Towards Inclusion of Environment Performance in Gross State Domestic Product, evolving an Index (E+GSDP) and ranking the States.

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Effective and balanced utilization of the country's resources is at the Core of our development strategy. An attempt has been made to improve and make GDP more meaningful by including Environmental Performance and evolve an Index (E+GDP) to recognize the efforts made by the states to arrest degradation of the environment while pursuing efforts to increase per capita GSDP. This article details a methodology for constructing an E+ GDP index for the country and based on the E+ GDP scores, rank the States and suggest options for devolving Central funds to States

Keywords: Gross State Domestic product, Environment, Performance, Sustainable Development Goals, E+GDP index, Scores and ranks.

Gross State Domestic Product (GSDP)

Many opine that Economic growth is 'destroying more than it is creating' and others – feel that our current GDP metric offers no indication of whether a country is becoming richer or poorer in terms of its natural resources. Some countries, argue that neglect and degradation comes from a failure to value 'natural capital' and include that within existing gross domestic product (GDP) calculations. The UN TEEB report[1] attempted to put a value on ecosystems services like forests, lakes, soils, water quality and fisheries.

There has been considerable research in developing alternative measures of GDP. These include environmental adjusted or 'green' GDP. But there is no agreed definition for these adjusted versions of GDP and these tend to be undertaken by research institutions rather than by national statistical institutions. There is however an environmental index being developed by the EU Commission as a result of its report, 'Beyond GDP'[2], published in 2009. The Commission plans to run a pilot of the index and publish the results alongside standard GDP figures.

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A study led by the University of Adelaide's Environment[3] in Australia has ranked most of the world's countries for their environmental impact. The research uses seven indicators of environmental degradation to form two rankings -- a proportional environmental impact index, where impact is measured against total resource availability, and an absolute environmental impact index measuring total environmental degradation at a global scale

It is felt that for India an attempt could be made to improve and make GDP more meaningful by including Environmental Performance; including conservation efforts while recognizing development made by the states i.e states contribution to GDP and efforts made towards managing and conserving their natural resources.

Environmental Performance Index

The adverse impact of development is felt due to, natural resource depletion and the health consequences of air, soil and water pollution and inadequate waste management. Recognising the influence of natural resources depletion and unabated pollution on many sectors of the economy and well being of the citizens, in an earlier paper[4] an **Environment Performance Index (PC-EPI) was evolved in 2013 and suggestion made to recognize environmental performance by states and devolve central funds.**

EPI-BD Index for funding.

Further to the Environmental Performance Index (PC-EPI) evolved in the Planning Commission , which consisted of 5 criteria and 16 indicators., at the behest of the Ministry of Environment and Forests , GOI a bio-diversity criteria comprising 3 indicators were finalized after deliberation with experts and an EPI+BD index has been evolved which is as indicated in Table-1. With the evolution of the Sustainable Development Goals (SDG)[5] and identification and near finalization of Targets and indicators for monitoring the progress in achieving the Goals , e-waste has been added to the waste category. With the addition of e-waste in waste management criteria and a new criteria , Biodiversity, the number of indicators now stand at 20.

The cumulative EPI+BD is a measure of the environmental well being of the States, i.e., the States with a score of **1** are characterized by cleaner environment , adherence to environmental standards including implementation of legislation and institutional mechanisms and efforts towards Natural resource and Biodiversity conservation. EPI-BD can also be used as a monitoring tool for SDG

Table-1:- Category

S. No	Criteria	Indicators	No. of Variables 2013	2018
1	Air Pollution	1. NOx, 2. SOx, 3. RSPM ,	3	3
2	Forests	1. TFC as % of state GA and Contribution to national FC, 2. Change in forest cover, 3. Growing Stock and 4. Afforestation efforts.	4	4
3	Water quality	1. % Dom. Waste water, and 2. Surface water quality(.DO , BOD & TFC) . 3. Ground water extraction %.	3	3
4	Waste Management	1. MSW, 2.Bio-med.,3.Hazardous Wastes and 4.E-waste.	3	4
5	Climate Change	1. Preparation of SAPCCs , 2. RE growth Rate including mini Hydro., 3. Electricity intensity of SGDP.	3	3
6	Biodiversity	1.Indigenous livestock population change, 2. change in wetland and 3. change in Protected Area Network		3
TOTAL			16	20

Table-2 and **Fig-1** presents PC-EPI+BD scores and ranking of the states and UT's as of 2017 for the 6 categories separately, based on arithmetic mean of scores of all the indicators covered under each category and Ranking of the states, based on mean cumulative Scores. Data used are all the latest available in Government publications.

