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Impacts and Effects of Pollution on Marine and Coastal Resources

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Marine (beaches, intertidal, littoral, bathyal, abyssal, and pelagic) and coastal (interface between land and the sea) resources play a pivotal role in the livelihood of coastal people. Management of land-based activities is a major challenge in coastal areas, since it can produce hazards impacts on coastal resources. Anthropogenic drivers such as climate change, globalization, increased personal wealth and living standards, industrialization, migration, population growth, and urbanization can generate multiple impacts of different strength on coastal resources. It is evident that all biotic coastal resources are highly impacted by land-based activities, with agriculture, ports/harbours and aquaculture. Population growth is a key driver for several land-based activities related to the provision of food, water and energy. These include fishing, aquaculture, agriculture, deforestation and salt extraction, as well as oil and gas production and marine renewable energy production. For effective coastal resource management, the local control bodies should prepare a mandate for conservation of coastal resources by planning, protection, regulatory enforcement, legislation, intergovernmental relations, relations with non-governmental organizations, and with extension and technical assistance. The present review provides compilation of an updated published literature on the impact of anthropogenic drivers on the coastal resources. This study suggests that, local

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government plays an important role for protection and recovery of coastal and marine resources. Further, communities should be involved in coastal resource management by activities such as identification of stakeholders and formation of partnerships, community organization and mobilization, community participation in the planning process, and information, and education.

Keywords: Coastal resources; marine biodiversity; coastal resource management; sustainable use.

1. INTRODUCTION

"The vulnerable coastal and marine ecosystems of the Asian and Pacific Region provide major resources to the region's peoples supporting a diverse and stabilizing natural system" [1]. Coastal resources include all natural resources occurring within coastal waters and their adjacent shore lands. They consist of beaches, intertidal, littoral, bathyal, abyssal, and pelagic) and coastal (interface between land and the sea [2]. Coastal communities are benefitted with marine resources for various purposes. Aesthetic and cultural values provide the socio-psychological benefits, whereas the aquaculture allows the breeding, rearing, and harvesting of marine organisms for seafood, or other products [3]. Coastal areas are rich in recreational opportunities through tourism, beach going, tide pooling, boating, wildlife viewing, surfing, swimming, hiking, etc [4].

According to Weinstein et al [5] "human have dominated the coastal ecosystems and the practices of sustainable utilization have become an integral part of emerging coastal governance and management". "Human are dependent on the coastal zone for living space and recreation, extractable commodities, ports and harbors, commerce and the military, wastewater disposal, sites for power production and distribution, and for industrial water supply. Over-exploitation, plastics and microplastics, pollution and climate change are causing a serious loss of marine biodiversity" [6].

Izabella and Potocnik [7] noted that, "land-based human activities significantly impact the marine environment. About 80 per cent of marine pollution originates on land. Still, there are no any truly effective governance mechanisms that take account of land-ocean interactions". "Coastal resources were affected by different drivers such as climate change, globalization, increased personal wealth and living standards, industrialization, migration, population growth, and urbanization" [8].

Isa et al. [9] stated that "marine coastal resources are found at the land-and-seawater interface, and are situated in the ocean and on the seabed. Coastal resources were represented by both the abiotic and biotic components. Abiotic components include all non-living resources, while biotic features include a wide range of live resources that are important to people, such as finfish and shellfish such as fish, shrimp, crabs, lobsters, molluscs, reptiles, aquatic animals (whales and sharks), phytoplankton's, and higher aquatic plants". Schuhmann et al. [10] noted that, "extreme degradation of coastal and marine resources due to overfishing, coastal overdevelopment, siltation, pollution, and climate-related factors is experienced worldwide".

"Marine resources have traditionally supported people's lives in coastal regions, via subsistence fishing, farming, and commerce. The cumulative impacts of human pressures and natural calamities, global marine resources are quickly depleting. The overexploitation of fishing resources and non-living raw materials is mostly to blame for the observed decrease. Oil pollution, plastic pollution, marine litter, and habitat degradation are all kinds of marine pollution that have a negative influence on many marine species' breeding grounds and nurseries. Climate change, insufficient legal instruments, and coastal erosion all pose dangers to marine and coastal ecosystems" [9].

Islam and Tanaka [11] noted that, "most of the coastal areas of the world have been reported to be damaged from pollution, significantly affecting commercial coastal and marine resources. Therefore, control of aquatic pollution has been identified as an immediate need for sustained management and conservation of the existing fisheries and aquatic resources. Coastal and marine pollution has already caused major changes in the structure and function of phytoplankton, zooplankton, benthic and fish communities over large areas". This is correlated with ocean acidification as a consequence of the significant increase in C and CO_2 particles.

