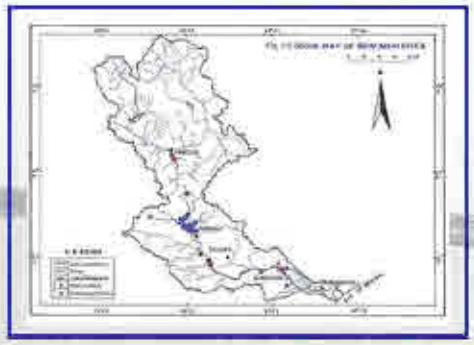
Report Card Of Dhamra Coastal Ecosystem -2015

Prepared by :
Integrated Coastal Zone Management Project
State Pollution Control Board, Odisha

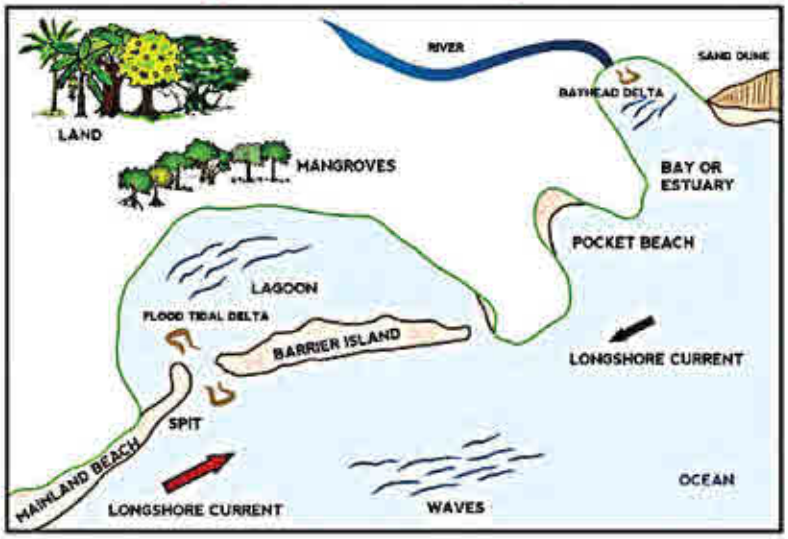
Tremendous population and developmental pressures have been building in the coastal areas for the last four decades. Coastal resources play a critical role in food security and livelihoods of the people living in the region, particularly for low-income groups. The unsystematic utilization of these resources directly impudence human health as well as economic viability. In fact coastal pollution becomes a truly human life-threatening issue. As most ecosystems is vulnerable to human exploitation in various ways; the studies on overall health of Dhamra coastal-sea ecosystem for some of the more critical coastal habitats may serve as sentinel of the ecosystem health. Further threats to the survival of all coastal ecosystems, are pollutions caused by human activities furtherance with climate change in varying intensity and effects. Pollution problems are significant from Industries, fishing, urban and agricultural activities, which culminate in coastal areas. The level of pollution can often be correlated to the degree of industrialization in a country (Tanabe, 2002). Similarly, the over-exploitation of coastal resources has been shown to correlate to the intensity of fishing and anthropogenic activities (Burke et al, 2000). The Dhamra coastal stretch is dynamic and influenced by two major river systems namely Brahmani and Baitarani with minor impacts from Mahanadi river.

The comprehensive ecological health assessment of Dhamra coastal stretch in this study is to examine the deviation of multiple ecosystem parameters including nutrient, primary productivity, biodiversity, and/or habitat. As the estuarine ecosystem is a nonlinear system, of which the structure/services are interacting in 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).In fact, understanding the complex relationship within an ecosystem along the landforms is highly essential.



Degradation of estuarine-sea ecosystem often occurs as syndromes of simultaneous declines in multiple structure and services, an appropriate evaluation in thedeviation of ecosystem's health both in structure and its services from the desired status is a prerequisite to take appropriate steps to restore it (Carpenter et. al., 2006). A healthy sea-estuarine ecosystem; where various components (biological, physical and chemical) are operating effectively to maintain a functioning system within the limits of natural variability. It should also be resilient to some level of stress (Rapport et al. 1998). Assessing estuary-sea ecosystem health (or condition) requires a framework for setting the objective of the assessment and by selecting, monitoring and reporting of appropriate indicators that measure components of an estuary-sea ecosystem that contribute to its overall health/conditions. Environmental monitoring in this area for obtaining concrete findings will make a direct contribution unraveling the complex nature of coastal pollution in this region and also identifying the emerging coastal environmental governance challenges for the future.

