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Baseline

Water quality assessment using water quality index and geographical information system methods in the coastal waters of Andaman Sea, India

Dilip Kumar Jha [a,b,*], Marimuthu Prashanthi Devi [c], Rajendran Vidyalakshmi [c], Balan Brindha [c], Nambali Valsalan Vinithkumar [b], Ramalingam Kirubagaran [a]

[a] Ocean Science and Technology for Islands (OSTI), Earth System Science Organization (ESSO)—National Institute of Ocean Technology (ESSO—NIOT), Ministry of Earth Sciences, Govt. of India, Chennai, India
[b] Andaman and Nicobar Centre for Ocean Science and Technology (ANCOST), ESSO—NIOT, Ministry of Earth Sciences, Govt. of India, Port Blair, India
[c] Department of Environmental Management, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli, India

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ABSTRACT

Seawater samples at 54 stations in the year 2011–2012 from Chidiyatappu, Port Blair, Rangat and Aerial Bays of Andaman Sea, have been investigated in the present study. Datasets obtained have been converted into simple maps using coastal water quality index (CWQI) and Geographical Information System (GIS) based overlay mapping technique to demarcate healthy and polluted areas. Analysis of multiple parameters revealed poor water quality in Port Blair and Rangat Bays. The anthropogenic activities may be the likely cause for poor water quality. Whereas, good water quality was witnessed at Chidiyatappu Bay. Higher CWQI scores were perceived in the open sea. However, less exploitation of coastal resources owing to minimal anthropogenic activity indicated good water quality index at Chidiyatappu Bay. This study is an attempt to integrate CWQI and GIS based mapping technique to derive a reliable, simple and useful output for water quality monitoring in coastal environment.

The productivity and sustainability of coastal, marine and estuarine ecosystems largely depend on the coastal water quality. The coastal regions are believed to hold better biodiversity than open ocean regions (Gray, 1997). However, it has been altered over time due to the consequences of human activities (Vitousek et al., 1997). Eutrophication and harmful algal blooms are the major global issues affecting the coastal environment, often as a result of anthropogenically driven heavy nutrient loads (Anderson et al., 2002). Decline in water quality is mainly due to the increased concentration of various pollutants such as oils, heavy metals, nutrient and organic compounds (Shahidul and Tanaka, 2004) causing turbidity (Orpin et al., 2004) and a significant drop in dissolved oxygen levels (Sanchez et al., 2007).

Coastal water quality variables such as pH, dissolved oxygen, biochemical oxygen demand, total suspended solids, ammonia, nitrate, total phosphorous, chlorophyll-*a* and fecal coliform are the health indicators of coastal environment. Nevertheless, the large datasets created are often complex to understand. Thus, in an attempt to present the complex datasets in a more comprehensive approach, a single indicator of Coastal Water Quality Index (CWQI) was attempted. The CWQI is a dimensionless number that combines multiple water quality variables into a single number by normalizing values to subjective rating curves (Horton, 1965; Brown et al., 1970; Miller et al., 1986). Though, several researchers have worked for drinking water quality index (Horton, 1965; Pesce and Wunderlin, 2000; Liou et al., 2004; Nasiri et al., 2007), studies are limited for the CWQI, globally (Gupta et al., 2003; Kiddon et al., 2003; Jones et al., 2004; Carruthers and Wazniak, 2004). The CWQI takes complex scientific information of measured parameters and synthesizes into a single number (0 to 100 scale) based on the recommended level to derive significant information that are easily understandable by the coastal policy managers and administrator.

Coastal regions played a significant role in the history of human settlement as it provides natural resources as well as route for the trade. The human dependence on the bays and channels for livelihood has given rise to urbanization that led to decline of water quality. The concern on coastal water quality is being raised in the past two decades due to excessive settlements near the coastal areas and over exploitation. Though studies have been conducted to assess the water quality of Andaman coastal bays (Sahu et al., 2013; Jha et al., 2013, 2014, 2015; Renjith et al., 2015; Dheenan et al., 2014), this study proposes an innovative approach by combing CWQI and Geographical Information System (GIS) based overlay mapping technique in a comprehensive manner to visually demarcate the healthy and polluted areas for sustainable coastal resources management.

