

Indicators identification and indexing of the Indian costal States/UTs towards Blue Economy

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Abstract: For sustainable development of economy emphasis on Blue Economy is important for any country. India is having a long coastal border. It has huge potentials on Blue Economy. India has nine coastal states (West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, Gujarat) and four coastal union territory (Andaman Nikobar, Lakshadweep, Daman and Diu, Pondicherry). Considering the different resources (living, Non living, renewable resources, trade and commerce regulation and supporting services etc.) this study will index the coastal states and UTs basis on some indicators according to their commercial outcome from different blue economic resources. Indicators of the SDG Goal-14 also included within this study.

Keywords: Blue Economy, SDG, Marine Resources, Sustainability, Economy, Indicator, BE Index Score

1. INTRODUCTION

By 2030 the world population will exceed 8 billion and it will require 30% more water, 40% more energy and 50% more food [1]. The huge demand can be address by Blue Economy that is ocean based counterpart of Green Economy to improve the human well-being maintaining the environmental sustainability and economic growth [18]. The Organization for Economic Cooperation and Development (OECD) estimates the gross value added to global output from the oceans shall be ~ US\$ 3.5 trillion in 2030 and shall supporting more than 40 million jobs [1]. India with a coastline of 7517 kms and 1208 islands has 13 major ports, 200 notified minor and intermediate ports. The EEZ includes 1.64 million km² near the Indian mainland and Lakshadweep, and 0.66 million km² in the Andaman and Nicobar Island area. Considering its strategic interest, India is currently seeking to extend its EEZ to 563kms, by which the total EEZ area will equal its land area [1]. The Indian Ocean Reign is abundant with resources like fisheries, aquaculture, ocean energy, sea bed mining and minerals and has a tremendous economical opportunity in marine tourism and shipping activity. In the Indian Ocean fish production has increased drastically from 1950 to 2010 also in the report of The United Nation Food and Agriculture Organization (FAO) states that in Indian Ocean region potentiality of fish production will increase but in other world ocean its limit is decreasing. Indian has received the exclusive right for the exploration of two mineral resources of commercial interest Polymetallic nodules and Polymetallic massive sulphides since 1987. Strategic importance of The Indian Ocean will rise exponentially by 2025 as most of the counties oil and gas is imported through these region. The Blue economy can provide a model to rethink how to preserve, sustain and improve bio diverse ocean resources for future generation. India should tap the enormous potential of the Ocean based Blue Economy to propel the nation in higher growth trajectory following the SDG Goal-14 targets and then it can be a growth catalyst for India to achieve the vision of \$10 trillion economy by 2032 [3].

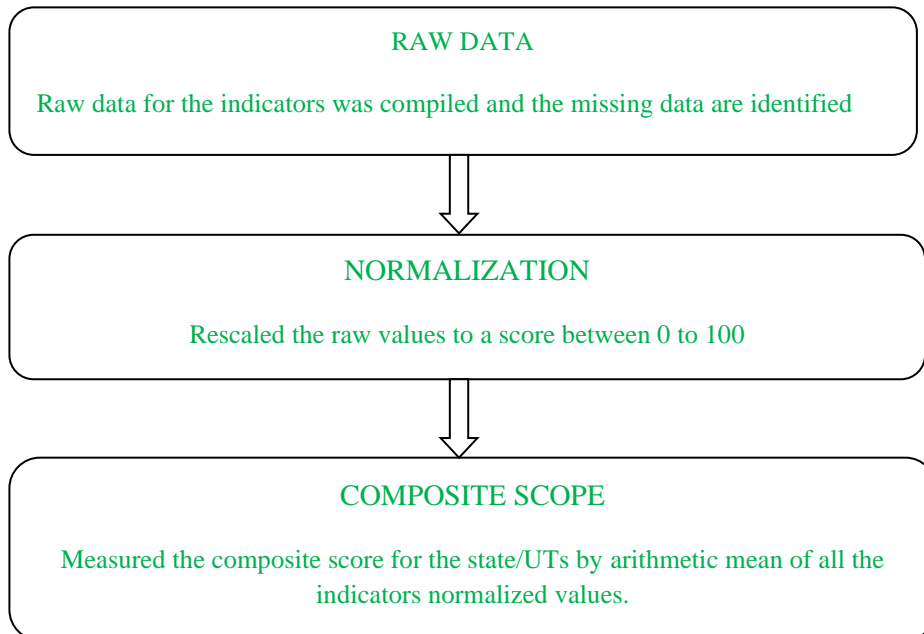
This paper aims to answer the following questions

1. What are the indicators for evaluating the economic values of different sectors related to Blue Economy?
2. What will be the methodology for indexing?
3. What are the potentials of Blue Economy for different Indian States including UTs?