C. Environmental Performance + Gross Domestic Product (E+GSDP) Index

After deliberations with regard to possible integration of the cumulative EPI+BD scores with that of GSDP to evolve the Environment Performance + Gross Domestic Product index , it was resolved that scores be assigned to the % contribution of states to the National GDP and it be integrated with EPI+BD scores ,averaged to arrive at Environment + Gross Domestic Product Scores –E+GSDP for each states and states ranked. **Table -3** details the % contribution to GDP Scores, EPI+BD scores and E+GDP scores and Ranking.

Table-2:PC -EPI +BD Scores and Ranking (RK) 2016															
No	STATE / UTs	AIRPOL		WATER		FORESTS		WASTES		Climate Change		Bio-Diversity		EPI+BD -2016	
		Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank
1	A. Pradesh	0.9406	10	0.4554	30	0.5052	11	0.4227	23	0.2638	22	0.4642	3	0.5087	16
2	Aru. Pradesh	0.8107	24	0.3333	32	0.8733	5	0.2500	34	0.4879	6	0.3365	10	0.5153	14
3	Assam	0.9298	11	0.6536	18	0.3078	21	0.4604	17	0.3654	17	0.3175	13	0.5058	17
4	Bihar	0.8362	20	0.6074	25	0.1207	28	0.5381	11	0.0339	34	0.2519	21	0.3980	27
5	Chhattisgarh	0.8536	19	0.6656	16	0.7605	6	0.5149	13	0.2546	23	0.2502	22	0.5499	10
6	Goa	1.0000	3	0.9360	2	0.1754	26	0.6123	5	0.0637	30	0.3769	6	0.5274	12
7	Gujarat	0.8914	15	0.6969	7	0.2857	23	0.5490	10	0.5223	4	0.5117	1	0.5762	7
8	Haryana	0.7836	28	0.6524	19	0.0679	31	0.3818	25	0.1405	29	0.1461	36	0.3621	32
9	H. Pradesh	0.8939	14	0.9843	1	0.5111	10	0.3818	25	0.3196	19	0.3294	11	0.5700	9
10	J&K	0.5238	34	0.6758	10	1.2268	3	0.3149	30	0.2124	26	0.3171	14	0.5451	11
11	Jharkhand	0.7703	30	0.6667	11	0.3811	14	0.2618	33	0.0369	33	0.1879	29	0.3841	28
12	Karnataka	0.9524	8	0.6825	9	1.0632	4	0.6321	3	0.4826	8	0.3160	18	0.6881	3
13	Kerala	1.0000	3	0.6433	23	2.4842	2	0.4470	18	0.3717	15	0.2402	23	0.8644	2
14	M. Pradesh	0.8127	23	0.7014	6	0.6993	7	0.4226	24	0.4617	9	0.3247	12	0.5704	8
15	Maharashtra	0.8647	17	0.8946	3	0.6611	9	0.5644	9	0.4358	10	0.3162	17	0.6228	4
16	Manipur	0.9048	12	0.6667	12	0.3304	19	0.3500	28	0.3736	14	0.1609	32	0.4644	22
17	Meghalaya	0.8647	17	0.6544	17	0.2052	25	0.4249	22	0.4056	13	0.1657	30	0.4534	23
18	Mizoram	1.0000	3	0.6667	11	-0.1143	36	0.4742	16	0.6275	2	0.2008	27	0.4758	21
19	Nagaland	0.9608	7	0.6458	21	0.1714	27	0.2900	32	0.0373	32	0.1595	33	0.3775	29
20	Orissa	0.8992	13	0.6486	20	0.6704	8	0.4372	20	0.5786	3	0.2646	20	0.5831	6
21	Punjab	0.4403	35	0.5673	29	0.0489	33	0.4319	21	0.2401	24	0.1475	35	0.3127	36
22	Rajasthan	0.7857	26	0.5921	27	0.3462	17	0.3464	29	0.6532	1	0.3396	9	0.5105	15
23	Sikkim	0.8107	24	0.6933	8	0.4286	13	0.6675	2	0.4873	7	0.4708	2	0.5930	5
24	Tamil Nadu	0.9524	8	0.7431	5	4.3106	1	0.5942	7	0.1596	28	0.3165	16	1.1794	1
25	Telangana	0.5628	33	0.3253	35	0.0424	34	0.5270	12	0.1884	27	0.4642	3	0.3517	33
26	Tripura	0.8293	22	0.6667	11	0.3149	20	0.6021	6	0.3708	16	0.2156	25	0.4999	18
27	UP	0.7772	29	0.6456	22	0.4853	12	0.6872	1	0.3035	20	0.2238	24	0.5204	13
28	Uttarakand	0.7850	27	0.5948	26	0.3410	18	0.4788	15	0.4341	11	0.3170	15	0.4918	19
29	West Bengal	0.7425	31	0.5739	28	0.3004	22	0.3516	27	0.4904	5	0.2034	26	0.4437	25
30	A & Nicobar	0.4071	36	0.3333	32	0.3776	15	0.3075	31	0.2849	21	0.3544	7	0.3441	34
31	Chandigarh	0.8841	16	0.6132	24	0.3785	15	0.5931	8	0.0380	31	0.3903	5	0.4829	20
32	D & NH	1.1795	1	0.6667	11	0.1114	29	0.4418	19	0	35	0.1900	28	0.4316	26
33	D& Diu	1.2381	2	0.3100	36	0.0972	30	0.0225	36	0	35	0.3534	8	0.3369	35
34	Lak'dwp	0.8306	21	0.3333	32	0.2109	24	0.2039	35	0.3267	18	0.3070	19	0.3687	31
35	Delhi	0.6524	32	0.3571	31	0.0563	32	0.6320	4	0.4177	12	0.1476	34	0.3772	30
36	Pondi	1.0000	3	0.7500	4	0.0428	34	0.5066	14	0.2151	25	0.1619	31	0.4461	24