Typical Estuarine Ecosystem



IMPORTANCE OF DHAMRA MARINE ECOSYSTEM

The Dhamra port, along the mainland north of the Dhamra River mouth and west of Kanika Sands, is located about 13 km away from the nesting beaches of the Gahirmatha Marine Sanctuary in a straight line. It falls along the extremely important and fragile zone of Northern boundary of Bhitarkanika National Park. The Brahmani and Baitarani rivers meet and form the Dhamra River, which then flows into the Bay of Bengal, forming an estuary. The area is characterized by alluvial silt deposits due to regular tidal inundation and high detritus content. The soil consists of clayey loam with sand and a humus layer on top. The mangroves support land accretion, slow down erosion and absorb nitrates and phosphates preventing contamination of shore waters. The assign stretch is rich in biodiversity (More than 22 species of crabs including Horseshoe crabs: Tachypleusgigas and Carcinoscorpiusrotundicauda, White-bellied Mangrove snake Fordonialeucobalia, 14 species of amphibian species including Crab-eating Frog Fejervaryacancrivora, Dolphins: Sousa chinensis, Orcaella, brevirostris, Stenellaattenuata, Delphinusdelphis and Neophocaenaphocaenoides,etc.); a portion is also the hatching ground for Olive Ridley turtles particularly on Ekakulanasi rookery after its separation from the mainland Ekakula. Ekakulanasi end is also very unstable due to fluctuating and sudden changes in the cycle of erosional forces. The intensity of these forces is more facilitated by the geographical configuration of the area. Beyond Ekakulanasi, the coastline is completely semicircular. According to La Fond (1956), there are wide changes in the physical and chemical properties of water of Bay of Bengal and its circulation are the result of unique meteorological conditions associated with monsoon. Monsoon completely changes the direction of the current and often changes the beach morphology is the common feature in this area. Heavy siltation, riverine influx carrying pollutants from catchment areas makes this stretch more deceitful. On other hand the Dhamra port is a new and growing port, having definite impacts on the coastal ecosystem which may be upsurge in future.

PRESSURES AFFECTING ESTUARINE-SEA ECOSYSTEM OF DHAMRA

The Dhamra coast gets pressure constantly from discharges of Brahmani, Baitarani, Maipura, Dhamra rivers and of several rivulets of Brahmani. They caries the agricultural and urban runoff in to the sea, may affecting the ecosystem of the coast. The system pressure and probable degradation that the coast experienced and the associated resultant cycles might be due to rampant fishing, pollution from landward discharges, dredging activity of Dhamra port, marine transport, associated barge discharges &accidents and also might be from drifting of sediments from riverine systems.

Area	Pressure	Impacts
Agriculture	• Reclamation of coastal wetlands • Use of fertilizers and pesticides • Abstraction of water / large irrigation schemes	• Water quality impairment due to nutrients resulting in eutrophication • Loss of biodiversity • Reduction in fresh water flow
Aquaculture	• Conversion of mangroves, agricultural lands into aquaculture firms • Use of biocides, nutrients	• Loss of biodiversity • Water quality impairment due to nutrients resulting in eutrophication
Fisheries	• Coastal and deep-sea fisheries	• Reduction in catch due to over-exploitation of resources
Forestry	• Mangrove forest products harvesting • Large-scale upland deforestation	• Loss of biodiversity • Increased erosion during rains and higher sediment load in water
Industry	• Coastal industrial plants • Coastal and marine mining (e.g. sand) • Salt extraction • Industrial waste disposal	• Impaired water quality due to release of untreated / partially treated effluents containing metals and other chemicals
Tourism	• Coastal hotels and recreation facilities • Sewage and waste disposal	• Waste discharges and microbial pollution • Change in land use due to constructions, changes in drainage patterns • Loss of biodiversity due to land use changes
Transportation	• Waste discharge and microbial pollution • Change in land use due to constructions, changes in drainage patterns • Loss of biodiversity due to land use changes	• Water quality impairment due to disposal of dredging spoils • Increased water turbidity • Water quality impairment due to waste disposal • Shoreline changes, changes in land use pattern
Urbanization	• Shoreline modification • Waste disposal (e.g. landfills) • Water and sewerage development • Urbanization of coastal areas in natural or semi-natural state, upland watersheds • Groundwater abstraction	• Water quality impairment due to higher nutrient loads, suspended solids, organic loads • Impact on coastal ecosystems, e.g. coral reefs, see grass beds due to suspended solids, higher turbidity, reduced photosynthesis • Subsidizing cities due to soil compaction • Loss of biodiversity • Water quality impairment due to trace metals and microbial pollution • Health impact for coastal people due to arsenic and fluoride intake