2. MATERIALS AND METHOD

The study was carried out on basis of secondary data. Extensive Literature review was done to collect the secondary data. Relevant policy document and government reports were collected from different online resources. Indicators were designed following SMART concept. Also for each indicator the Meta data collection framework also designed.

2.1 Methodology of construction of Index



2.2 Resources of the Blue Economy and Identify Indicators

2.2.1 Indicators for Living resources

Living resource type	Indicators	Economical Prospect
Fisheries	1.1 Marin Fish Production (In lakhs Tones)	The sector contributes 1.1% of the national GDP and creates annual export earnings of about US\$ 5 billion. Out of total fish production of 6.4 million tons, marine contributes 3 million tons and production from about 73,000 km ² of inland water bodies is about 3.4 million tons [1].
Mangrove	1.2 Mangrove Cover area (in sq km)	Major economic return from mangrove are timber, fisheries, honey, wax and tourism [2].
Corals, Sea Grass, Seaweeds, Plankton	Amount of Seaweeds produced	Seaweed Mari culture could support a large scale bioenergy production [8].

2.2.2 Indicators for non living resources

Non Living resource type	Indicators	Economical Prospect
Oil & Gas	2.1 Estimated Hydrocarbon Resources – Crude Oil and Natural Gas(In Million Matric Tone of Oil and equivalent of gas-MMTOE)	The prognosticated conventional hydrocarbon resources in 26 sedimentary basins of the county are of the order of 41.87 billion tons (oil and oil equivalent of gas) [5].
Sea Salt	2.2 % of salt production in India	This sector creates million of employments [2].
Fresh Water	Capacities of the plants (m ³ /day)	NIOT has designed and implemented Low Temperature Thermal Desalination (LTTD) plants of 100 m ³ /day capacities that proved multiple socio-economic advantages including health of the island community [1].
Minerals	million tons of minerals	The polymetallic nodules comprise of manganese, nickel, copper, cobalt, molybdenum, rare earth metals, and traces of elements of commercial interest, including platinum and tellurium. The seafloor sulphides are rich in copper, gold, zinc, lead, barium, and

		silver. The cobalt-rich crusts contain manganese, iron and a wide array of trace metals including cobalt, copper, nickel, and platinum [1].
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2.2.3 Indicators for renewable resources

Renewable resources type	Indicators	Economical Prospect
Solar Energy, Tidal Energy, Solar Energy	Amount of Electricity generated	Renewable ocean energy, or 'blue energy' production including offshore wind and tidal energy [12,13].

2.2.4 Indicators for trade and commerce

Trade and commerce resources type	Indicators	Economical Prospect
Transport & Ports	4.1 Traffic handled (In million tons)	In India, during 2018, the major ports with a capacity of 1.45 BT handled 0.7 BT and non-major ports handled ~ 0.5 BT. The successful realization the Sagarmala program, involving an infrastructure mobilization of US\$ 60 billion, aspires to reduce the logistics costs for EXIM and domestic cargo by US\$ 6 billion annually, double the share of waterways, boost exports by US\$ 110 billion, create 4 million direct jobs, 6 million indirect jobs, and increase the commercial vessel fleet to 1600 by 2025 [1].
Tourism	4.2 No of domestic and foreign tourist visit	The most prominent marine ecotourism industries are recreational fishing, scuba diving and snorkeling, and viewing of sharks and marine mammals [9,10,11], though there are numerous other initiatives such as coastering, coastal hikes and kayak trips specifically advertising marine ecosystems.
Industries, Ship Yards, Ship Breaking	Revenue earned(in million USD) & Job opportunities (in million)	The shipbuilding sector holds promises as a future growth area for the national economy [2].
Aqua Culture	4.3 Percentage of available potential area developed under aquaculture	Global SDG target 14.7 aims to increase the economic benefits from the sustainable use of marine resources, including sustainable management of fisheries, aquaculture and tourism. Government of India also aims to achieve full utilization of the aquaculture potential in the country under Project Blue Revolution [3].