Fig-1: PC-EPI+BD scores and ranking of the states and UT's as of 2017

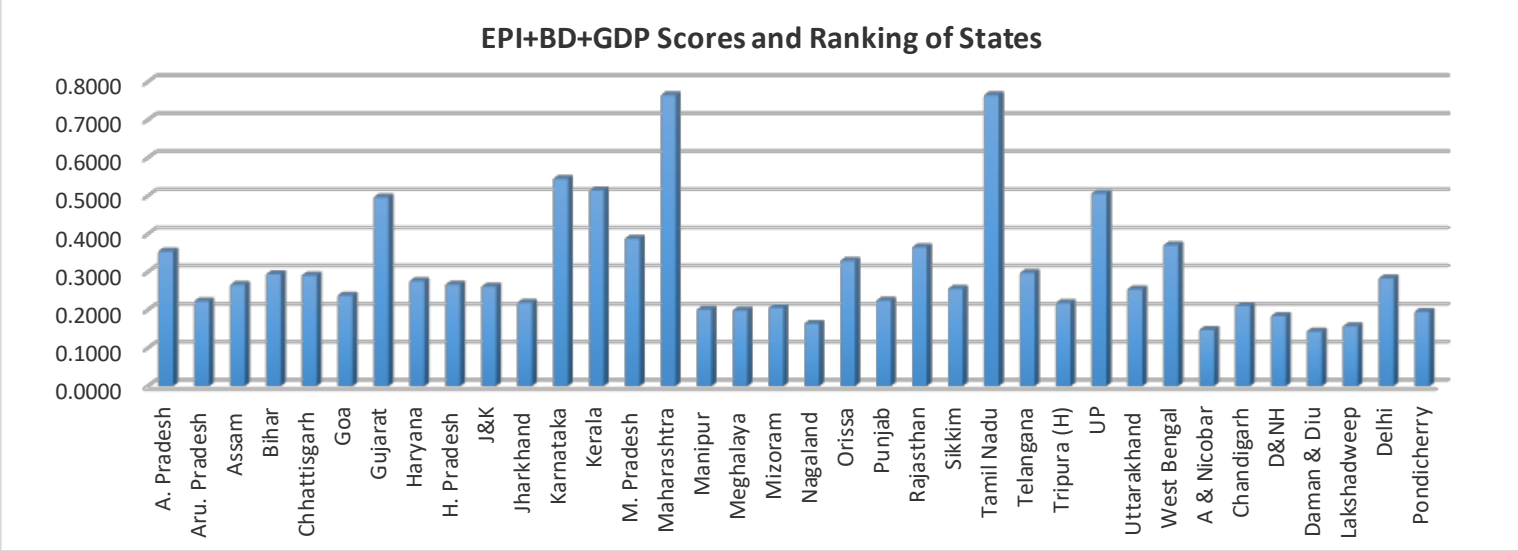


Fig-2 depicts **percent contribution of GSDP to GDP states wise , EPI+BD scores and E-GSDP scores** based on the PC-Environmental Performance Index (EPI) method, evolved in the earlier paper and updated with the inclusion of E-waste in the Waste Category