Vikas and Dwarakishb [12] described that, “pollution in marine coastal areas is from point and non-point land-based sources, such as rivers, drainage ditches, submarine outfalls and coastal cities. There can be many causes of coastal pollution such as oil spills, plastic debris, sewage and effluents, and non-point sources (such as runoff of septic tanks, cars, trucks, boats, farms, ranches, and forest areas)”.

Duraisamy and Latha [13] observed that, “the biggest source of pollution in the ocean is directly from land based sources. Thousands of tons of waste and trash are dumped into the ocean on a daily basis. The pace of coastal development and increasing pollution loads threaten the sustainability of the marine and coastal resources and the continued exploitation of the significant reserves of offshore oil and gas provide the potential for both economic prosperity and an increased risk of environmental degradation”.

Present review, “Impacts and effects of pollution on marine and coastal resources” is a compilation of published literature on hazardous impacts and effects of pollution on the resources exploited from marine region for the livelihood of human beings.

2. LITERATURE SEARCH METHODS

This review was carried out by collecting information on relevant research findings using Internet search engines like Google, Google Scholar, PubMed, ScienceDirect, and ResearchGate and other published articles, reports, and monographs. According to the content relevancy, 10 papers were eliminated, and 26 papers remained. Relevant articles have been reviewed and the related information was gathered for this current study concerning impact of pollution on marine and coastal resources.

3. TYPES OF MARINE AND COASTAL RESOURCE

Isa et al. [9] stated that, coastal resources are classified into living resources and non-living resources.

3.1 Living Resources

Herbert-Read et al. [14] stated that, living marine resources were represented by finfish and shell-fish, such as shrimp, crabs, lobsters, molluscs, reptiles, aquatic animals, and higher aquatic plants. These resources mainly consist of more 200 species of plankton-feeding clupeoid fishes, including the anchovies, sardines, herrings, and shads. Molluscs are the most exploited marine resources represented by cephalopods (octopuses, and squids), gastropods and bivalves. Crustacean resources were like shellfish such as lobster, shrimp, and crabs. Reptiles and mammals maintain a healthy and diversified marine ecology. Other resources include seagrass and algae covering a large area [9].

3.2 Non-Living Resources

“Non-living resources consist of water, fuels, minerals (salts, sand, gravel, oxygen, dissolved nutrients, magnesium, and phosphorus), waves, currents, light, fuel, and oil. The pure sediment deposit of gravel and sand may be employed in the glass, iron, and steel industries. Garnet, Zircon, Rufite, Tourmaline, Illenite, and Sillimanite are among the valuable solid minerals found along the shoreline and in submerged places. The presence of crude oil and gas in the marine environment has been detected. This occurs in the shallow continental platform’s thick layer of sedimentary layers, which is close to the surface” [15].

4. IMPACTS OF POLLUTION ON MARINE AND COASTAL RESOURCE

Elenwo and Akankali [16] reported that, “the effects of marine pollution to coastal resources are extensive, impacting the flora, fauna and entire ecology of the coastal environment. Pollution can cause various negative effects on the coastal resources such as, depletion of coastal resources, damage to ecosystems, damage to the esoteric value of beaches, and lethal and sub-lethal effects. Other effects also include malformations, reproductive impairment, and sterilization. Various stressors influenced by land-based activities, and have the potential to change the condition of living or non-living of a coastal ecosystem”.

4.1 Depletion of Coastal Resources

According to Tekman et al. [17], ghost nets generally degrade the marine and coastal diversity due to entanglement. These nets disturb the habitat of benthic fauna and also cause trapping of benthic organisms. Marine plastic debris causes mortality of many marine organisms, particularly the birds due to physical

injury or entanglement. Plastic wastes also affect the feeding and breeding of marine fauna, thereby causes their depletion.

4.2 Hazards to Aquatic Fauna and Flora

Texas Disposal Systems [18] reported that, marine debris in the coastal area slowly degrades using oxygen and resulting in less oxygen in the ocean. It leads to the death of ocean animals such as penguins, dolphins, whales and sharks. Excess nitrogen and phosphorus in seawater also cause oxygen depletion as a result of eutrophication. When a great deal of oxygen depletion occurs in an area of the ocean, it can become a dead zone where very little marine life can survive.