2.2.5 Indicators for Regulations and Supporting services

Regulations and Supporting resource type	Indicators	Economical Prospect
Coastal Protection, Carbon Storage, West Disposal	5.1 Average value of i) Mean shore zone coastal water quality -Biochemical Oxygen Demand (BOD) (mg/l). ii) Mean shore zone coastal water quality - Total Nitrogen (TN) ($\mu\text{mol/l}$) iii) Average marine acidity (pH) measured at representative sampling stations in the shore zone	For the three indicators measuring water quality (Biochemical Oxygen Demand, Total Nitrogen and pH levels), there is no definite quantitative global or national standard that can be set as target. The permissible limits are susceptible to seasonal and spatial fluctuations due to the different atmospheric and coastal processes. Moreover, in a coastal segment, water is used for various purposes and the range of acceptable water quality changes in accordance with the types of uses and activities [3].

2.3 Normalization of Raw indicator values: The following steps were used to arrive at normalized scores. The normalization of indicators values to a standard scale of 0-100 was required to ensure comparability as different indicators has different ranges of values. The following formula was used

$$X = \frac{x - \min(x)}{\max(x) - \min(x)} \times 100$$

Where, x=raw data value.

max(x)=maximum observed value of the indicators.

min(x)=minimum observed value of the indicators.

X=normalized score after scaling.

2.4 Computation of state/UTs scores: Computation of state/ UTs scores was estimated as the arithmetic mean of normalized values of all indicators. Equal weight was assigned to each indicator

$$I_i = \frac{1}{N} \sum_{j=1}^N I_{ij}$$

I_i=Score for state/UT i

N=No of indicators.

I_{ij}=Normalized value for state/UT i of indicator j

2.5 Metadata Collection

TABLE-1: Metadata Framework

Sl No	Indicators	Indicator data source	Computation Approach	Data Period(year)	Data Unit	States/UTs covered
1	1.1 Marin Fish Production (In lakhs Tonnes)	Ministry of fisheries, animal husbandry & dairying.	Directly from the data source.	2018-19	In lakhs tones.	13
2	1.2 Mangrove Cover area (in sq km)	Forest Survey of India,Dehradun. India state of forest report (2019).	Directly from the data sour	2019	Area in square km	12
3	2.1 Estimated Hydrocarbon Resources – Crude Oil and Natural -In Basin Category-I-Gas(In Million Matric Tonne of Oil and equivalent of gas-MMTOE)	Ministry of Petroleum and natural Gas.	Directly from the data source.	2019-20.	In Million (MMTOE)	3
4	2.2 % of salt production in India	Tamil Nadu Salt Corporation Site	Directly from the data source.	2011-12	% of production in India	9
5	4.1 Traffic handled (In million tonnes)	Ministry of Ports, shipping and waterways	Directly from the data source.	2020-21.	In million tonnes	9
6	4.2 No of domestic and foreign tourist visit	Ministry of tourism	Domestic+ Foreigner	2018	No of tourists	13
7	4.3 Percentage of available potential area developed under aquaculture	SDG India Index & Dashboard (2020-21)	Directly from the data source.	2020-21	In %	9
8	5.1 (BOD) (mg/l)+(TN) (μmol/l)+(pH)	SDG India Index & Dashboard (2020-21)	((BOD)+(TN) ₊ (pH)values)/3	2020-21	NA	9

