Pollution and its Impacts in Ennore Creek, Southeast Coast, India – A Review

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ABSTRACT

The coastal ecosystem is essential to life on our planet as well as to the support of the livelihood of people living near and dependent on the coastal resources. The abundance of coastal resources of good quality is fundamental to all marine biological processes, for maintenance of biodiversity and ecosystems and for primary and secondary production functions that support human needs. Coastal ecosystems are ecologically important on the global scale and highly valuable for the services they supply. These include regulation services such as shoreline stabilization, nutrient regulation, carbon sequestration, and both detoxification of polluted waters and waste disposal; provisioning services such as supplying food, fuelwood, energy resources, and natural products; and amenity services such as coastal livelihoods, shipping, domestic tourism and recreation, and international tourism and recreation. In the seas, the marine life faces threats in many ways, such as overexploitation and harvesting, deposit of waste, contamination, exotic species, soil recovery, dredging and global climate change. One of the major kinds of human impact constitutes a major threat to marine life: the pollution by plastic debris. Most of the world's important fisheries have now been damaged to varying extent; situations are even more critical in those fisheries that are already overexploited or otherwise vulnerable and, therefore, deserve immediate attention. Effective and sustainable management of coastal and marine environment should be initiated from local to international and global scale to ensure a sustained and best possible utilization of the resources for broader interest of mankind.

KEYWORDS: Biodiversity, ennore creek, species, pollution

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUCTION

Water pollution happens when toxic substances enter water bodies such as lakes, rivers, oceans and so on, getting dissolved in them, lying suspended in the water or depositing on the bed, resulting in degradation of the quality of water. The world's majority of human populations are located along the coastal areas. Coastal habitats alone account for approximately 1/3 of all marine biological productivity. Around 20% of human population inhabit in the coastal zone around the world. In case of India, around 30% of people are living in the coastal zone. 40% of the world's oceans have been heavily affected by human activities, including fishing, coastal development and pollution from shipping. Over 80% of all marine pollution originates from land-based source which are primarily industrial, agricultural and urban. In global scenario, the coastal pollution rates are twice than that of inland sites due to the generations of wastewater releasing into the marine waters either by directly or indirectly. Coastal pollution is an emerging issue of the present-day world, agitating the natural balance of the ecosystem. Shipping and Ports plays a critical role in coastal development; it retains several probable hazards to coastal region and its environment. Sustainable growth is an important idea which incorporates multiple extremity line: social, environmental, and economic components into entire features of decision making. There is frequent oil spillage occurring in marine water that leading to adversative influence over the ecosystem. The interception of industrials wastes in marine water highly impacts the living of people and marine ecosystem. Oil spills, pipeline leaks, submarine accidents, plastics, industrial effluents, earthquakes, mudslides, and volcanic eruptions contribute to the coastal and marine pollution. The most affected coastal systems include wetlands, mangroves, and coral reefs, which provide natural cover to alleviate the impact of coastal disasters. Concentration of heavy metals such as mercury, lead, and cadmium in coastal waters has become a cause of great concern (Chakraborty et al., 2016). Ennore estuary is highly dynamic with geographic changes in the bar mouth and characterized by the influence of discharge from various industries and wastewater from municipal sewage. As a result availability and distribution of metals in water, sediment and biotic compartments of Ennore estuary exhibit seasonal and spatial changes. Ennore estuary has been extensively studied for its biodiversity, fishery resources, metal concentration and their biological effects on selective resident species (Karthikeyan et al., 2020). High concentrations of organic substances increase hypoxia or anoxia by O_2, and COD, and O_2 by oxidation oxidase and other inorganic reduced components (Kennish, 2017) when decomposing microorganisms. Due to the shallow nature of the water, high water inputs have a long coastline input

throughout the year, except for the winter water (December and November). Natural factors include weathering actions of rocks and soils, atmospheric precipitation, and aeolian sediments (Chandrasekaran et al., 2015; Perumal et al., 2021). Many contaminants, along with significant metals, can cause biological hazards or sub-lethal effects to aquatic organisms due to toxicity, and the behavior of Hm's is still not fully understood (Chandrasekaran et al., 2015; Singh et al., 2020; Iordache et al., 2022). Sediment analysis plays an essential role in determining the concentration of metals in many aquatic ecosystems, surface integration of dissolved Hm's, spatial distribution, sedimentation, behaviors of Hm's and re-suspension, as well as determining the patterns of pollution in ecosystems (Singh et al., 2020; Li et al., 2022). Cadmium is another important element to investigate the contamination of sediments in the river bed and basin. Urbanization and industrialization are the primary reason for the cadmium contamination in soil. It will affect plant growth and intensively affect agriculture practices (Yang et al., 2022; Kumar et al., 2022).

