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Narratives of Coastal Pollution in Andaman and Nicobar Islands, India: A Review

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***Abstract*:- Previously published research reports encompassing various topics viz., coastal water quality, heavy metals, and plastics from Andaman and Nicobar Islands (ANI's) were reviewed. It was understood for the review the coastal water quality around Port Blair is deteriorating owing to the presence of more than half of the island's population and the rest of the islands are pristine. Since the ANI's are devoid of major manufacturing industries the region is free from heavy metal pollution. However, Plastic pollution needs to be addressed through proper solid waste management techniques since, (ANI's) hosts the most diverse ecosystems like coral reefs, seagrasses, mangroves mudflats, etc. Also, constant monitoring of coastal waters around Port Blair is highly recommended.**

Keywords: Coastal water quality, Heavy metals, Plastics

INTRODUCTION

Since times immemorial humans' have been residing on the coastal frontier for the affluence of navigation and plentiful food and other economic services (Jickells, 1998; Coskun et al., 2008; Jha et al., 2015a). Presently 40% of the global population lives within 100 km of the coastal regime with an average global human density of population being 80 persons/km^2 (Zhenghua et al. 2010). All the co-creations are nature-wise except humans' who are otherwise. One such example of the otherwise attitude of humans' is the contamination of the coastal waters by anthropogenic activities and is a global agenda of concern (Beatley, 1991; Vitousek et al., 1997; Snelgrove, 1999; Sahu et al., 2013; Jha et al., 2015a). India is one of Asia's largest country houses a dense human population with heavy rainfall and tropical climate leading to the exoneration of pollutants, domestic wastes as compared with other regions of the world, has a harmful influence on the quality of the coastal waters (Shahidul and Tanaka, 2004; Dunn, et al., 2012; Gokul et al., 2018).

The Andaman and Nicobar Islands (ANI's) are known for their rich, unique biodiversity and endemism in the entire world (Anon. 2007, 2008; Hornby et al., 2015). However, coastal waters of ANI's are experiencing higher rates of pollution owing to anthropogenically influenced activities and surface land runoff intimidating the pristine marine flora and fauna (Dheenan et al., 2014; Renjith et al., 2015). Henceforth the present article aims at assessing the status of pollution in ANI's through the research outcomes of various investigators in the past.

STUDY AREA AT A GLANCE

ANI's is the maritime island territory of India in the Bay of Bengal sandwiched between peninsular India and Myanmar, spreading like a broken necklace trending in a north-south direction with a geographical extent of 8293 sqkm. Bounded by the coordinates (92° to 94° East and 6° to 14° North), it is an archipelago with > 500 islands/islets, stretching over 700 km. As per the Census of India 2011, there are 38 inhabited islands with a population of approximately 3,56,000. They are closer to the Indonesian landmass than to mainland India (1200 km), with the southernmost island (Great Nicobar) only 150 km from Sumatra and the northernmost landfall (Diglipur, North Andaman), 190 km south of West Myanmar (figure 1). These islands are forming two major groups, popularly known as Andaman Group or the Northern Group of Islands and Nicobar Group or the Southern Group of Islands. The capital town of all the groups which form the Union Territory is Port Blair. Out of > 500 islands, only 38 of them are inhabited.