and a new Criteria Biodiversity with 3 indicators and performance of the states in addressing environment issues thus adjudged. The E+GDP index now evolved integrates both environmental performance and developmental efforts of the states. Fig 3 presents the status state wise in 2012.

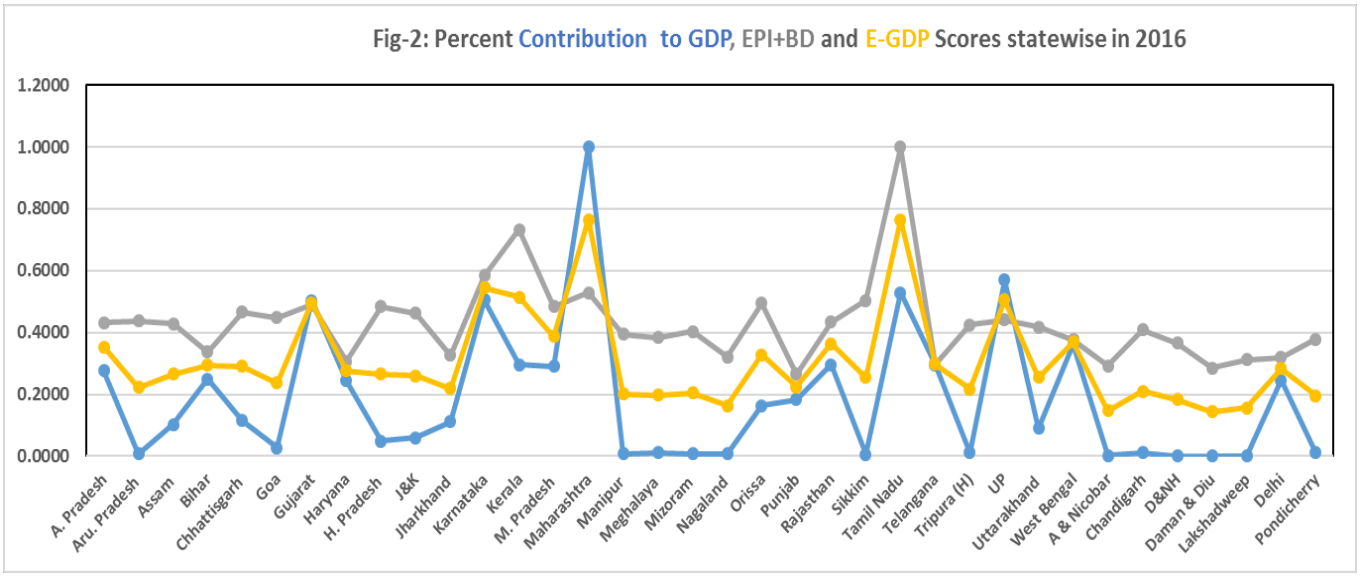
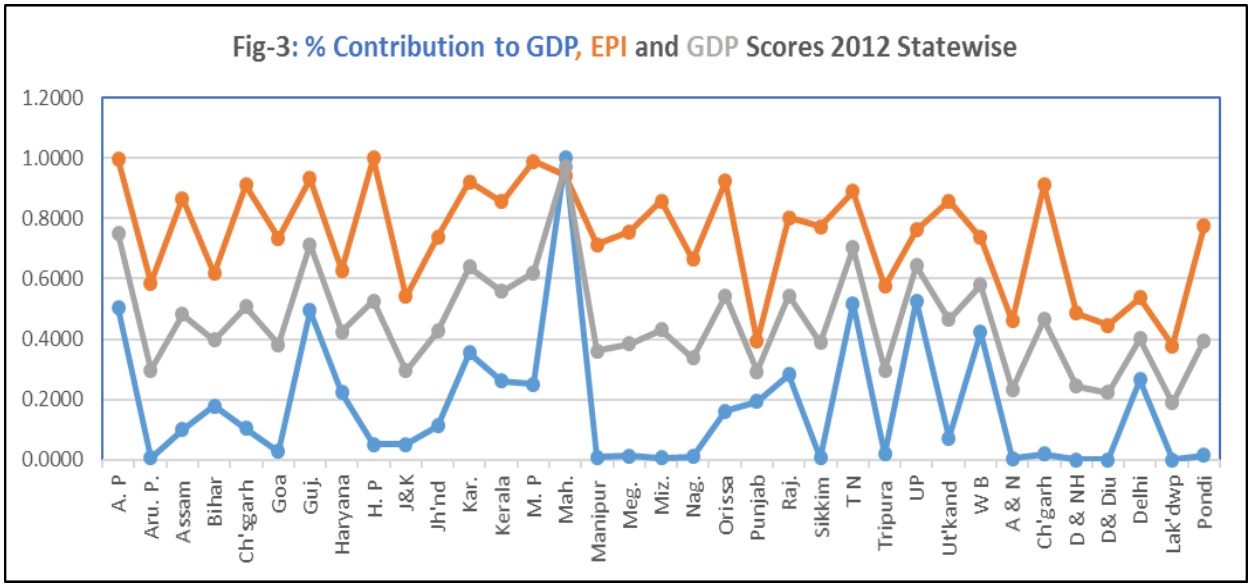


