Health Card of
Paradeep Coastal Stretch
2020

ODISHA

SEA-ESTUARY HEALTH CARD OF PARADEEP COASTAL STRETCH 2020
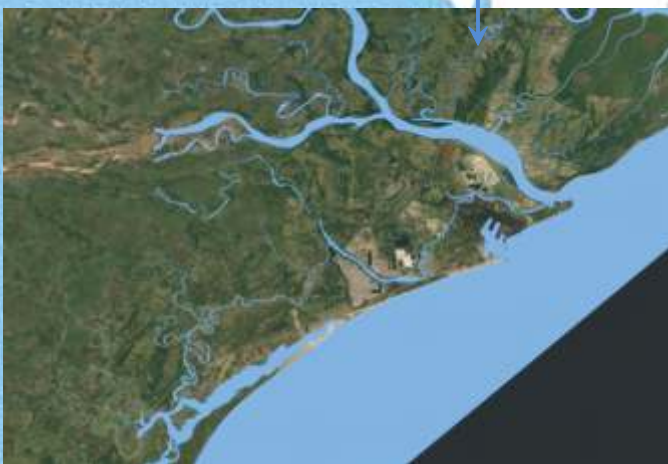
Changes in the world's climate are affecting its oceans and associated estuaries. There are likely to be major impacts in coming decades in the form sea level rise, extreme weather events, altered ocean currents, associated changes in productivity, high carbon dioxide levels of the oceans, changing patterns of biodiversity and productivity in near shore waters. It is of great concern that gradual increase of marine pollution is now a days deeply associated with the pollutants it receives through the polluted rivers, municipal sewage, agricultural & aqua-cultural runoff, expanding port activities, oil spills and other activities . Currently although there are limited signs of these changes, will develop further and have adverse consequences for our coastal communities, ecosystem and fishing. Planning to cope with these incremental impacts requires constant strategic monitoring and evaluations to gather a time series data. The comprehensive ecological health assessment is to examine the deviation of multiple ecosystem parameters including nutrient, primary productivity, biodiversity, and/or habitat. As the estuarine-sea ecosystem is a nonlinear system, of which the structure/services are interacting in a complex dynamic ways & when the components are damaged to different extents, consequent mismatching among them tends to result in dysfunction, even a sudden collapse of ecosystem observed (Chen et. al., 2013). Degradation of estuarine-sea ecosystem often occurs as syndromes of simultaneous declines in multiple structure and services. An appropriate evaluation of ecosystem's health both in structure and its services is a prerequisite to take appropriate steps to restore it (Carpenter et. al., 2006). A healthy ecosystem operates effectively with its biological, physical and chemical components within the limits of natural variability- the resilience to some level of stress (Rapport et al. 1998).

Assessing the estuary-sea ecosystem requires fixing of proper objectives such as selecting, monitoring and reporting the appropriate indicators, the measure components of the ecosystem that contribute to its overall health. Further, an overall measure on basic characteristics and impacts on bio-system (1st trophic level: phytoplankton) is highly required in the designated area, which plays a major role on the structural and functional aspect of the ecosystem.

This approach has been an effort to obtain a holistic diagnosis of ecosystem health on long term, which would help in getting firsthand information on Paradeep Coastal Stretch (estuary and sea) and to aware different stake holders including decision-makers.

Estuarine-sea ecosystem of paradeep - important for local livelihood and creek environment

Paradeep is one of the major Ports of India is located near the Confluence of river Mahanadi and Bay of Bengal on Paradip coast. Paradip port is situated 210 nautical miles south of Kolkata and 260 nautical miles north of Visakhapatnam with Latitude 20° 15' 55.44"N and Longitude 86° 40' 34.62"E. The fishing from Paradeep coastal area is usually done through mechanized trawler as well as in conventional boats by the local fishermen.

Paradeep town has been developed to a semi urban agglomeration due to the existence of major industries, which creates associated livelihoods and subsequent flushing of population near the coast. As this area is also rich in diversity with respects to mangroves, aquatic lives; tend to face tremendous pressure from associated anthropogenic activities.

Port

IOCL

PPL

Pressures on Estuarine-sea ecosystem of Paradeep

The major industrial clusters comprising of mainly Oil refinery (IOCL), Iron and steel (ESSAR), Port (PPT), Thermal Power (ESSAR), Fertilizer (IFFCO & PPL), Breweries (SKOL) etc. have influenced a lot and thereby in deviation of the said estuarine-sea ecosystem. The discharges from riverine system has been contributing the pollutants carrying from agricultural runoff, industrial flush outs, mine discharges, Municipal discharges, etc. from its catchment to this estuarine-sea ecosystem.