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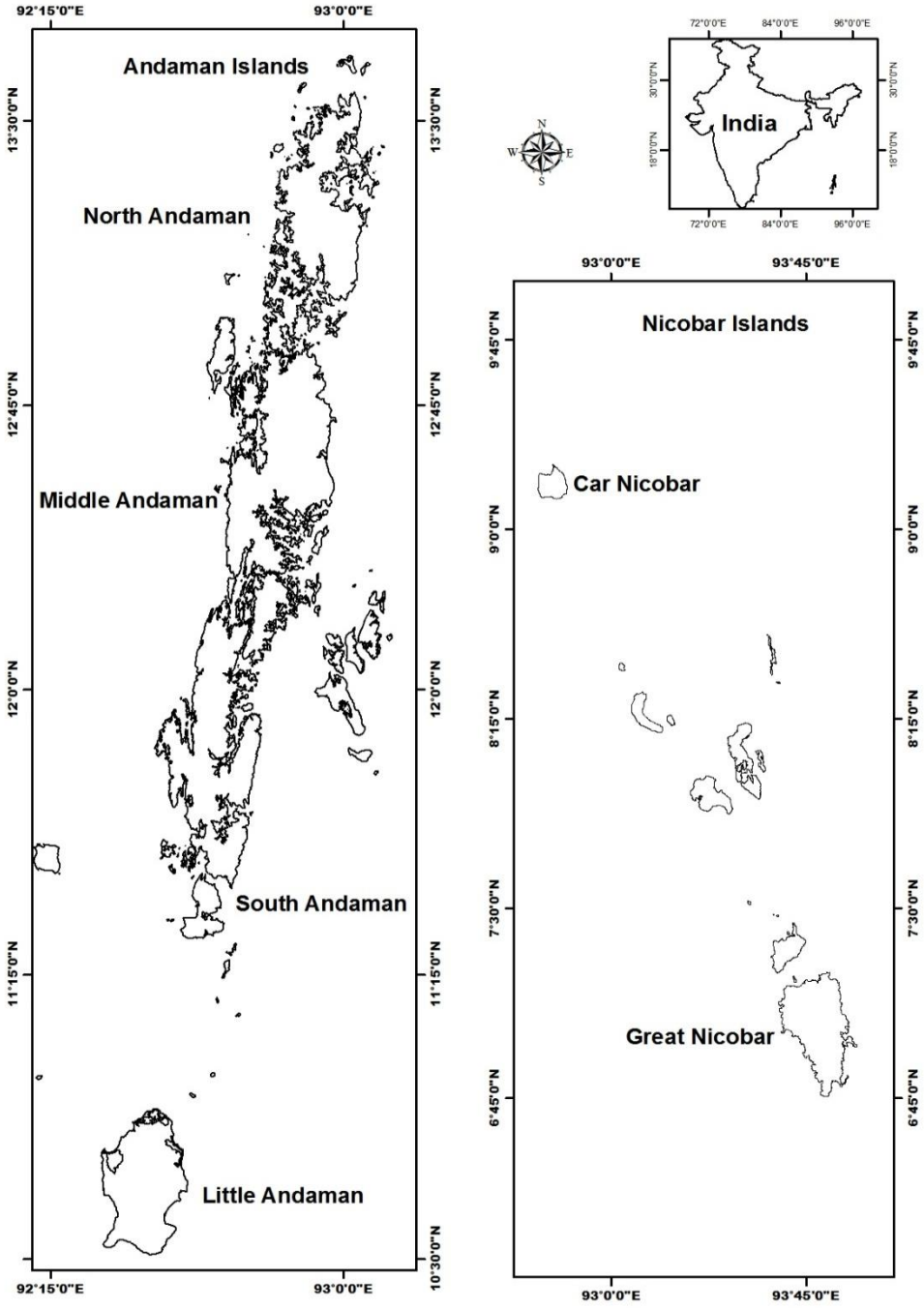

Figure 1: Map showing study area

METHODOLOGY

The objective of the present study was comprehended through the retrospection of previous publications by various researchers in the study area on coastal marine pollution.

COASTAL WATER QUALITY

Parameters of physical, organic, inorganic, heavy metals, and biological parameters of the coastal waters of Phoenix Bay, Haddo, Chatham were quantified by Mahajan et al. (1996). According to them, the heavy metals concentration and physico-chemical parameters in their study area were within the Indian standard permissible limits. High values of chloride, total hardness, and conductivity were recorded. High oil and grease concentration were due to the routine maintenance of the inter-island, mainland boat, and ships services. The coliform count is also high in the coastal waters of the study area owing to the anthropogenic influence (Fecal contaminants). Eashwar et al., (2001) reported on the moderate to intense blooming of a dinoflagellate called *Noctiluca scintillans* around Port Blair during northeast monsoon (June and July) of 2000. They opined that the bloom was not always concurrent with the nutrient influx of monsoon in Port Blair Bay. The results of Nallathambi et al.,

