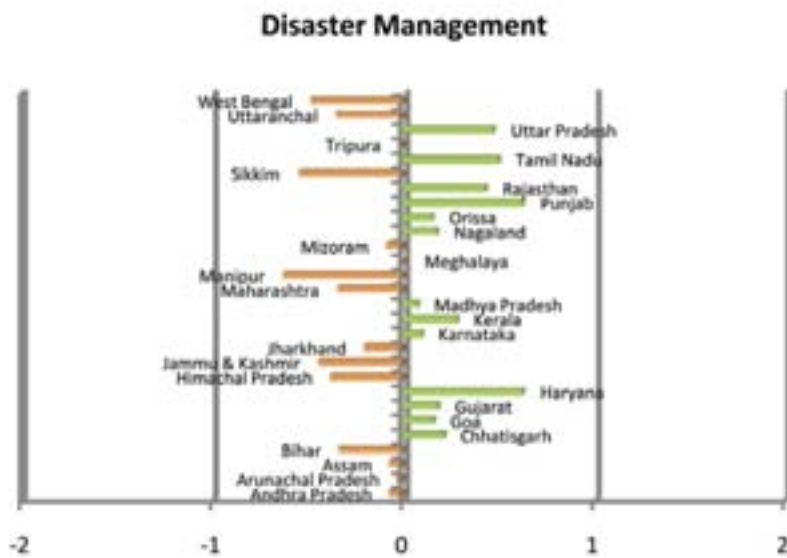
Best among 28 states  
Goa & Meghalaya

Least among 28 states  
Gujarat & Haryana

#### INDICATOR 10: DISASTER MANAGEMENT

Underlying Variables: % of degraded/wastelands, % of flood affected area, % of arid/drought prone and hazard prone area

Disaster management is important for sustainable habitat creation. Drought and flood are stress situations, affect wealth and wellbeing and disturbs the ecological balance. More area under degraded category means there is less productive area and thus the pressure on environment becomes high. Similarly hazard prone areas cannot grow sustainably and make the ecosystem fragile. Disaster exposure increases vulnerability and reduces productivity.



Best among 28 states  
Punjab & Haryana

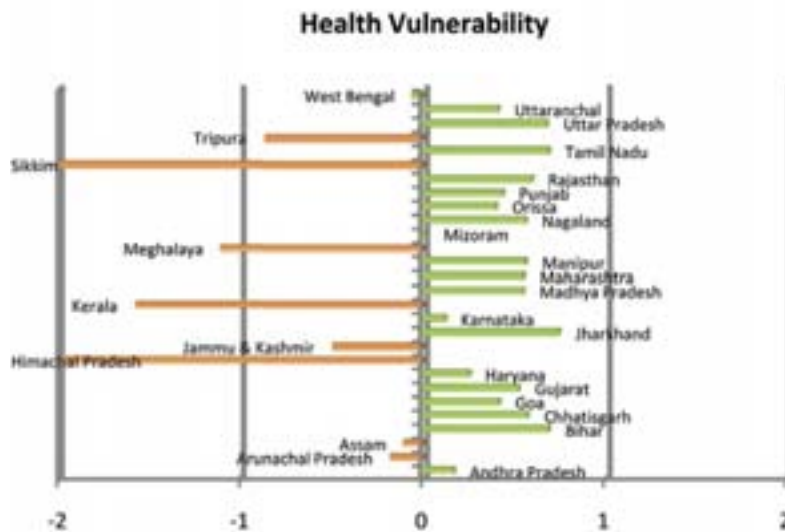
Least among 28 states  
Manipur & Sikkim

#### INDICATOR 11: HUMAN HEALTH VULNERABILITY

Underlying Variables: Incidence of acute respiratory and water borne diseases

Reducing health problems caused by environmental pollution is a priority recognized by every society. Clean environment enhances health and well being and can reduce child mortality rate, increase life expectancy and quality of life. Inadequate sanitation, lack of quality drinking water, clean environment leads to respiratory and water borne disease.