The Paradeep coast gets pressure constantly from both natural and anthropogenic sources. The system pressure and probable degradation that the coast experienced and the resultant cycles are depicted, which might be due to rampant fishing, sporadic aquaculture, pollution from industries, port activity including discharge & dredging, marine transport, associated barge discharges & accidents and drifting of sediments from riverine systems.

ESSAR

How the report card was prepared?

The protocol for the environmental monitoring, sampling and analysis of Paradeep - Dhamra coastal stretch of Odisha State Pollution Control Board, ICZMP, provides a standardized approach to evaluate estuary-sea ecosystem conditions/health by monitoring, analysis and reporting based on best practice. Environmental samples were collected, analyzed and subjected for interpretation for outcomes. Water Quality Standards were selected to evaluate the Water Quality Index (WQI) for each zone. The estuarine-sea ecosystem of Paradeep has been considered into four (04) zones viz., (1) Estuary (Atharabanki creek and River Mahanadi) (2) Mixing zone (confluence of river Mahanadi and sea) (3) Mixing zone Down Stream and (4) Mixing zone up stream.

Measures of Report card

pH, temperature, TSS & Turbidity :
Indicate water column characteristics and put both direct & indirect impact on nutrient cycle and indirect impact on primary productivity & influence in controlling the food chain and food web.

Dissolved Oxygen (DO) & BOD:
Indicate the impact on biological status or health of aquatic environment (Hypoxia/anoxia)

Nutrients (NO_2, NO_3, PO_4, Silicate):
Signify the status of presence of nutrient and its enrichment in the ecosystem & suggest the extent of control on biological growth and health of the marine eco system.

Pollutants (TOC, Fe, Mn, Cd, Pb, Hg):
Indicate potential biological response to marine matrix contamination (Toxicity)

Chlorophyll, FC:
Indicate the health status of the marine ecosystem for primary production and carbon cycle of the ecosystem

Why Monitored?

The report card was developed as an integral part of the mandate of the ICZM activity adopted by Odisha State Pollution Control Board, in order to enhance the understanding and management of coastal stretch of 80 KM from Paradeep to Dhamra in Bay of Bengal. As Paradeep estuarine-sea ecosystem is quite vulnerable due to various activities; it is important to determine the quality of water in terms of health of the designated ecosystem, so that natural-resource-managers may oversee the condition of this ecosystem and to target investment to improve ecosystem health. This reporting would also provide prominence to determine appropriate management actions, monitoring the effectiveness of management and contributing to the ongoing management of sea, estuaries and their catchments. The report card of estuarine-sea ecosystem of Paradeep for the year 2020 is prepared to understand and to improve the quality of health/conditions by addressing different issues arising out of this assessment. The result is subjected for comparison with the result of 2013-15 & 2015-17.

What is Ecosystem Report card?

Ecosystem health is determined by the response of the environment to natural and human inputs; may be defined as the degree to which the actual state of an ecosystem diverges from an ideal state as described in management objectives. A healthy estuarine and marine ecosystem is said to have the desired characteristics: key processes operating to maintain stable and sustainable ecosystems, zones of human impacts that do not expand or deteriorate and aquatic ecosystems (critical habitats) which remain intact. These characteristics are complex and really difficult to measure the attributes comprehensibly. While compiling this report card, few key water quality as well as biological indicators, which were determined during the monitoring period and analysis were considered and compared to acceptable levels and of national and international reference conditions.

Desired Conditions & Guide for Report card

Desired conditions (Threshold) are based on available guidelines, current scientific knowledge, and/or data and trends, taking into account the influence of a variable climate from year to year. The table below outlines the desired conditions developed or identified for each indicator and the source of this information.

Calculating the Report card grade for Estuarine-Sea Conditions at Paradeep

The report card for estuarine-sea ecosystem of Paradeep is developed by comparing with standards for different indicators (Temperature, pH, dissolved oxygen, BOD, TSS, Turbidity, TOC, Nitrate, Phosphate, Silica, Chlorophyll-a, Fecal coliform, Fe, Mn, Hg, Pb and Cd) and derived thresholds scientifically. These indicators are combined into an Overall Health Index, which is presented as percent score.