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(2002) on the heterotrophic bacterial around six stations viz., Aberdeen Bay, Phoenix Bay, Haddo, Junglighat Bay, and Minne Bay suggests that Aberdeen Bay has the highest count of diseases causing fecal contaminants like *Vibrio Cholerae*, *Vibrio parahaemolyticus* (causes cholera), *Escherichia coli* (dysentery). They also opined that the region with rolling topography escorts the anthropogenic contaminants to the coastal waters as runoff during meteorological events.

Spatial variation of hydrochemical and physicochemical characteristics was studied by Muduli et al., (2011) around six stations of Port Blair Bay viz., Flat Bay, Minnie Bay, Junglighat Bay, Haddo, Aberdeen Bay, Phoenix Bay. They concluded that high values of nutrients in the coastal waters resulted in enhanced primary productivity. Also, they noted that off the six chosen stations Junglighat and Minne Bay is polluted by anthropogenic activities and emphasized to safeguard the interest of the local fisherfolk community in and around Port Blair waters. Arun Kumar et al., (2012) reported on the high intense bloom of nitrogen-fixing cyanobacterium *Trichodesmium erythraeumin* at Burmanallah during summer (march 2012). They opined that an increase in the sea surface temperature and salinity in presence of excesses of nutrients are the causative factors for the bloom. Karthik et al., (2012) reported on the same red tide species as Arun Kumar et al., (2012) from the same station from September 2011 to March 2012. The results of Karthik et al., (2012) were concordant with the results of Arun Kumar et al., (2012). A preliminary assessment of physicochemical and biological parameters of coastal water of Treis Island, Nicobar was conducted by Begum et al., (2012) and concluded that the coastal waters of the island were free from anthropogenic sources of pollution.

Sachithanandam et al., (2013) for the first time reported on the harmful algal bloom (*phaeocystis spp*) from the coastal water of Diglipur, North Andaman in June 2011. They opined anthropogenic activities coupled with monsoon has triggered the bloom. Jha et al., (2013) compared the coastal water quality of Aerial Bay & Rangat Bay using spatial modeling techniques. They concluded that Aerial Bay is polluted very much by anthropogenic activities when compared to Rangat Bay. Sahu et al., (2013) evaluated the significance of source influencing the variation in pollutants of Flat Bay, Minnie Bay, Junglighat Bay, Haddo, Aberdeen Bay, Phoenix Bay, and Aberdeen Bay in an interval of three months for two years. They concluded that sewage outfall and land runoff are key factors for the pollution in their chosen study stations. Also, they reported that off the 7 stations Junglighat Bay and Phoenix Bay are most contaminated.

Dinoflagellate bloom (*Protoperidinium divergens*) was reported by Karthik and Padmavati, (2014) in Junglighat Bay. They concluded that anthropogenic activities increased eutrophication in Junglighat Bay and led to nutrient enrichment in the water column, although precipitation could also have favored the outbreak of these dinoflagellates. Karthik et al., (2014a) reported on the occurrence of dinoflagellate bloom of *ceratium furca* in the coastal waters of Chouldari. They opined Intense fertilization of the farms coupled with ineffective management strategies had a direct link to the increase in nutrients found in Chouldari and may have been the trigger for the initialization of these blooms. Karthik et al., (2014b) reported that increased concentration of silicates and nitrates are the causative factors for the periodic algal blooms in Junglighat bay. Sahu et al., (2014) opined that the dominance of *Trichodesmium* in the coastal waters of Flat Bay, Minnie Bay, Junglighat Bay, Haddo, Aberdeen Bay, Phoenix Bay, and Aberdeen Bay was due to the presence of loads of contaminants of anthropogenic origin. Jha et al., (2014) studied the seasonal variation of pollutants in the coastal waters of Aerial Bay, North Andaman. They concluded that Aerial Bay was most contaminated during monsoon followed by post-monsoon. Dheenan et al., (2014) reported that land runoff and sewage discharge resulting in the contamination of coastal waters of Rangat.