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 Dhamra has been considered into four (04) zones viz., (1) Bay water (Maipurariver impact) (2) Mixing zone 1 (confluence of maipura) (3) Mixing zone 2 (River Dhamra) and (4) Sea up stream towards Dhamra port.

WHY MONITORED?

The report card was developed as an integral part of the mandate of the World Bank funded ICZM Project, 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 the Gahirmatha-sea ecosystem is a part of the designated study area, marine sanctuary, quite vulnerable due to various activities; it is important to determine the quality of water in terms of health, so that natural-resource-managers may oversee the condition of this ecosystem and to target investment to improve ecosystem health.Thisreporting would also provide prominence to determine appropriate managementactions, monitoring the effectiveness of management and contributing to the ongoingmanagement of sea, estuaries and their catchments. The report card of estuarine-sea ecosystem of Dhamra for the year 2015is prepared to understand and to improve the quality of health/conditions by addressing different issues arising out of this assessment.

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 period monitoring and analysis were considered and compared to acceptable levels and of national and international reference conditions.

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

NUTRIENTS (NO2, NO3, PO4, 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 responseto marine matrix contamination (Toxicity)

CHLOROPHYLL, TC/FC: Indicate the health status of the marine ecosystemfor primary production and carbon cycle of the ecosystem

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.

Category	Indicator	Desire Condition	Source of Data
Water Quality	Temperature	20°C-30°C	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

CALCULATING THE REPORT CARD GRADE FOR ESTUARINE-SEA CONDITIONS AT DHAMRA

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.

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

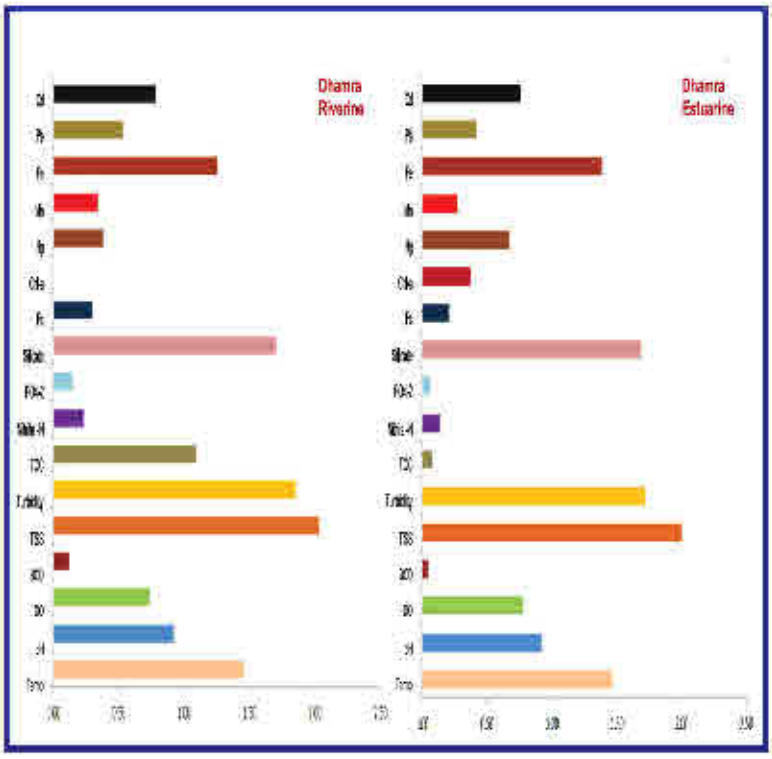
C 40-60% Blend of good and poor levels of water quality indicators. Quality of water in these locations tends to be fair, leading to fair habitat conditions for Marine lives