2. SIGNIFICANCE OF COASTAL ECOSYSTEMS

Coastal areas around the world are dynamic environments at the interface of terrestrial, marine, and freshwater systems. Nearly 2.4 billion or 40% of the world's people already live in these areas. Out of 23 mega cities (more than 10 million inhabitants) in the world, 16 are on the coast and accommodate 3.5% of the world's population. Most of these cities use the ocean for sewage discharge because of its extensive assimilation capacity (Liu et al., 2019). But this degrades the quality of the coastal waters and is recognised as a major threat to the marine environment (Vijay et al., 2010). Coastal and marine ecosystems are one of the most productive ecosystems world, provide many services to human society and are of great economic value. The coastal ecosystem is essential to life on our planet as well as to the support of the livelihood of people living near and dependent on the coastal resources. The abundance of coastal resources of good quality is fundamental to all marine biological processes, for maintenance of biodiversity and ecosystems and for primary and secondary production functions that support human needs. Competition for limited resources has intensified with human population growth in coastal regions, and the diversion of wetlands for economic activities has been experienced globally. It is equally important to underline that such threatened ecosystems can no longer provide their biological functions and regulatory services that sustain the coastal economic production and livelihoods (Premchandra, 2010).

Coastal ecosystems are ecologically important on the global scale and highly valuable for the services they

supply. These include regulation services such as shoreline stabilization, nutrient regulation, carbon sequestration, and both detoxification of polluted waters and waste disposal; provisioning services such as supplying food, fuel wood, energy resources, and natural products; and amenity services such as coastal livelihoods, shipping, domestic tourism and recreation, and international tourism and recreation (Bene et al., 2011). A total of 75% of commercially harvested fish and shellfish depends on estuary and nearby coastal water for some part of their lifecycle. The economic importance of coastal areas has increased further with the growth of human settlements and the development of commercial harbours, fishery harbours, landing facilities, river training and out fall schemes, transport, communications, recreational facilities and tourism.

3. POLLUTION OF COASTAL AND MARINE ECOSYSTEMS

In the seas, the marine life faces threats in many ways, such as overexploitation and harvesting, deposit of waste, contamination, exotic species, soil recovery, dredging and global climate change. One of the major kinds of human impact constitutes a major threat to marine life: the pollution by plastic debris (Douglas et al., 1987). Plastics are the predominant amongst the marine litter, and its proportion consistently varies between 60% and 80% of the total marine debris (Gregory and Ryan, 1997). Domestic sewage and industrial effluents are released in the water courses in and around India in untreated or partially treated form. These, of course, add a mixture of pollutants which include, among others, certain toxic heavy metals and metalloids. An estimated 38,354 million liters of sewage with an equivalent amount of sludge day^{-1} is presently generated in India. In Mumbai, sewage is generated at a rate of 2700 million litres day^{-1} (MLD). The principal cause of marine pollution with oil is shipping. Traditionally shipping is considered to be "a polluting industry". Ocean is polluted by oil on a daily basis from oil spills, routine shipping, runoffs and dumping. Oil spills make up about 12% of the oil that enters the ocean. The rest come from shipping travel, drains and dumping (Vikas and Dwarakish, 2015).

Addressing marine plastic pollution is an urgent action, considering the rising levels of plastics in the environment and the impacts to coastal and marine ecosystems. The problem of plastic pollution is cross boundary and cross-cutting, and it requires systemic solutions covering policy, technology, management, financing, knowledge and research, awareness raising and behaviour change. Numerous national and regional initiatives have been implemented around the world, but gaps in policy remain. Coastal and marine pollution has already caused major changes in the structure

and function of phytoplankton, zooplankton, benthic and fish communities over large areas including impacts on public health. Of particular interest is the impact of pollution caused to fisheries and other commercial use of coastal and marine habitats. Most of the world's important fisheries have now been damaged to varying extent; situations are even more critical in those fisheries that are already overexploited or otherwise vulnerable and, therefore, deserve immediate attention. Effective and sustainable management of coastal and marine environment should be initiated from local to international and global scale to ensure a sustained and best possible utilization of the resources for broader interest of mankind (Islam and Tanaka, 2004).

4. EFFECTS OF POLLUTION ON PHYSICO-CHEMICAL PROPERTIES OF WATER

Physico-chemical parameters are responsible for the spatio-temporal variations of all aquatic organisms. The investigations on meteorological and hydrographical features are necessary for assessing the fertility and productivity of any ecosystem (Slobodan, 2022). (Rajkumar et al., 2022) opined that water quality plays a significant role in safeguarding a well-balanced environment. Estuaries determine the fate of physico-chemical parameters of continental origin to the ocean. The net flux of riverine inputs to the open ocean depends on their biogeochemical behaviours in the estuary. Among the nutrients in estuarine waters, nitrite is the main form of dissolved inorganic nitrogen followed by ammonia and nitrate in the process of nitrification. As long as nitrification is stirring in the water, an increase in nitrite and a reduction in ammonia is a normal event. High levels of both phosphates and nitrates can lead to eutrophication ultimately reducing dissolved oxygen levels in water. Silicate is associated with land-based resources with concentration higher in rainy season than in dry season. Forming vital nutrients, the nitrite, nitrate, ammonia, inorganic phosphate and reactive silicate are the major sources contributing to the deficiency and diseased state of a creek.