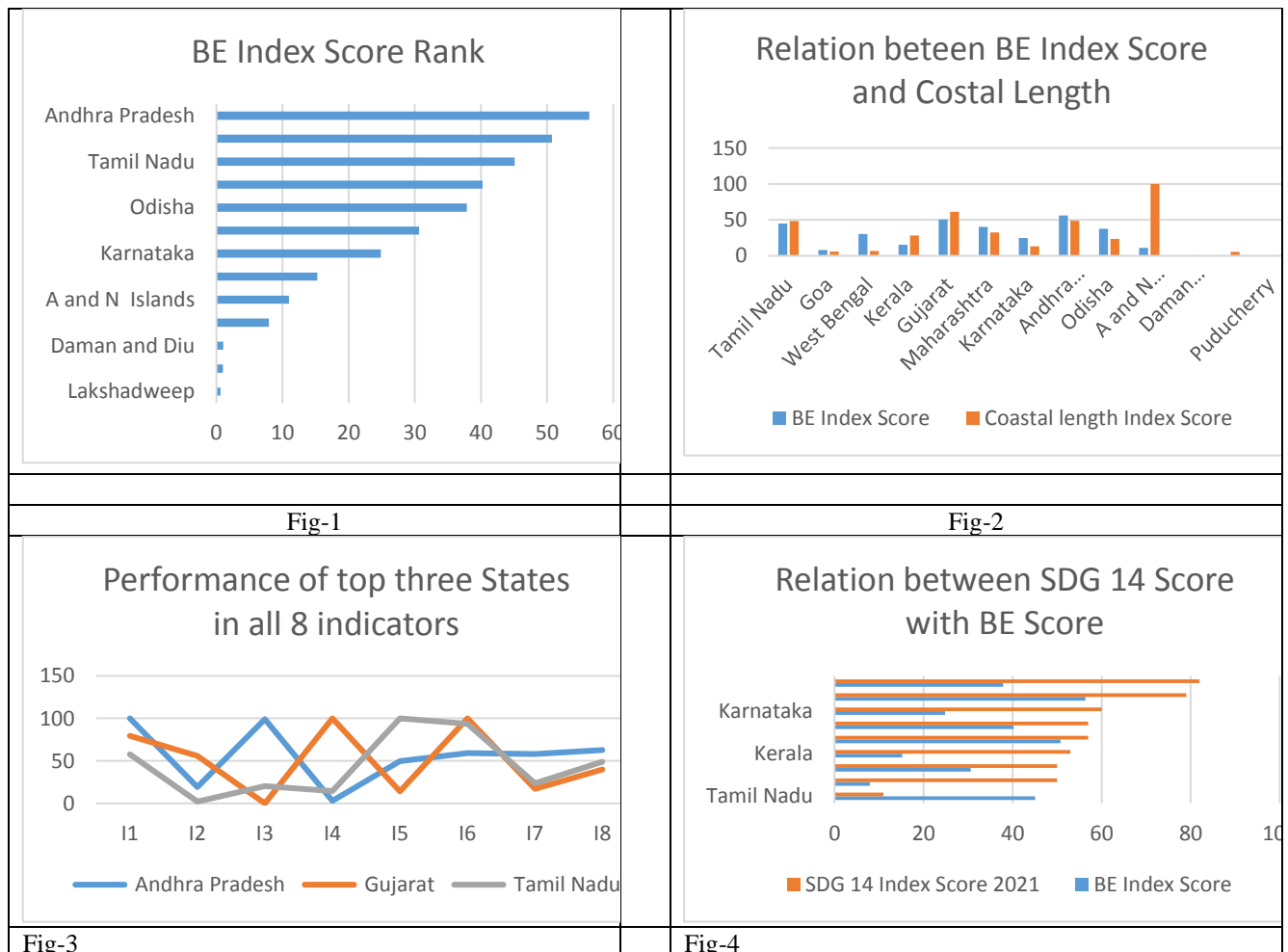
3. RESULTS AND DISCUSSION

The Index score for each State/UT was computed by aggregating their performance across the indicators, by taking the arithmetic mean of individual indicator normalized index score. The normalized indicator score ranges from 0 to 100 and denotes the overall achievement of the State/UT in the indicator. A score of 100 implies that the State/UT at the top scorer in that indicator and a score of 0 implies that the particular State/UT is at the bottom of the table.

- Andhra Pradesh retained its rank as the top State with a score of 56 (Table 2).
- Gujarat and Tamil Nadu took the second and third spot while Goa, Karnataka, A and N Islands, Daman and Diu, Lakshadweep and Pondicherry shared the bottom spot on the table (Fig 1).