Table-3:-Percent contribution to GDP,EPI+BD , E+GSDP Scores and Ranking

S.No	States	GDP Cr.				. EPI+BD -2016			EPI+GSDP	
		GDP Cr.	% C-GDP	Score	Rank	Scores	Norm.Scr	Rank	**Score**	**Rank**
1	A. Pradesh	699000	4.14812	0.2757	11	0.5087	0.4313	16	**0.3535**	**10**
2	Aru. Pradesh	19492	0.115673	0.0077	28	0.5153	0.4369	14	**0.2223**	**24**
3	Assam	258000	1.531066	0.1018	19	0.5058	0.4288	17	**0.2653**	**18**
4	Bihar	632000	3.750517	0.2493	12	0.3980	0.3375	27	**0.2934**	**13**
5	Chhattisgarh	290000	1.720965	0.1144	17	0.5499	0.4662	10	**0.2903**	**14**
6	Goa	70400	0.417779	0.0278	23	0.5274	0.4472	12	**0.2375**	**22**
7	Gujarat	1275000	7.566312	0.5030	5	0.5762	0.4885	7	**0.4957**	**6**
8	Haryana	618000	3.667436	0.2438	14	0.3621	0.3070	32	**0.2754**	**16**
9	H. Pradesh	124000	0.735861	0.0489	22	0.5700	0.4833	9	**0.2661**	**17**
10	J&K	151000	0.896089	0.0596	21	0.5451	0.4622	11	**0.2609**	**19**
11	Jharkhand	282000	1.67349	0.1112	18	0.3841	0.3257	28	**0.2185**	**25**
12	Karnataka	1280000	7.595984	0.5049	4	0.6881	0.5835	3	**0.5442**	**3**
13	Kerala	748000	4.438903	0.2951	9	0.8644	0.7329	2	**0.5140**	**4**
14	M. Pradesh	736000	4.367691	0.2903	10	0.5704	0.4836	8	**0.3870**	**7**
15	Maharashtra	2535000	15.04361	1.0002	1	0.6228	0.5281	4	**0.7642**	**1**
16	Manipur	18042	0.107068	0.0071	29	0.4644	0.3938	22	**0.2004**	**29**
17	Meghalaya	29567	0.175461	0.0117	25	0.4534	0.3845	23	**0.1981**	**30**
18	Mizoram	17561	0.104213	0.0069	31	0.4758	0.4035	21	**0.2052**	**28**
19	Nagaland	17727	0.105198	0.0070	30	0.3775	0.3201	29	**0.1635**	**33**
20	Orissa	412000	2.444957	0.1625	16	0.5831	0.4944	6	**0.3285**	**11**
21	Punjab	465000	2.759479	0.1834	15	0.3127	0.2651	36	**0.2243**	**23**
22	Rajasthan	750000	4.450772	0.2959	7	0.5105	0.4329	15	**0.3644**	**9**
23	Sikkim	16637	0.09873	0.0066	32	0.5930	0.5028	5	**0.2547**	**20**
24	Tamil Nadu	1339000	7.946112	0.5282	3	1.1794	1.0000	1	**0.7641**	**2**
25	Telangana	750000	4.450772	0.2959	7	0.3517	0.2982	33	**0.2970**	**12**
26	Tripura (H)	29666	0.176049	0.0117	25	0.4999	0.4239	18	**0.2178**	**26**
27	UP	1446000	8.581089	0.5704	2	0.5204	0.4413	13	**0.5058**	**5**
28	Uttarakhand	230000	1.364903	0.0907	20	0.4918	0.4170	19	**0.2539**	**21**
29	West Bengal	920000	5.459614	0.3629	6	0.4437	0.3762	25	**0.3696**	**8**
30	A & Nicobar	6150	0.036496	0.0024	33	0.3441	0.2918	34	**0.1471**	**35**
31	Chandigarh	30304	0.179835	0.0120	24	0.4829	0.4094	20	**0.2107**	**27**
32	D&NH	2440	0.01448	0.0010	34	0.4316	0.3659	26	**0.1834**	**32**
33	Daman & Diu	1059	0.006284	0.0004	35	0.3369	0.2856	35	**0.1430**	**36**
34	Lakshadweep	407	0.002415	0.0002	36	0.3687	0.3127	31	**0.1564**	**34**
35	Delhi	622000	3.691174	0.2454	13	0.3772	0.3198	30	**0.2826**	**15**
36	Pondicherry	29557	0.175402	0.0117	25	0.446073	0.3782	24	**0.1949**	**31**