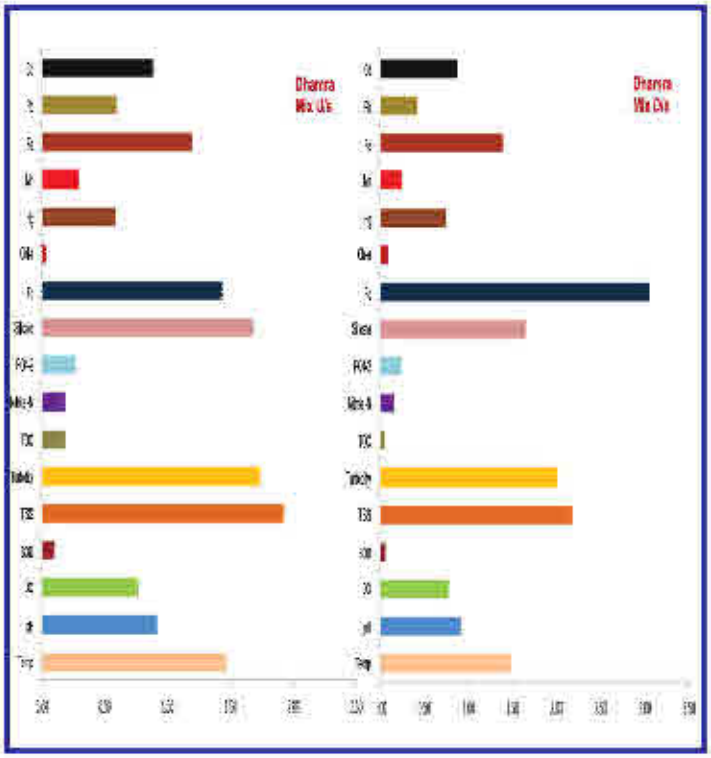
D 20-40% Few water quality indicators meet desired levels. Quality of water in these locations tends to be poor often leading to poor habitat conditions for Marine lives