Category	Indicator	Desire Condition	Source of Data
Water Quality	Temperature	20^0C-30^0C	SPCB, ICZMP
	pH	6.5-8.5	CPCB
	Dissolved Oxygen	≥3 mg/l	CPCB
	BOD	≤ 3 mg/l	CPCB
	TSS	≤ 20 mg/l	ANZECC(2000)
	Turbidity	8 NTU	ANZECC(2000)
	TOC	≥ 0.3 mg/l	ANZECC(1992)
	Nitrate	≤ 1 mg/l	ANZECC(2000)
	Phosphate	≤ 0.1 mg/l	ANZECC(2000)
	Silicate	0.3-1.0 mg/l	ANZECC(2000)
	Fecal Coliform	≤ 100 nos./100 ml	CPCB
	Chlorophyll-a	≤ 3.4 µg/l	ANZECC(2000)
	Mercury	≤ 1 µg/l	CPCB
	Manganese	≤ 500 µg/l	CPCB
	Iron	≤ 500 µg/l	CPCB
	Lead	≤ 1 µg/l	CPCB
	Cadmium	≤ 10 µg/l	CPCB

How is it measured?

The overall water quality index is calculated by comparing the threshold of water quality standards to the average of the water quality indicators for the period (Temperature, pH, dissolved oxygen, BOD, TSS, Turbidity, TOC, Nitrate, Phosphate, Silica, Chlorophyll-a, Fecal coliform, Fe, Mn, Hg, Pb and Cd) specified for. Alternately the index is the computed average of the water quality indicators.

What do the grades mean?

A 80-100% All water quality indicators meet the desired levels of Standard. The water quality in those locations tends to be very good, most often leading to very good habitat condition for Marine lives

B 60-80% Most water quality indicators meet the desired levels of Standard. The water quality in those locations tends to be good, most often leading to good habitat condition for Marine lives

C 40-60% Blend of good and poor levels of water quality indicators. Quality of water in these locations tends to be fair, leading to fair habitat conditions for Marine lives
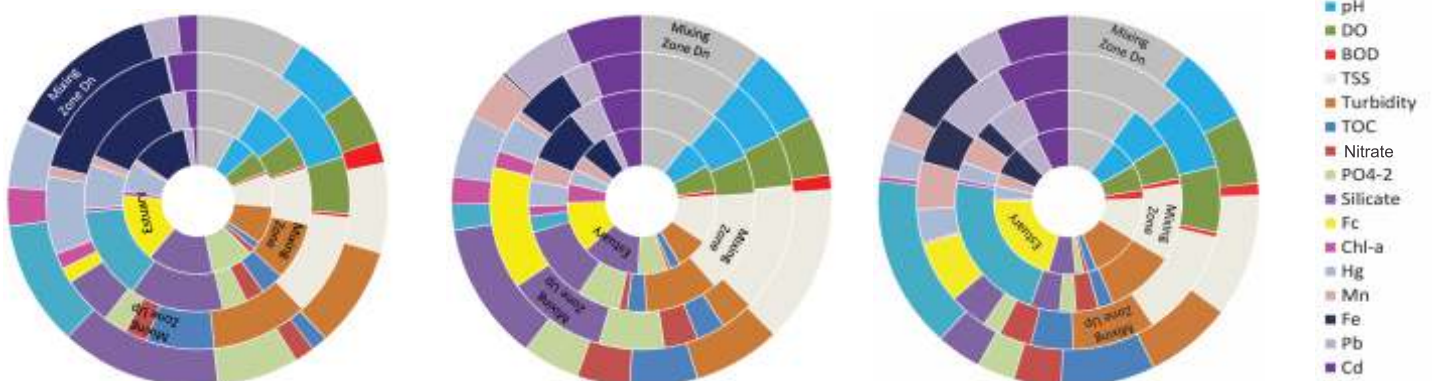
D 20-40% Few water quality indicators meet desired levels. Quality of water in these locations tends to be poor often leading to poor habitat conditions for Marine lives

F 0-20% Very few or no water quality indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to very poor habitat conditions for Marine lives