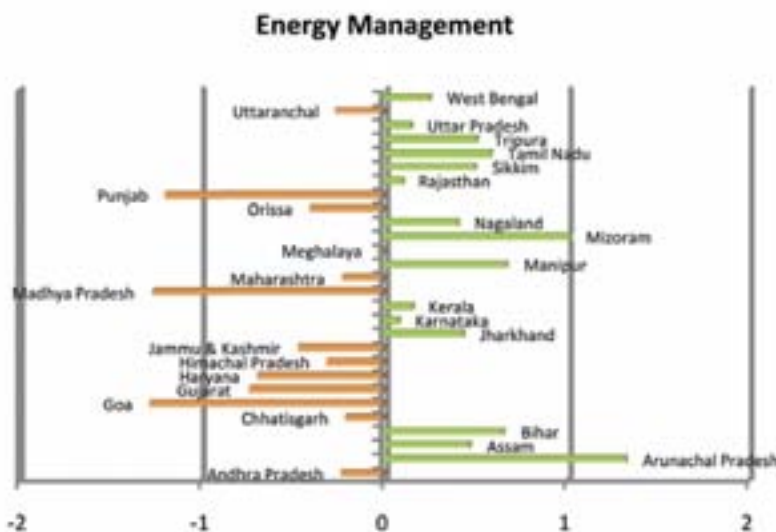
Best among 28 states  
Jharkhand & Tamil Nadu

Least among 28 states  
Himachal Pradesh & Sikkim

### INDICATOR 12: ENERGY MANAGEMENT

Underlying Variables: Per capita power consumed, share of renewable energy and energy-GDP ratio

Energy and environment are highly interlinked, better energy management enhances sustainable growth. Renewable energy is clean and eco-friendly, more share of renewable in a state's portfolio is a good indication of its future environment management. Higher power consumption leads to more demand for power leading to burning of fossil fuels and emission. Economic growth process of a state is more efficient if less energy is needed to produce a given set of goods and services. Hence such states have higher capacity to grow and at the same time preserve its environment.



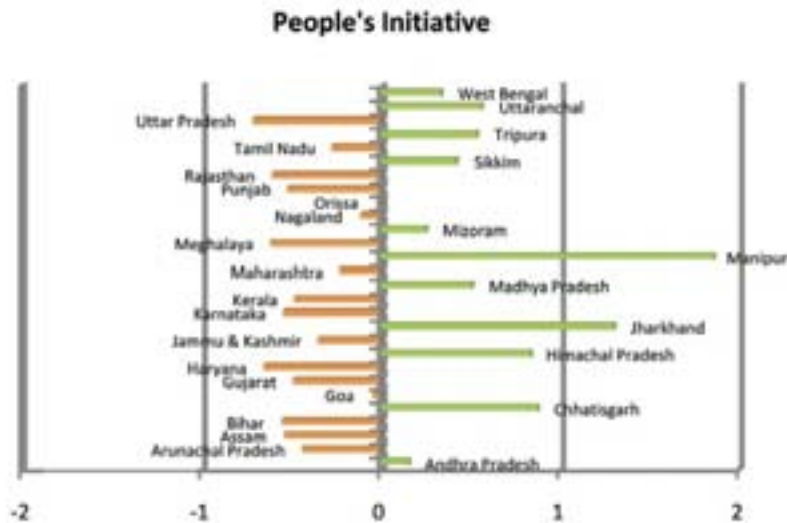
Best among 28 states  
Arunachal Pradesh & Mizoram

Least among 28 states  
Goa & Madhya Pradesh

### INDICATOR 13: PEOPLES INITIATIVE

Underlying Variables: Presence of environmental NGOs and joint forest management initiative

Since environment is a public good, people's initiative in preserving it is essential. Presence of environmental NGOs indicates better awareness and initiative in the state to preserve the ecosystem. Joint forest management is a good parameter to measure a society's involvement in protecting its environment since it is a community initiative to protect and conserve the forest. Such indicators are important in judging a state's ability to take care of its environment in the coming decades.