E 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

Overview of Dhamra Coastal Stretch with Estuaries

DISTRIBUTION OF DIFFERENT PARAMETERS IN THE ESTUARINE-SEA CONDITIONS AT DHAMRA





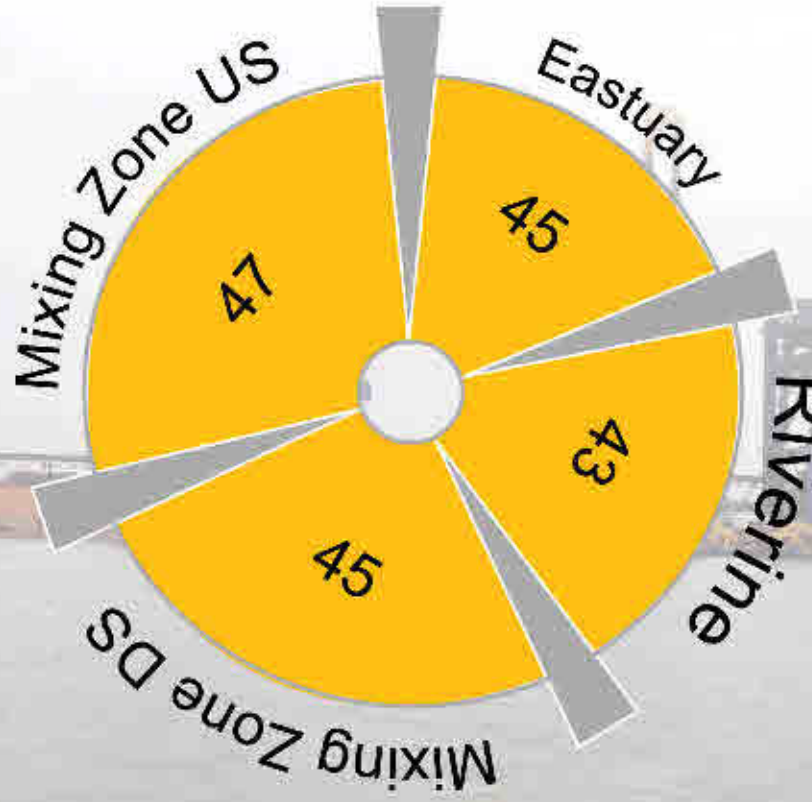
Temp pH DO BOD TSS Turbidity

TOC Nitrite-N PO4-2 Silicate Fc Chl-a

Hg Mn Fe Pb Cd

Scoring Legend (Grades)

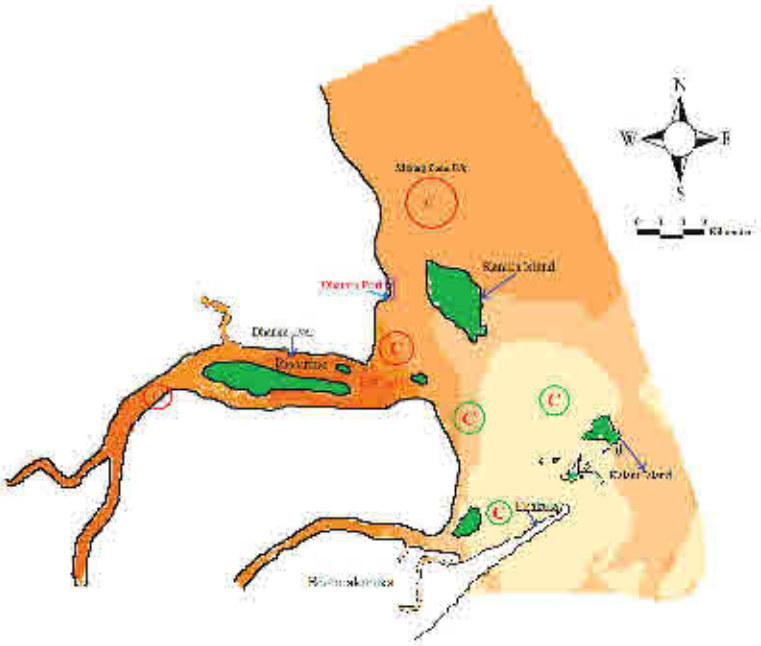
- A — 100-80%
- B — 80-60%
- C — 60-40%
- D — 40-20%
- E — 20-0%



OVERALL WATER QUALITY REPORT CARD OF THE ESTUARINE-SEA CONDITIONS AT DHAMRA COASTAL STRETCH

ESTUARINE-SEA ECOSYSTEM CONDITION OF DHAMRA

The score of Dhamra coastal stretch broadly falls into 'C' category. The influence of riverine impact is more in this stretch. The result also corroborates the same as the riverine; D/s and Estuarine stretch falls under more or less in same scale as43 % for riverine influence, 45% both for estuarine zone and D/s. The higher value of 47% in the mixing zone U/s,sign posted for additional impacts of port activities, nearer to the assigned part. Storm water contributes a high load of sediment, nutrients and heavy metals to the Dhamra coastal stretch. Discharges from boats, agricultural runoff & other discharges from catchment area which enters with riverine systems deteriorated the quality in the estuary and also in the mixing zones (Grade-C), which require different mitigation plan to restrict the inflows of pressures to upgrade the quality, ultimately to the ecosystem.



KEY MANAGEMENT RESPONSE STRATEGIES TO BE ADOPTED INCLUDING AS FOLLOWS

1. Establishing hierarchical and multi scalar inventory of hydrological, ecological, socioeconomic and institutional features and ecosystem services to support management planning and decision making including different Stakeholders (Water Resource, Wildlife, Fisheries, IMD, Coast Guard, etc.) to understand the complexities of the ecosystem.
2. Detailed studies with collaboration of different institute to calculate other aspects like silt movement and nutrient dynamicity of the estuary-sea ecosystem to promote sustainable management practices.
3. Help to promote sustainable livelihood by maintaining nutritional security to ensuring health of the coastal ecosystem and promoting institutional integration with other institutes such as Universities, IITs and other working groups/stakeholders in this field for sharing of knowledge and formulating innovative strategies to restore.