Contribution of different parameters in the Estuarine-Sea Conditions at Paradeep
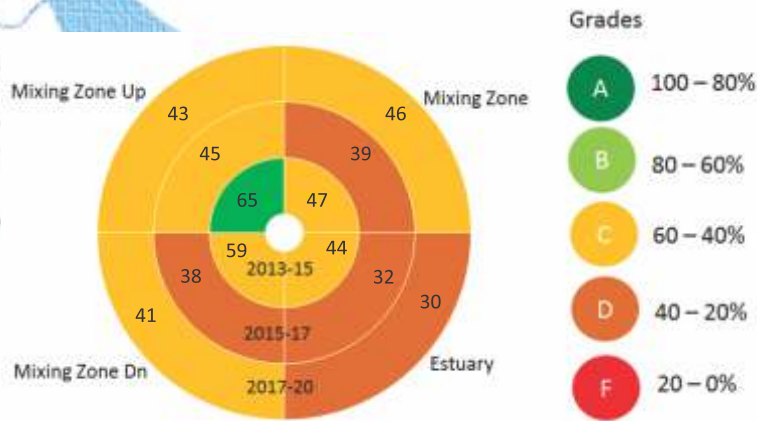
Contribution of parameters (2017-2020)   Contribution of parameters (2015-2017)   Contribution of parameters (2013-2015)


Legend: Temp, pH, DO, BOD, TSS, Turbidity, TOC, Nitrate, PO4-2, Silicate, Fc, Chl-a, Hg, Mn, Fe, Pb, Cd

OVERALL WATER QUALITY OF THE ESTUARINE-SEA CONDITIONS OF PARADEEP COASTAL STRETCH: COMPARISION (2013-15, 2015-17 & 2017-2020)

Estuarine-Sea Ecosystem condition of Paradeep

WATER QUALITY OF THE ESTUARINE-SEA CONDITIONS OF PARADEEP COASTAL STRETCH A COMPARISION (2013-15, 2015-17 & 2017-2020)