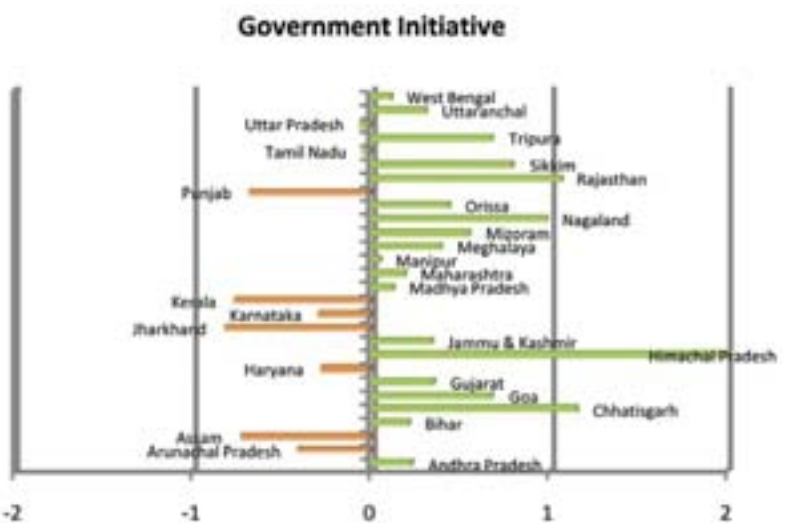
Best among 28 states  
Manipur & Jharkhand

Least among 28 states  
Uttar Pradesh & Haryana

**INDICATOR 14: GOVERNMENTS INITIATIVE**

Underlying Variables: % of industries defaulting and closed, state government’s expenditure on environment as % of total revenue expenditure, union government’s funds actual expenditure as % of agreed outlay for environment

Resource endowment, depletion, pollution might vary among states due to historical conditions, economic growth and efficiency. When it comes to proactive government all states are on equal footing to start and promote better environment. Government’s action towards promoting sustainability can come through stricter regulation and increased funding. Closure of defaulting industries indicates transparent governance. The amount of funds released for environment issues in a state measures the degree to which government is concerned about the states environment.



Best among 28 states  
Himachal Pradesh & Chhattisgarh

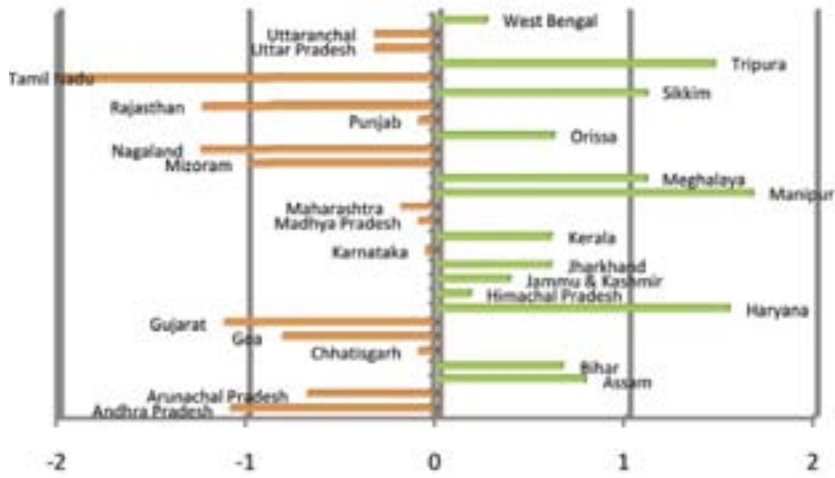
Least among 28 states  
Jharkhand & Kerala

**INDICATOR 15: GHG EMISSION**

Underlying Variables: % change in green house gas emissions

Green house gases are generated due to anthropogenic activities like burning fossil fuels, industrial emission, methane release from livestock and agriculture. The GHG gases are the most important reason for global warming and climate change. The states are going to face the biggest environmental challenge arising from climate change in terms of change in temperature, monsoon pattern, crop yield, increased incidence of extreme weather events and loss of human life and wealth. GHG emission changes as a single indicator encapsulate changes in multiple environmental dimensions towards better governance.

### GHG Emission



Best among 28 states  
Manipur & Haryana

Least among 28 states  
Tamil Nadu & Nagaland

## CONCLUSIONS AND POLICY RECOMMENDATIONS

ESI is a quantitative measure of the condition of the environment in each Indian state. The ESI results demonstrate that indicators can, to a large extent, quantify heterogeneous information into measurable and manageable units that can aid in better policy making. Such information can help to measure and calibrate progress towards sustainable development goals.