IRP [8] reported that, anthropogenic stressors such as eutrophication, sewage, and thermal pollution can cause damage to the resourceful coastal ecosystem. Dumping of sewage or oxygen-demanding wastes into the marine environment leads to depletion of dissolved oxygen and increase in CO_2. Release of untreated or partially treated sewage effluent can cause the mortality to marine plants and animals due to eutrophication. Growth of algal blooms results in discolours the water, clog fish gills, and toxic to fishery resources.

Isa et al. [19] reported that; “thermal pollution increases the ambient temperature of coastal waters and enables fish and other aquatic resources to thrive. Formation of thermal plume results into destruction of aquatic life due to acute thermal shocks. It also affects the normal physiological processes such as growth and reproduction of aquatic species”.

4.3 Loss of Resourcefulness of Coastal Beaches

Verma et al. [20] pointed that, coastal beaches are resourceful with respect to finfishes, shell fishes, and mangrove vegetation. Eutrophication due to coastal pollution affects the beaches, and impacting their resources. Fowl smells, awful colour, and occurrence of dead marine animals affect the fish and other macrobenthic organism, sometimes leading to death also. Discard of single use plastic, other solid wastes, ghost nets, and dead organisms also affect the recreational uses of beach.

Kari [21] stated that, toxins released from plastics and plastic ingested by fish and shellfish may lead to food poisoning. Loss of habitat and coastal biodiversity affect the ocean’s capacity to provide food and other services. Marine debris consisting of plastics of different colours, sizes and shapes because physical injuries to the coastal organisms. Trapping of ghost nets and plastic materials may stunt the growth of mangroves and affect the feeding and sheltering of juveniles of most marine organisms. Coastal pollution also affects the natural beauty of beaches, and their aesthetic value.

4.4 Mortality of Marine fauna and Flora by Water Contamination

Xu and Zhang [22] stated that, pollution of coastal water with toxic chemicals, hazardous pesticides, oil spills, and other persistent chemicals can cause behavioural changes, physiological damage, and impair reproduction in marine organisms. Pathogenic contamination of coastal water by biomedical waste, results in infection and occurrence of several lethal diseases in coastal fauna.

Acute coastal pollution with pesticides (DDT), and other persistent chemicals (PCBs) cause accumulation of these substances in the fatty tissue of animals and finally to death. Toxic chemicals such as anti-fouling substances (tributyl-tin/TBT) can affect animal life. Marine pollution with heavy metals such as mercury, lead, cadmium, and zinc pose health risks to aquatic organisms due to their carcinogenic effect.

4.5 Health Impacts of Plastics and Microplastics

Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel [23] noted that, marine debris is any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine and coastal environment. Plastic debris is a global problem associated with detrimental effects and causes the loss of biodiversity. Plastics kill many marine animals (turtles) by swallowing floating plastic bags by mistaking them for jelly- fish. Animals are often strangled when they become entangled with plastic debris. Accumulation of microplastic debris in marine habitats is raising health and safety concerns. Marine debris is a key environmental issue at the global level and a major threat to marine and coastal biodiversity [24].

4.6 Effects of Extractive Activities on Coastal Resources

Extractive resources for minerals and metals can occur in the coastal zone have the twin characteristics of generating impacts on coastal resources and potentially being affected by changes in coastal resources. Different extractive activities operating in the coastal zones include aggregate, evaporates, oil and gas, other coastal mining, placer, salt extraction, and sulphide [25].

4.7 Effects of Shrimp Aquaculture on Coastal Resources

Aquaculture is commonly undertaken in coastal ecosystems such as wetlands and estuaries, and often in close proximity to mangroves. The stage of development, species and location all influence the stressors generated by aquaculture. Aquaculture can cause unwanted societal effects when it produces boom and bust cycles, with potential collapses caused by disease outbreaks, food safety recalls or natural disasters. It can prompt resource conflicts when traditional users feel that aquaculture is encroaching on their 'patch' [26].

5. CONCLUSION

For coastal resource management, various key issues should be addressed by organization of programmes on degradation of coastal habitats, open access to fishery resources, increased fishing pressure to unsustainable levels, destructive/illegal fishing practices, coastal law enforcement, loss of marine biodiversity, inappropriate tourism and coastal/shoreline development practices, and resource use conflicts. Effective and sustainable management of coastal resources should be initiated to ensure a sustained and best possible utilization of the resources for broader interest of mankind. Efforts should be made to protect the coastal resources from the disaster by natural disasters. Further, guidelines issued by the governmental bodies at regional, national and international levels should be strictly followed and implemented for the conservation and restoration of marine and coastal resources.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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