2013-15

2015-17
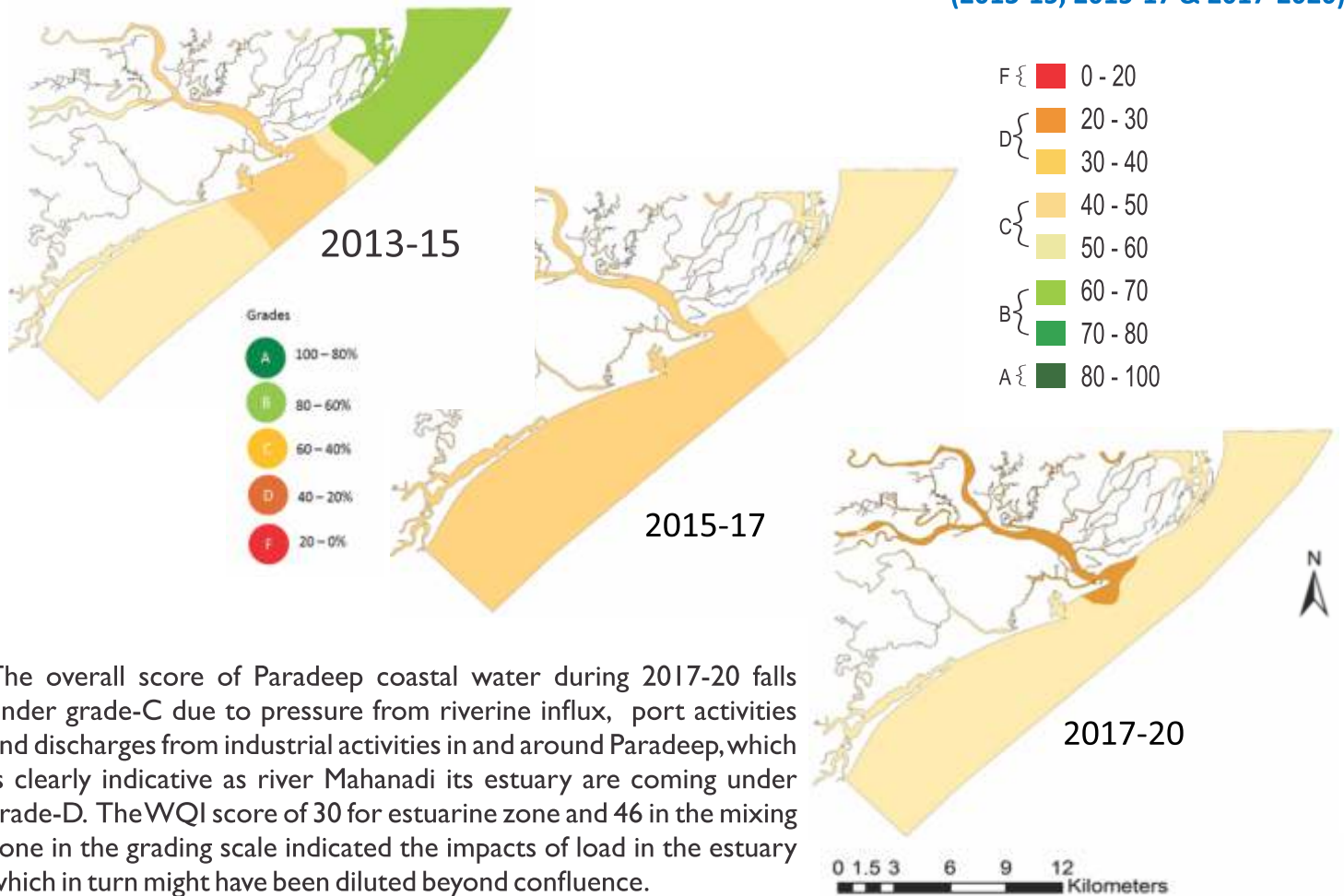
2017-20

The overall score of Paradeep coastal water during 2017-20 falls under grade-C due to pressure from riverine influx, port activities and discharges from industrial activities in and around Paradeep, which is clearly indicative as river Mahanadi its estuary are coming under grade-D. The WQI score of 30 for estuarine zone and 46 in the mixing zone in the grading scale indicated the impacts of load in the estuary which in turn might have been diluted beyond confluence.

During 2013-15 the WQI score for estuarine zone, mixing zone, Mixing zone Up and Mixing zone down were as 44, 47, 65 and 59 and that of 2017-20 was 32, 39, 45, and 38 respectively. It's clearly indicative that the water quality is gradually deteriorating. Especially the estuarine condition declined with respect to WQI from 44 in 2013-15 to 30 in 2017-20 (a decline of 32%). Similarly, the mixing zone condition though decline from 47 in 2013-15 to 39 in 2015-17, revived back to 46 in 2017-20. Like estuary, the mixing zone up is also showing a decline trend from 65 WQI to 43 in 2017-20 with a rate of 32% decline. The mixing zone down area which is influenced by Jatadhari River, activities of IOCL, is also declined from 59 WQI value to 38 in 2015-17 and to 41 in 2017-20. Storm water contributes a high load of sediment, nutrients and heavy metals to the Mahanadi River estuary. Port stock yard with piles of different ore, huge industrial waste deposits (Gypsum of IFFCO and PPL), discharges from boats in fishing jetty, agricultural runoff & other industrial discharges from Paradeep as well as from catchment area which is flowing with riverine systems may play a major role in deteriorating the quality of the estuary and also in the mixing zone (Grade-C or D), which require proper mitigation plan to restrict the inflows of pressures to upgrade the quality, ultimately the ecosystem.

The major contributory parameters for Paradeep are TSS, Turbidity, FC, Nitrate, Phosphate, Silicate, Mercury and Iron. They showed remarkable difference in respective phases (2013 to 2020). The TSS & Turbidity, though contribute its role in major fraction, remain more or less constant in the entire study period (2013-2020). In 2017-20, Iron and mercury remarkably dominated in their contribution may be due to port activity (stock yard leaching through rain). The increase influence of Nitrate and Phosphate in the Paradeep estuarine-sea ecosystem, across the time line, may be due to influence of nearby fertilizer plants.

Key management strategies required to be adopted:

1. **Develop scenarios to increase understanding** of how resilient or under stress at different locations and timelines to thresholds that may affect habitats and ecosystem services.
2. **Evaluate the ecosystem services** to support management planning and decision making involving different Stakeholders (*Water Resource, Wildlife, Fisheries, IMD, Coast Guard, PPT, Different Industries in the periphery of the assign stretch of the Paradeep such as IOCL, PPL, IFFCO, ESSAR etc.*) and to understand the complexities of the Paradeep estuarine-sea ecosystem.
3. **Conducting micro level Environmental Studies** collaborating with industries present in Paradeep such as *IOCL, PPL, IFFCO, ESSAR, PPT* to assess their direct and indirect impact on estuarine-sea ecosystem
4. **Detailed studies of estuary and sea** with collaboration of different institute to calculate other aspects like silt movement and nutrient dynamics to promote sustainable management practices.
5. **Sharing of knowledge** and formulating innovative strategies to restore the ecosystem through working in joint ventures with institutes / stakeholders for Paradeep estuarine-sea ecosystem..

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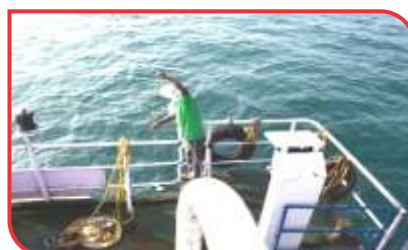
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