While quantification of environment is challenging both theoretically and in policy context; ESI can provide a platform for empirical, analytical and data-driven policy making. ESI is a powerful policy tool that can be used to identify priorities; a state might be facing several environmental challenges such as water pollution, air pollution and loss of forest and biodiversity. Using ESI it can be determined which of these issues needs the most urgent attention. It can be effectively used to formulate targeted policies and to allocate funds more rationally, within states and within sectors. Governments can benchmark their performance to peer states or with the best performing state to identify what are the historical and man-made factors that have created the difference in ranking and how best it can be changed.

ESI is designed to help the policy makers understand a state's sustainability in terms of natural resource management, pollution load, vulnerability and institutional capacity. It creates a baseline for cross-state and cross-sectoral performance comparisons and identifies priority environmental issues and areas of action. The historic resource endowments, past policies, extraction intensity and institutional capacities determine the future sustainability to a great extent. ESI has limited utility in suggestive of specific policy actions to be taken by states, its effectiveness lies in categorizing greener states and states in danger zones along multiple environmental indicators, analysing strengths and areas that need improvement, identifying best practices and successful policy models and evaluating adequacy and sufficiency of current policies. Through these analysis supplemented by data and peer comparisons, ESI can reinforce the economy-environment linkage and importance of integrated policy making. Complementing HDI

Ranking of the states across different environmental indicators shows that each state has managed various aspects of its environment with unique strengths and weaknesses. Thus the future policies should be customized according to the requirements and conditions of each state, which has been one of the primary focuses of this study.

The ESI is fundamentally a policy tool designed to make environmental decision making more empirical and analytically rigorous. The comparative nature of analysis aids in developing benchmarks and creating peer pressure.

and GDP measures, ESI also provides a third dimension of ecological sustainability to evaluate the effectiveness of government policies.

ESI uses the state as the unit of measurement. Each state has different ecological, geographical, social, economic and institutional structures. Beyond inter-state differences, variation within states, especially large states, can be quite high. While large states like Uttar Pradesh or Maharashtra are heterogeneous with unequal wealth and resource distribution, smaller states like Sikkim and Goa are more homogenous with a small population and geographical area. Although these differences may have some impact on ESI scores, the state was chosen as the unit of measurement as most of the resources in India are measured at the state level, and hence data are available at the state level only. Moreover, as the state is the key unit for policy formulation and implementation, the choice of the state as the unit of measurement is relevant for policy makers.

ESI reveals that most of the richer states with high per capita GDP (Punjab, Haryana and Gujarat) have fared poorly in ESI whereas Orissa, Assam, Bihar scores high on sustainability despite low per capita GDP. Most states show mixed results, Himachal and Kerala are the states which have managed to grow sustainably. The relationship between economic growth and the environment is complex and controversial and is likely to remain so. The Environmental Kuznet's Curve (EKC Hypothesis<sup>1</sup>) is the most popular and widely accepted model in this regard. Extending EKC and Brock and Taylor hypothesis (2003)<sup>2</sup>, it can be assumed that most of the Indian states are likely to cause further damage to the environment in the growth process and then after a certain point of economic growth, the states will be able to invest in pollution control and environment friendly technologies. Given the fact that most of the states are growing rapidly, environmental challenges in the future is most likely to remain a key policy concern. The experience of rapidly growing countries has been to grow first and clean up later. However, this neglect of the environment has resulted in irreversible losses and high cleanup costs. Indian states have to learn from these experiences, and the best way forward is to focus on "green growth" strategies by promoting renewable energy, investing in pollution control and waste management practices, environmental taxes, conservation of natural resources and raising public awareness.

ESI for Indian state is a pioneer effort in establishing the linkages between data and decisions in environmental sectors. Its robustness is limited by data inadequacy, conceptual questions on measuring sustainability, methodological short-comings and necessary interpretations of relative rankings. The ESI is particularly suitable in cross-state and cross-sector comparisons which drive better policy focus. Given robust data sets and analytical framework, using proximity-to-target method a better sustainability performance measurement can be developed to be used in time-series comparisons.

The state of the environment is multidimensional and is difficult to capture in a single index. The ESI is not designed to provide an exhaustive picture of a state's environmental issues, but rather to help reveal trends and draw attention to phenomena that require further analysis and possible action. It can be used to create baseline data of the environmental performance of states, which can then be used in the future to analyze trends and patterns. It aims to create awareness among policy makers, researchers and practitioners and should guide policy makers in setting achievable sustainable development standards and strategies for the states.