DEVOLVE FUNDS BASED ON E-GDP RANKING OF THE STAT Table-4 and Fig-4 indicates resource allocation of Rs 2000 Crores based on cumulative E-GDP Scores and ranking of the states in 2012 and 2016. An attempt has also been, made to evaluate the difference brought about by the EPI+BD, 2016 index on the E-GDP scores and allocation. As can be seen, inclusion of the biodiversity criteria , which helps conservation of bio-resources, enhances allocation to Tamil Nadu, Maharashtra, Karnataka, Kerala and Uttar Pradesh and States like Andhra Pradesh, Uttarakhand, Himachal Pradesh, Assam, Jharkhand and UT's such as Puducherry, Chandigarh, etc see a drop in allocation.

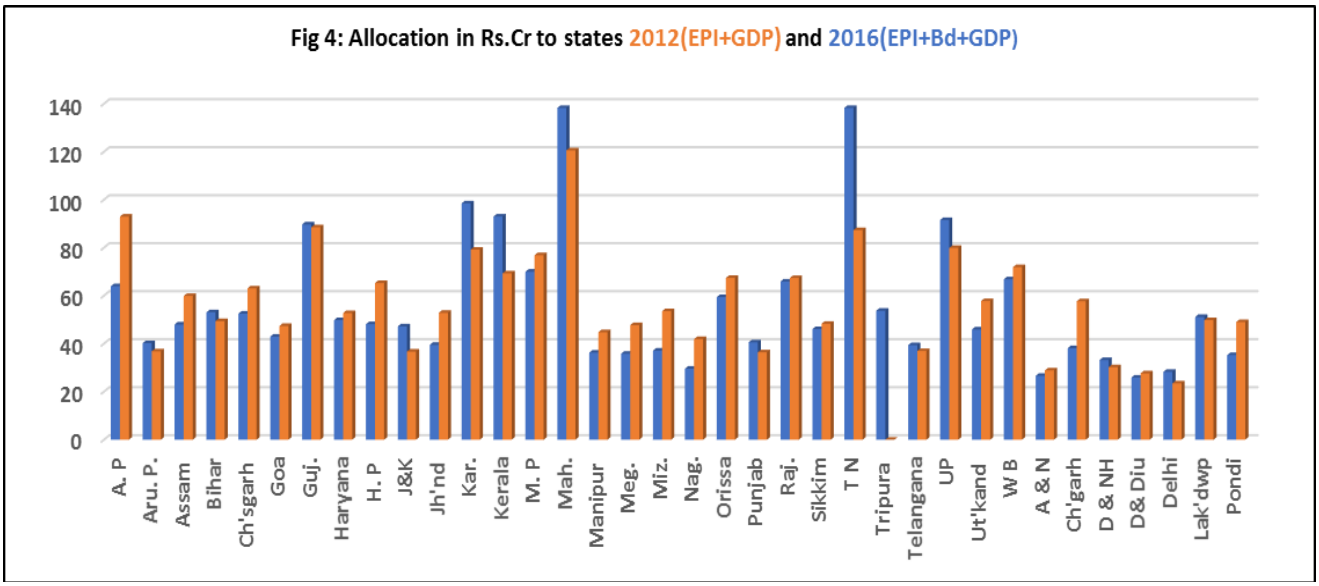


Table-4:- Resource allocation based on EPI+BD+ GSDP Scores 2016 and EPI+GDP Scores 2012 to States. Budget Rs 2000 crores.

S.No	States	EPI+GDP 2016		Rs 2000 Cr PY	EPI+GDP 2012		Rs 2000 Cr PY
		Score	Rank	Allocation	Score	Rank	Allocation
1	A. Pradesh	0.3535	**10**	**63.96**	0.7493	2	92.98
2	Aru. Pradesh	0.2223	**24**	**40.22**	0.2968	29	36.83
3	Assam	0.2653	**18**	**48.00**	0.4827	14	59.90
4	Bihar	0.2934	**13**	**53.09**	0.3982	21	49.41
5	Chhattisgarh	0.2903	**14**	**52.53**	0.5081	13	63.06
6	Goa	0.2375	**22**	**42.97**	0.3820	25	47.40
7	Gujarat	0.4957	**6**	**89.70**	0.7134	3	88.53
8	Haryana	0.2754	**16**	**49.83**	0.4253	19	52.78
9	H. Pradesh	0.2661	**17**	**48.15**	0.5260	12	65.28
10	J&K	0.2609	**19**	**47.20**	0.2960	30	36.73
11	Jharkhand	0.2185	**25**	**39.53**	0.4261	18	52.87
12	Karnataka	0.5442	**3**	**98.47**	0.6383	6	79.21