Table 2 : PERFORMANCE OF STATES AND UTs ON INDICATORS FOR BLUE ECONOMY

S NO	States/UTs	1.1 Marin Fish Production (In lakhs Tonnes)	1.2 Mangrove Cover area (in sq km)	2.1 Estimated Hydrocarbon Resources – Crude Oil and Natural -In Basin Category-I- Gas(In Million Tonnes)	2.2 % of salt production in India	4.1 Traffic handled (In million tonnes)	4.2 No of domestic and foreign tourist visit	4.3 Percentage of available potential area developed under aquaculture	5.1 (BOD) (mg/l)+(pH)	1.1 Marin Fish Production (In lakhs Tonnes)	1.2 Mangrove Cover area (in sq km)	2.1 Estimated Hydrocarbon Resources – Crude Oil and Natural Gas(In Million Metric Tonne of Oil and Gas)	2.2 % of salt production in India	4.2 No of domestic and foreign tourist visit	4.1 Traffic handled (In million tonnes)	4.3 Percentage of available potential area developed under aquaculture	5.1 (BOD) (mg/l)+(pH)	BE Index Score
Raw Data																		
1	Andhra Pradesh	8.75	404.00	9554.5	2.28	72.72	195048957	37.1	16.45	100	19	99	3	50	59	58	63	56
2	Goa	1.15	26.00	Nil	<2.28	16.02	8015400	1.4	9.6	11	1	0	3	2	13	2	31	8
3	Gujarat	6.99	1,177.00	Nil	76.7	122.61	54882986	10.8	11.5	79	56	0	100	14	100	17	40	51
4	Karnataka	3.89	10.00	Nil	<2.28	39.14	214850172	13.4	12.5	43	0	0	3	55	32	21	44	25
5	Kerala	5.49	9.00	Nil	Nil	34.04	16701068	4.7	7.3	62	0	0	0	4	28	7	20	15
6	Maharashtra	4.67	320.00	9646	<2.28	60.7	124270053	10.6	14.47	52	15	100	3	32	50	17	54	40
7	Odisha	2.52	251.00	Nil	<2.28	112.69	15319358	41.7	24.5	27	12	0	3	4	92	65	100	38
8	Tamil Nadu	5.13	45.00	1964.4	11.16	114.58	391983721	15	13.5	58	2	20	15	100	93	23	49	45
9	West Bengal	1.82	2,112.00	Nil	<2.28	Nil	87274470	63.9	2.9	19	100	0	3	22	0	100	1	31
10	A and N Islands	0.41	616.00	Nil	Nil	63.98	513521	Nil	<2.9	2	29	0	0	1	52	2	1	11
11	Daman and Diu	0.24	3.00	Nil	<2.28	Nil	904518	Nil	<2.9	1	0	0	3	1	0	2	1	1
12	Lakshadweep	0.22	Nil	Nil	Nil	Nil	11748	Nil	<2.9	1	0	0	0	1	0	2	1	1
13	Puducherry	0.45	2.00	Nil	Nil	Nil	1757793	Nil	<2.9	3	1	0	0	1	0	2	1	1



Observing fig-2, we can conclude that Blue Economy (BE) is not directly depending on the Coastal Length of the state/ UT. It can vary also. But the states/ UTs those who have larger coastal line have potential to increase their Blue Economy (BE).

- Comparing with the SDG 14 score of 2021 with the computed indexed score, we have observed that though Tamil Nadu is having higher Blue Economy (BE) Index score, but according to the SDG 14 2021 Index, their sustainable development area is very poor (Fig-4).

5. CONCLUSION

Blue economy is considered as a holistic development based upon the optimum and efficient utilization of oceanic resources without compromising on the sustainability. India and the world as a whole should look to adapt the sustainable approach of balancing economic benefits derived from blue economy for meeting the broader goals of growth, employment generation, equity and protection of environment. An integrated approach with long term vision, technology, management, monitoring, and time-bound regulatory reforms are essential for building a sustained blue economy for India. There should be a proper ICT based Blue economy management system in India for capturing data ,storing ,analyzing and research purpose.

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