Begum et al., (2015) concluded in their research that the persistence of nuisance algal blooms in Junglighat bay and Haddo are due to anthropogenic activities. Renjith et al., (2015) reported that the deterioration of coastal water quality of Phoenix Bay was due to anthropogenic influences such as boat traffic, tourism, and urban settlements. Jha et al., (2015a) after analyzing the water quality of Chidiyatappu Bay concluded that the region is undisturbed. Jha et al., (2015b) compared the status of pollution in various sites viz., Aerial Bay, Rangat Bay, Port Blair Bay, Chidiyatappu Bay concluded that Port Blair Bay is highly polluted and Chidiyatappu Bay as pristine. Franklin et al., (2018) constantly monitored the status of pollution in six stations viz., Flat Bay, Minnie Bay, Junglighat Bay, Haddo, Aberdeen Bay, and Phoenix Bay for a period of five years (2011-2015) and concluded that Phoenix Bay was most polluted followed by Junglighat Bay.

HEAVY METALS

Sujata and Analia (1981) studied the occurrence of trace metal(loid)s in the waters of the Andaman Sea. They concluded that the long-term distribution of trace metal(loid)s dissipated with depths. Trace metal concentration viz., Cd, Pb, and Hg in the tissue samples of fishes from Andaman waters were studied by Kureishy et al. (1981, 1983) and found that the analyzed trace metal(loid)s were high in the liver. On the contrary, the concentration was less in the edible part of the fish (muscles). Nobi et al. (2010) investigated trace metal(loid)s in 16 locations of various ecosystems viz., mangroves, seagrasses, dead corals, and sandy beaches of the Andaman Islands. They opined the concentration of analyzed trace metal(loid)s were compared to be less than the values from mainland India. However, the values of Cr and Cd were higher than the background values. Enrichment of trace metal(loid)s in eight seagrasses species from Andaman was studied by Thangaradjou et al. (2010). They found the concentration of it was within the permissible limits and concluded that the region was pristine. Trace metal(loid)s were investigated from twenty-five locations along the Andaman coast due to anthropogenic activities in the regions devoid of seagrass meadows and coral reef Jayaraju et al. (2011). They pointed out that the foraminiferal deformations were due to anthropogenic activities. Bio-concentration of trace metal(loid)s in an oyster (*Saccostrea cucullata*) from Andaman water was studied by Abhilash et al. (2013). They opined the concentration was within the permissible limits as prescribed by the central pollution control board (CPCB). However, they recommended continuous monitoring of *S. cucullata*. Trace metal concentration in water and edible oyster (*Crassostrea rivularis*) from North Wandoor and Phoenix Jetty of South Andaman was investigated by Seetharaman et al. (2015).

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They found high values of Cu, Zn, and Cd in Phoenix jetty sample when compared to North Wandoor sample. Further, an in-depth study on trace metal concentration of four seaweeds viz., *Halimeda gracilis*, *Padina pavonica*, *Sargassum swartzii* and *Turbinaria ornata* was conducted in Wandoor, South Andaman by Kaviarasan et al. (2018). The trace metal concentrations were less according to Dadolahi's metal pollution index. Sachithanandam et al. (2020) reported the incidence of heavy metals in the coastal surface sediments of 23 locations in south Andaman and concluded high concentrations in the pristine ecosystem. Shiva Shankar et al. (2021) compared the incidence of heavy metals in mangrove sediments with that of the adjacent host rock and concluded that the environment is prestine except for Junglighat. Further, their study suggest the linkage of heavy metal mobilization from rocks to sediments and the anamolous values indicated contimination. This novel methodology of assessing incidence of heavy metals in mangrove sediments and host rocks had given a window to the dynamics of mobilization of heavy metals from source to sink. Importantly, their study pointed out the flaws of reporting heavy metal contamination of any given study area with similar environment globally.