The objectives are 1) to derive a CWQI using recommended standards, 2) to prepare a thematic map to visually demarcate the impacted

* Corresponding author at: Ocean Science and Technology for Islands, Earth System Science Organization (ESSO)—National Institute of Ocean Technology (ESSO—NIOT), Ministry of Earth Sciences, Govt. of India, Chennai, India.
E-mail address: dilipjhaniot@gmail.com (D.K. Jha).

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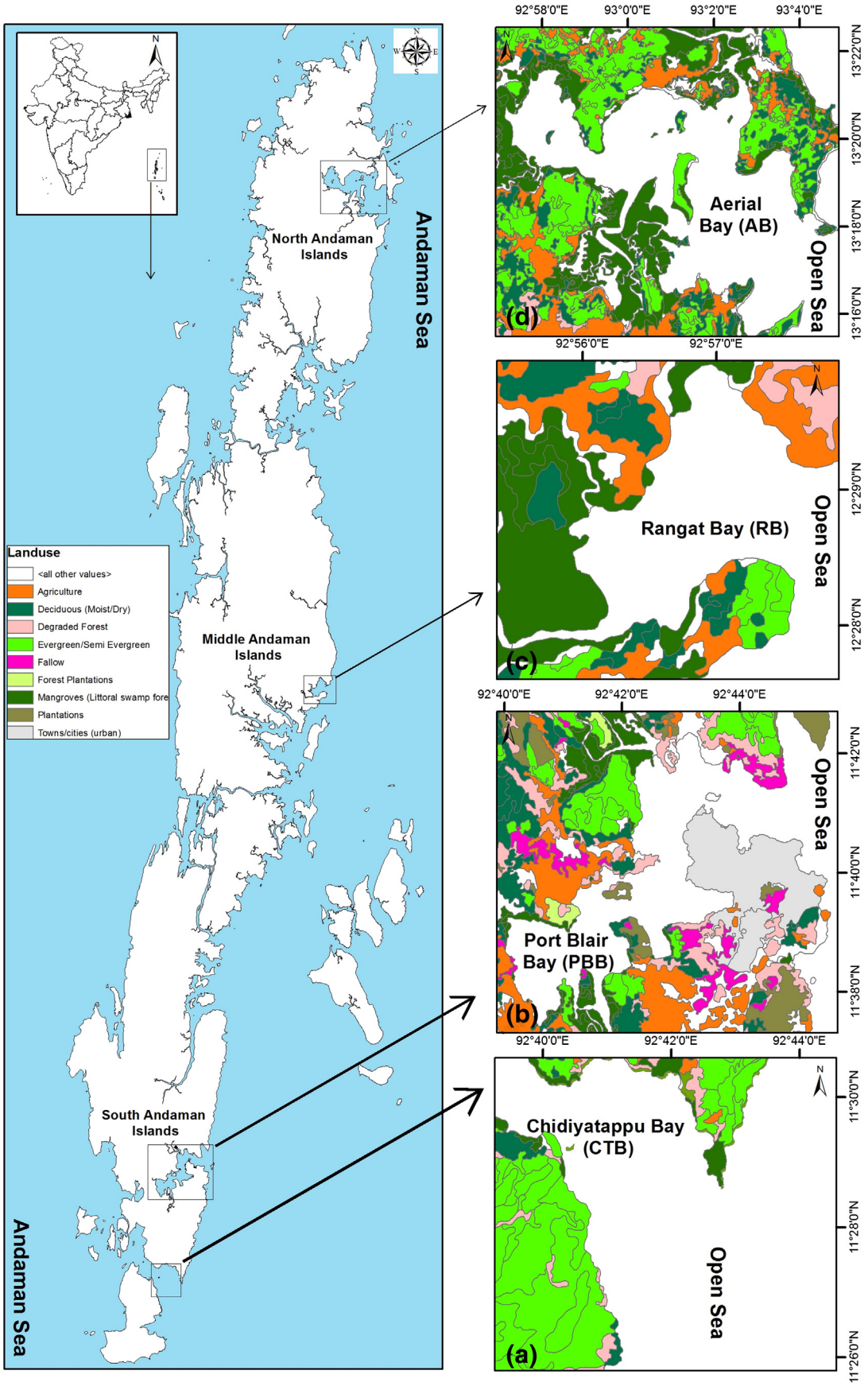

Fig. 1. Land use of selected coastal bays of Andaman (a) CTB, (b) PBB, (c) RB, and (d) AB.

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