13	Kerala	0.5140	**4**	**93.00**	0.5586	9	69.32
14	M. Pradesh	0.3870	**7**	**70.02**	0.6196	7	76.89
15	Maharashtra	0.7642	**1**	**138.26**	0.9715	1	120.55
16	Manipur	0.2004	**29**	**36.27**	0.3610	26	44.80
17	Meghalaya	0.1981	**30**	**35.84**	0.3847	24	47.74
18	Mizoram	0.2052	**28**	**37.13**	0.4319	17	53.59
19	Nagaland	0.1635	**33**	**29.59**	0.3379	27	41.93
20	Orissa	0.3285	**11**	**59.43**	0.5432	10	67.41
21	Punjab	0.2243	**23**	**40.58**	0.2934	31	36.41
22	Rajasthan	0.3644	**9**	**65.93**	0.5430	11	67.38
23	Sikkim	0.2547	**20**	**46.08**	0.3894	23	48.32
24	Tamil Nadu	0.7641	**2**	**138.25**	0.7038	4	87.34
25	Telangana	0.2970	**12**	**53.74**			0.00
26	Tripura (H)	0.2178	**26**	**39.40**	0.2977	28	36.94
27	UP	0.5058	**5**	**91.53**	0.6440	5	79.91
28	Uttarakhand	0.2539	**21**	**45.93**	0.4655	15	57.76
29	West Bengal	0.3696	**8**	**66.87**	0.5796	8	71.93
30	A & Nicobar	0.1471	**35**	**26.62**	0.2329	33	28.90
31	Chandigarh	0.2107	**27**	**38.12**	0.4649	16	57.69
32	D&NH	0.1834	**32**	**33.19**	0.2435	32	30.22
33	Daman & Diu	0.1430	**36**	**25.88**	0.2229	34	27.66
34	Lakshadweep	0.1564	**34**	**28.30**	0.1892	20	23.48
35	Delhi	0.2826	**15**	**51.13**	0.4016	**35**	**49.84**
36	Pondicherry	0.1949	**31**	**35.27**	0.3951	**22**	**49.02**

Recommendation

The EPI+BD and EPI+BD+GDP index now evolved will not only enable better understanding and efforts made by the states in pollution abatement and biodiversity conservation but also gauge the relationship between GSDP and sustainable environmental development.