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1 For a comprehensive review of literature on EKC hypothesis see Dinda (2004) and Stern (1998). Working Paper: Economic Growth and the Environment: Matching the Stylized Facts, 2003. William Brock and M. Scott Taylor, Department of Economics, University of Wisconsin-Madison.

# ESI FOR INDIAN STATES 2008

## DETAILED METHODOLOGY

### *Selection of the variables in ESI*

In calculating ESI, data covering a wide range of environmental factors were sought. The variables were chosen according to their relevance, accuracy and reliability. For some variables, as was the case for air and water pollution, data for each state were not available. Thus datasets had to be customized with data gathered from multiple sources. If the chosen datasets were relevant, they were further scrutinized for accuracy and reliability. In most cases, data were sought from the most recent available government sources and reports. In India, government data are the most reliable and are collected using a standard methodology. For example, all data related to forest cover, total geographical area, etc. was taken from the Forest Survey Report, 2005. In certain cases proxy variables were used to capture important measures. For biodiversity, since data for threatened species of mammals, birds and reptiles as a percentage of total known breeding species were not available at the state level, the proxy variables of total percentage of wetland area and total percentage of protected area were used instead. The percentage of untreated waste water discharged to total waste water generated was taken as a proxy for water pollution.

### *Standardization of the variables for comparisons across states*

To use data for calculating the ESI score for each state, the raw data should be on a comparable scale; therefore suitable denominators were chosen to transform data into a comparable scale. For example, data like forest cover was made comparable by taking total geographic area as the denominator, while data like incidence of respiratory disease was made comparable by taking total population as the denominator. The most commonly used denominators were GDP, total population and total geographical area. This process ensured that no state was given undue advantage or disadvantage because of its geographical size or population. Also the percentage change of a variable was taken into account in some cases to capture the rate of flow of resources or the rate of accumulation of waste. In doing so, a state's relative performance over the years is gauged; this procedure further mitigates differences arising from area or population size. The standardization for each variable is listed in Table 2.

### *Transformation of the variables for the imputation and aggregation procedures*

After adjusting the data for comparisons across states, the data were then aggregated. In order to adjust for the different units of the different variables and the need to assign a relative score to each state, the data were transformed into Z-scores, which represent standardized deviations from the mean. These Z-scores have a mean of 0 and a standard deviation equal to 1. The Z-score is calculated from the following formula:

$$Z = (x - \mu) / \sigma$$

Where,  $X$  = value of the variable;  $\mu$  = mean;  $\sigma$  = standard deviation

Z-scores computed from datasets with different units can be directly compared since these numbers do not express the original unit of measurement. As the Z-score represents the number of standard deviations from  $x$  to the mean, it gives a relative score for all variables. In the cases where a state's performance on either extreme of the



spectrum might have skewed its overall score, logarithmic transformation was performed to reduce the impact of outliers. All variables that had a skewness value less than 2.5 were transformed using the Z-score transformations and the rest were transformed using the logarithmic transformations. The latter were then again converted into Z-scores such that they can be aggregated.

### ***Substituting values for missing data***

There were many instances where no value was available for the variable in the current dataset. As discussed earlier, this is a serious constraint of the study, as no values for a particular state may affect its ESI score. Missing data may also reduce the precision of a calculated ESI score because there is less information than originally planned. The regression imputation method was used to impute the missing values. It is based on the assumptions that the marginal distributions of the data are normal and that linear relationships between variables exist that can be utilized for building linear regression models that predict the missing data.