Water quality deterioration is one of the most important water resource issues of the 21st century. Therefore, the quality status of coastal surface water is very important and would always be under public scrutiny because of health risk associated with sewage contamination. The potential deleterious effects of pollutants from sewage effluents on the receiving water quality of the coastal environment are manifold and depend on volume of the discharge, the chemical composition and concentrations in the effluent. It also depends on type of the discharge for example whether it is amount of suspended solids or organic matter or hazardous pollutants like heavy metals and organochlorines, and the characteristics of the receiving waters (Nemerow

and Dasgupta, 1991).

Large quantities of nutrients released into the coastal water through the sewage waste-water may result in nutrient enrichment stimulating algal growth that inturn affects the photic zone depth, cause dissolved oxygen depletion, bioaccumulation of organic and inorganic compounds, and alteration of trophic interactions among both aquatic flora and fauna (Danulat et al., 2002). Elevated nutrient levels may also result in excessive growth of algal blooms, some of which may result in production of algal toxins. The algal toxins are risks for water and sea food quality and safety (Owili, 2003).

5. ASSESSMENT OF ENVIRONMENTAL POLLUTION ALONG THE CHENNAI COAST

Waste disposal operations intentionally release materials to coastal waters via direct dumping and pipeline discharges, which constitute point sources of pollution. The dumping of municipal sewage sludge, dredged spoils, and industrial wastes (e.g. acid-iron waste, alkali chemicals, and pharmaceuticals, and the discharge of municipal and industrial effluents from outfalls are the primary point source categories. The principal non-point sources of pollution from land-based systems include urban runoff, septic tank leakage, groundwater transport, erosion and contaminated soils, and atmospheric deposition (Planichamy et al., 2000). Non-point sources of pollutants also originate from human activities at sea associated with accidental releases (e.g. oil spills in harbour areas), marine mining, and the operation of heavy vessels. In Chennai coastal water, municipal sewage wastes (both sludge and waste water), liquid industrial wastes (pharmaceutical, fertilizer, thermal power plants and other chemical factories) and dredged materials are the sources of most pollutants, released to coastal waters (Reddy and Nagendra, 2011).

The concentration of trace/toxic elements along the Chennai coast is higher than specified values for all the trace elements. Cu concentration higher in the zones of Adyar and Coum river influence due to surface run off and reduces towards Ennore creek. Ni increases drastically towards Ennore creek and concentration of Cr is very high all along the coast. Nitrite, phosphate and COD are also much higher, while pH of waters is less at 7.4–7.7 than the desired range of 7.8–8.3 (Reddy and Nagendra, 2011). The high pollution load in Ennore Creek has drastically changed the ecosystem. A baseline study of physico-chemical parameters and trace metals in waters of Ennore creek, Chennai. A study on the impact of water pollution on the socio-economic status of the stakeholders of Ennore Creek was undertaken by Shanthi and Gajendran (2009).

Ennore receives pollution through point and non-point sources from North Chennai Thermal Power Plant, Ennore port activities, Manali Petrochemical Industries, other nearby industries and untreated urban wastes from Chennai metropolitan. Exposure to heavy metals can also affect reproduction efficiency of aquatic biota and can lead to gradual extinction of their generations in polluted waters. Ennore estuary was one of the highly polluted estuaries due to heavy industrialization and the improperly treated effluents ultimately reached through. Ennore bar mouth and finally enter into the Bay of Bengal (Padmini et al., 2007) analysed the heavy metal concentration of seawater and marine organisms in Ennore creek, South East coast of India. Chitrarasu et al. (2013) investigated the heavy metal concentration in the sediment of Ennore estuary and reported that the heavy metals like Zn, Cd, Ni, Pb and Cr were above the permissible limits. Sachithanandam et al. (2017) analyzed the concentration of heavy metals in seawater, sediment and fishes like *Liza macrolepis* and *M. cephalus*.

6. CONCLUSION

The ranges of several biological, physical and chemical parameters in coastal water of Ennore creek. During, study observations demonstrated that low dissolved O_2 and high biochemical and COD in coastal surface waters of Ennore. As a result of freshwater input in monsoon, the absorptions of certain of these constraints became less in many places it shows the pollution within limits. However, new methods and spreading framework are essential to be presented to decrease the ranges of contamination in coastal parts.

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