REFERENCE

ANZECC & ARMCANZ. (2000). Australian and New Zealand guidelines for fresh and marine water quality: Volume 1 - The guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New

ANZECC.(1992). Australian Water Quality Guidelines for Fresh and Marine Waters. Canberra: Australian and New Zealand Environment and Conservation Council (ANZECC).

Burke, T. A, Lit. J. S. Fox, M. A., (2000) Linking Public Health and the Health of the Chesapeake Bay, Environmental Research, Section A, 82,143-149.

Carpenter SR, De Fries R, Dietz T, Mooney HA, Polasky S, et al. (2006) Millennium ecosystem assessment: research needs. Science 314: 257–258.

Chen, X., Gao, H., Yao, X., Chen, Z., Fang, H., and Ye, S. (2013) Ecosystem Health Assessment in the Pearl River Estuary of China by Considering Ecosystem Coordination., Journal Plos One, Volume 8, Issue 7, e70547.

CPCB (2010) Primary Water Quality Criteria For Class Sw-1 to Sw-5 Waters, Pollution control Acts, Rules and notification issued thereunder (CPCB)

Hughes, C.R. and Brent, B. 1972.The marine turtles of Tongaland, 7. Lammergeyer, 17 : 40-62.

La Fond, E.C. (1956). In: Andhra Univ. Mem. in Oceanography, 1:117.

Rapport, D., Costanza, R. and McMichael,A. (1998) Assessing ecosystem health. Trends in Ecology & Evolution

PHOTOGRAPHS OF FIELD MONITORING AND SAMPLING OF DHAMRA COASTAL STRETCH IN 2015












ACKNOWLEDGEMENT

This report card was prepared with kind support of THE WORLD BANK

This report card is prepared by ICZMP, SPCB, Odisha for the monitoring, sampling, and analysis of water samples of Dhamra Coastal Stretch rendered in 2015. The author would like to thank all concerned (World Bank, MoEF, SICOM, NPMU & SPMU) for their support and guidance in accomplishing ' Centre for Management of Coastal Ecosystem' (CMCE) at Paradeep and Coastal Laboratory at Bhubaneswar, under capacity building of SPCB, Odisha. The author also thank to Chairman & Member Secretary of OSPCB for their active support. We also thank to Monitoring Protocol Preparation Committee in formulating and approving the protocol for monitoring, sampling and analysis of Environmental samples of the designated coastal stretch of Odisha. We also grateful to Prof. M.C.Dash, Ex-Chairman, SPCB, Odisha and renowned ecologist, who had been providing valuable guidance and Dr. AjitPattnaik, IFS, Project Director, ICZMP, SPMU, Odisha for his inspiration and encouragement.

STATE POLLUTION CONTROL BOARD, ODISHA
(Department of Forest & Environment, Govt. of Odisha)
A-118, Nilakantha Nagar
Unit-VIII, Bhubaneswar
Odisha, India - 751012

ICZMP, BHUBANESWAR:
Coastal Laboratory, ICZMP
State Pollution Control Board
4th Floor, Central Laboratory
Plot No: 59-B/2&3, Chandaka Industrial Estate
Po: KIIT, Bhubaneswar, Odisha, India-751024

ICZMP, PARADEEP :
Centre for Management of
Coastal Ecosystem (CMCE), ICZMP
State Pollution Control Board
Nua Sandhakuda, Near Panthanivas, Paradeep
Dist: Jagatsinghpur, Odisha, India-754142

CONTACTS FOR MORE INFORMATION:

Member Secretary, State Pollution Control Board, Bhubaneswar,
E-mail: membersecretary@ospcboard.org
Nodal Officer cum Project Coordinator, CZMP, State Pollution Control Board, Bhubaneswar,
E-mail: cpcb.am@gmail.com

An electronic copy of this report can be found in www.ospcboard.org