### ***Changing direction of the Z-Score according to the ESI***

Since there were both positive and negative variables among the chosen ones, the computed Z-score for all variables lie within the range +3 to -3. For example, in the case of the variable % change in forest cover, a positive Z-score would highlight a change in a favourable direction and a negative Z-score would highlight a change in an unfavorable direction. Here, the interpretation of Z-score is the same as that of the ESI score. So in such cases Z-score can be used directly without recoding it for direction. But in the case of the variable population density, a more positive deviation from the mean (i.e., a higher Z-score), would mean a higher absolute value for a state. Thus a higher positive Z-Score would mean a high population density, which is not in a favorable direction for the ESI of that State. The Z-score should therefore be recoded for its direction. This was done by simply changing the sign of the z-score while keeping the magnitude of the Z-score same. Thus, all higher positive Z- scores would get converted into lower negative Z-scores and vice versa. Information about the recoding done to make all the indicators unidirectional is listed as below:

### ***Winsorization of the data***

Winsorization is an imputation rule limiting the influence of the largest and smallest observations in the available data (OECD, Definition). It does so by shifting the observations in the tails of the distribution to specified percentiles. For each variable, the values exceeding the 95<sup>th</sup> percentile are lowered to the 95<sup>th</sup> percentile and the values smaller than the 5<sup>th</sup> percentile are raised to the 5<sup>th</sup> percentile. This was done so that a few very large or very small values do not bias the ESI score for a state. Though extreme outliers had already been reduced by the means of data transformation, Winsorization further reduced the affect of outliers.

### ***Aggregation of the data to indicator scores and the final ESI score***

Out of the multiple methods of aggregation; the equal weighted average has been used to compute the ESI. There were 44 underlying variables, which were aggregated into the 15 indicators that were used to calculate the final ESI score. While taking the aggregate, equal weight was given to the each variable. The score for all the 15 indicators was combined to give the final ESI score. The ESI score was made comparable by rescaling the scores from a low of 0 to a high of 100. The states were ranked according to their ESI score. The higher the ESI score the better the state's performance and the higher its ranking.

## REFERENCES

- 2005 Environmental Sustainability Index (ESI), 2005 Environmental Sustainability Index. New Haven, Conn.: Yale Center for Environmental Law & Policy, World Economic Forum
- 2006 Pilot Environmental Performance Index (EPI), 2006 Environmental Performance Index. New Haven, Conn.: Yale Center for Environmental Law & Policy, World Economic Forum
- Ahmed K. A, Ferring A. And Ruizmanual L.I, 2003, Environmental Health Indicators and Benchmarks: Human Rights Perspectives, Science and Human Rights Program, American Association for The Advancement Of Science
- International Institute for Sustainable Development (IISD), et al., 2004, Compendium of Sustainable Development Indicators, Winnipeg: IISD
- Jha R., Murthy K.V. Bhanu, 2003, A Critique of The Environmental Sustainability Index
- Jochen Jesinghaus, Rosemary Montgomery, Et Al 1999, Towards Environmental Pressure Indicators for The European Union
- Keeping Score - ESI - '2001 Environmental Sustainability Index' - Statistical Data Included The Ecologist, April 2001
- Lefevre B., 2005, Urban Energetic Signature: A New Approach for Indicators, ERP Sustainable Development Research Conference
- Levy M.A., 2002, 2002 Environmental Sustainability Index: Lessons and Prospects, Argentina
- Marc Levy, 2006, Experiments In Measuring Sustainability - The Environmental Sustainability Index and Its Critics, CIESIN, Earth Institute, Columbia University
- Mohanraj R. And Azeez P. A., 2004, Health Effects Of Airborne Particulate Matter and The Indian Scenario, Current 742 Science, Vol. 87, No. 6, 25 September 2004
- Nardo M., Saisana M. et al (OECD), 2005, Handbook on Constructing Composite Indicators: Methodology and User Guide, OECD Statistics Working Paper
- OECD-China Seminar on Environmental Indicators Proceedings, Programme Of Dialogue and Co-Operation with China, Organization for Economic Co-Operation and Development (OECD), 2005
- SEDAC Compendium of Environmental Sustainability Indicator Collections Version 1 - Metadata
- Shortcomings of the Environmental Sustainability Index, Notes By Mathis Wackernagel, Redefining Progress, February 10, 2001
- Sors J. C., 2001, Measuring Progress towards Sustainable Development in Venice: A Comparative Assessment of Methods and Approaches
- The Working Group on Environmental Information and Outlooks (WGEIO), 2001, Aggregated Environmental Indices Review of Aggregation Methodologies in Use OECD Programme on Environmental Indicators
- Unescap, 2007, Handout Summary of Indicator Initiatives
- United Nations Division for Sustainable Development, 2001, Indicators of Sustainable Development: Guidelines and Methodologies. New York: United Nations Division for Sustainable Development





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