The EPI+BD index can also serve as a tool to monitor Sustainable Development Goals and facilitate annual reporting as data availability and analysis can be ensured as the indicators are backed by legislations which require annual reporting by the states.

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State/union territory	Air pollution		Water		Forests		Wastes management		Climate Change		Final Environmen Performance Index 2
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Andhra Pradesh	0.9406	11	0.7807	4	0.8270	6	0.8473	6	0.4523	10	0.7073
Aruna Pradesh	0.3333	33	0.3333	32	1.0000	1			0.4885	6	0.3377
Assam	0.9298	12	0.6536	19	0.4993	18	0.7643	12	0.3658	18	0.5053
Bihar	0.5028	32	0.6074	26	0.3248	31	0.7777	11	0.0343	33	0.3977
Chhattisgarh	0.8536	21	0.6656	17	0.5267	16	0.9373	1	0.2561	23	0.5871
Delhi	0.6524	30	0.3571	31	0.3615	29	0.3333	31	0.4187	13	0.4321
Goa	0.9608	7	0.9360	2	0.3223	32	0.7121	14	0.0645	29	0.6561
Gujarat	0.8914	17	0.6969	8	0.5346	15	0.8255	9	0.5234	4	0.5881
Haryana	0.7836	26	0.6524	20	0.4894	19	0.3997	30	0.1413	28	0.5586
Himachal Pradesh	0.8939	15	0.9843	1	0.6531	10	0.8550	5	0.3208	20	0.7309
J&K	0.8571	20	0.6758	11	0.5783	13	0.4161	28	0.2139	26	0.3516
Jharkhand	0.7703	28	0.6667	12	0.5549	14	0.7162	13	0.0374	32	0.5167
Karnataka	0.9524	9	0.6825	10	0.7654	9	0.5418	18	0.4836	8	0.6333
Kerala	1.0000	1	0.6433	24	0.4872	20	0.6528	16	0.3722	16	0.6600
Madhya Pradesh	0.8127	22	0.7014	7	0.8886	3	0.8014	8	0.4629	9	0.6387
Maharashtra	0.8647	18	0.8946	3	0.8444	4	0.5434	17	0.4365	11	0.6469
Manipur	0.9048	12	0.6667	12	0.4601	23			0.3740	15	0.6158
Meghalaya	0.8939	15	0.6544	18	0.4355	25	0.8718	4	0.4061	14	0.6629
Mizoram	1.0000	1	0.6667	12	0.5071	17	0.4220	27	0.6280	2	0.6822
Nagaland	0.9608	7	0.6458	22	0.3677	28	0.4679	23	0.0378	31	0.4938
Odisha	0.8992	14	0.6486	21	0.9949	2	0.4372	25	0.5794	3	0.6352
Punjab	0.7925	23	0.5673	29	0.2963	33	0.8328	7	0.2414	24	0.4309
Rajasthan	0.7857	24	0.5921	27	0.3968	27	0.5234	19	0.6543	1	0.5284
Sikkim	1.0000	1	0.6933	9	0.6230	11	0.9333	2	0.4892	7	0.5073
Tamil Nadu	0.9524	9	0.7431	6	0.6221	12	0.8297	10	0.1607	27	0.6627
Tripura	0.5881	31	0.6667	12	0.7851	8	0.4008	29	0.3713	17	0.3720
Uttar Pradesh	0.7772	27	0.6456	23	0.4652	22	0.5018	20	0.3043	21	0.4925
Uttarakand	0.7850	25	0.5948	28	0.8280	5	0.4283	26	0.4351	12	0.8086
West Bengal	0.7425	29	0.5739	30	0.4009	26	0.4567	24	0.4909	5	0.4859
Andaman and Nicobar	0.0000	0	0.3333	32	0.4409	24	0.4767	21	0.2853	22	0.3981
Chandigarh	0.8637	19	0.6132	25	0.8047	7	0.8951	3	0.0384	30	0.7168

Ref. Indrani Chandrasekharan, R.Sendhil Kumar, Seena Raghunathan and Shweta Chandrasekaran,Current Science , Vol., 104,no.4. 25th FEBRUARY 2013