PLASTICS

Marine debris of Great Nicobar and Nancowry was documented by Dharani et al. (2003). They reported that plastics around the aforementioned islands were carried by oceanic currents from Southeast Asian countries like Sumatra, Singapore, Malaysia, Indonesia, etc. Mohan and Dhivya (2013) reported the distribution of plastic wastes at Sunset Bay, Collinpur. This area was annually surveyed for six years (2003-2008) and articulated a 400% increase in plastics on the Sunset Bay. Based on the preliminary report submitted Kaladharan et al. (2017) indicated that plastics in ANI's was highest (47%) among other coastal states. Assessment of macro debris including plastics in mangrove and sand dune ecosystems of Carbyn's cove was carried out by Kaviarasan and James 2017. According to them, the macro debris were endangering sensitive ecosystems like mangroves and sand dunes. Occurrence, distribution and composition of micro-plastics in the sediments of eight South Andaman beaches via., HADDO, Carbyn's cove, Rangachang, Burmunallah, Kodyiaghat, Chottabalu, Wandoor, and North Wandoor was studied by Arunkumar et al. (2020). They concluded that improper solid waste management, tourism, and marine activities were the reason for the prevalence of microplastics in the chosen eight beaches. Also, they emphasized that the presence of micro-plastics would threaten the balance of the fragile marine ecosystem. Goswami et al. (2020) reported on the bioaccumulation of micro-plastics in marine organisms like zooplankton, finfishes, shellfishes, and sediments as well from four sites Port Blair region. They recorded high amounts of micro-plastics from zooplankton communities. Krishnakumar et al., (2020) studied the presence of various classes of macro-meso-microplastic debris in twenty sites of ANI's. They opined that the plastics were escorted by oceanic currents and deposited on the coastal front. Also, they concluded that the plastics were contributed by tourists, shipping activities, and improper handling of solid wastes. A study on microplastics was conducted by Goswami et al. (2021) in the continental shelves of Andman sea and Arabian sea. Their results articulate that the incidence of micorplastics was less in the former location in comparsion to the latter site.

The scanning of previous literature clearly articulates that the coastal water quality of ANI's are good except around Port Blair. The prevalence of heavy metals in different coastal ecosystems are natural background values escorted through the erosion of adjacent host rock. Plastics in the coastal and marine environments are the matter demands due consideration. Out of more than 500 islands, only 38 islands are inhabited by humans but rank first in plastic pollution in India (Kaladharan et al. 2017). The prevalence of plastic debris in the coastal waters of ANI's can be attributed to tourism, fishing, oceanic currents, and improper solid waste management.

CONCLUSION

A review of the research reports on the status of pollution in the coastal waters of ANI's suggests 1) paucity of continuous and regular pollution data from Nicobar group of Islands, 2) Most of the research are focused around Port Blair regions as it houses more than half of the human population and the center for all the rest of island activities, 3) few scientific investigations on Rangat Bay in Middle Andaman and Aerial Bay in Diglipur, North Andaman suggests that the coastal waters are polluted but not as much contaminated as Port Blair Bay, 4) Among various locations in Port Blair region Phoenix Bay, Junglighat Bay and Minne Bay are most polluted. Immediate intervention of the Andaman administration to curb the anthropogenic activity and sensitize among the common public about the importance of these coastal waters is the need of the hour, 5) Pollution of the coastal waters will have a direct bearing on the fishery potential of the island, 6) Sensitive ecosystems like coral reefs, mangrove, and the seagrass will be drastically affected by the pollution, 7) The presence of disease-causing bacteria would result in a massive outbreak of disease incurring huge financial liabilities to the Andaman administration, 8) A constant monitoring of pollution especially coastal waters of Port Blair region is highly recommended, 9) Installation of plastic recycling units, and 10) implementation of proper solid waste management techniques.

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