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Anthropogenic Activities Including Pollution and Contamination of Coastal Marine Environment

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Abstract: *The term anthropogenic designates an effect or object resulting from* human activity*. The increasing economic development and a rapidly growing population that has taken the country from 300 million people in 1947 to more than one billion people today is putting a strain on the environment, infrastructure and the country's natural resources. Today Industrial pollution, soil erosion, deforestation, rapid industrialization, urbanization and land degradation are all worsening problem due to environmental contamination Massive changes are reported due to various anthropogenic activities such as changes in temperature regime and radioactive background, discharges of toxic effluents and inflow of nutrients, irretrievable water consumption and damage of aquatic organisms, landing of commercial species, destruction of shoreline and construction of drilling rig. Simultaneous impact of several factors can cause synergistic effects when the consequences can exceed the mere sum of the effects caused by each factor separately. The concept of environmental contamination and its effect is extremely important for analyzing the changes in regional ecology due to anthropogenic activities.*

Keywords: Anthropogenic activities, Contamination, Effect, Marine environment**.**

Introduction

The coastal zone are regions where landmass, oceans and atmosphere interact. It represents about 18% of the earth surface. About 70% of the world cities are located in the coastal zone and about 25% of the world population live in coastal area. The coastal zone provides valuable living and non-living resources (Holligan, 1995). It has the highest biological diversity and productivity. It is estimated to contribute about 25% of the global biological production and support major fisheries (Norse, 1993). The coastal marine environment provides valuable food and energy resources beside performing essential functions such as carbon burial and nutrient recycling. Ecologists and environmental scientists have long sought to provide accurate scientific assessments of the environmental ramifications of human activities. Despite this effort, there remains considerable uncertainty about the environmental consequences of many human-induced impacts, particularly in marine habitats. The impact of anthropogenic activity cumulatively results in structural and functional responses of the water ecosystems and its biota. Therefore the assessment of anthropogenic impact is extremely important for understanding the ecology and biodiversity of coastal zone and management of its resources. (Mann and Lazier, 1991).

The most harmful impact due to anthropogenic activities is pollution. When something is added to the environment which is very harmful, poisonous or fatal to the animal, people surrounding it and other living things it is called as pollution. In simple term pollution is a contamination by a chemical or other pollutant that renders part of the environment unfit for intended or desired use. Marine pollution is the result of products being thrown into seas and oceans, mostly by mankind: domestic waste (sewage and rubbish, pollutants in runoff water), industrial waste (hydrocarbons, metals, synthetic chemical and organic substances, radionuclides) and

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agricultural waste (fertilisers, pesticides) (Islam and Tanaka, 2004). Simultaneous impacts of several factors can cause synergistic effects when the consequences can exceed the mere sum of the effects caused by each factor separately. The coastal states bordering Indian Ocean are densely populated and industrialized. As a consequence, the coastal areas are getting adversely affected by many human activities that result in inputs of industrial effluent of toxic nature, nutrients and harmful substances.

Pollutants and their impacts: There are diverse list of pollutants that are directly discharged into the seas and oceans (Fig. 1). A quantitative estimate of these pollutants for the Indian coast is given in Table 1. The seas around India have become quite vulnerable to man's destructive forces of pollution. About 35% of the India's population live in coastal areas. They depend directly or indirectly on the coastal resources and generate , to the tune of 3.9 km^3 of sewage. According to an estimate (McIntyre, 1995) human beings, on an average produce about 100 g of raw sewage per person per day, and that in the sewerage system flow is around 180 litres per person per day. The liquid from sewage is rich in nutrients but the sludge is high in BOD. According to an estimate about 21 $x10^9$ m^3 of sewage is being added annually to the Indian Ocean (Sen Gupta and Qasim,. 2001).

Addition of nutrient like nitrate and phosphate has a stimulating effect on phytoplankton growth and primary production, to a certain extent. The introduction of nutrient rich sewage change the algal community through eutrophication . The fluxes of dissolved nitrogen and phosphorus from the rivers of Asian countries into the northern Indian Ocean is estimated to

Fig. 1 Different Sources of pollution.

Table 1 Estimates of pollutants entering the Seas around India , (as of 1998).

River runoff (annual mean)	1500 km^3
Domestic sewage per year	13.17 X 10^9 m^3
Industrial effluents	1.32 X 10^9 m^3
Pesticide used per year	82500 tons
Fertilizers used per year	10.3 X 10^6 tons
Solid waste and garbage added per year	105 X 10^6 tons
Synthetic detergents used per year	125000 tons
Sedimentation per year	1606 million tons

be 6.13 x 10^4 and 5.17 x 10^4 tonnes per year, respectively (Islam *et al*, 2004).

The industrialization and urbanization has concentrated in the coastal areas now. According to an estimate of 1995 there were 232 coastal industries on the west coast and 218 on the east coast of India. There are fourteen major, forty four medium and 162 minor rivers together with eleven major, twenty seven medium and 106 minor ports in India. Most of the industrial centres in coastal states of India are grouped together for a number of facilities. They are located close to port and big cities along many estuaries. Many of these industries use large quantity of water for cooling, rinsing and cleaning. The nuclear power plants discharge heated water and some time radioactive waste into the marine environment. They have adversely affected the coastal belt. The coastal habitats are altered, disturbed or destroyed. The industries also generate and add the effluent and solid waste to the tune of 33 x106 m^3 per annum.

Metal pollution : The concentration of heavy metals in the marine biota around India is another case of anthropogenic activity. The concentration of few heavy metals in zooplankton and in muscles of fishes of commercial importance, including sharks is shown in Table 3 . It can be seen from the table that concentrations of almost all of the metals, particularly the toxic metals Pb, Cd, and Hg, are within the permissible limits for human consumption. Concentrations of the toxic heavy metals, Hg, Cd, and Pb, in different tissues of the fishes indicate that their highest occurrence is in the liver and the kidney (Table 2).

Pesticide pollution: The green revolution in India has improved our food production considerable during the last few decades. It was made possible due to the availability of chemical fertilizers, insecticides and pesticides. There is a 15% increase in the use of pesticides every year. The continuance in the use of chlorinated hydrocarbon pesticides (DDTs) and Polychlorinated biphenyls (PCBs) are of major concern

Table 2 Ranges and average concentrations of a few toxic heavy metals (ppm wet weight) in different body parts of fishes from the northern Indian Ocean. Source: Kureishy *et al* (1981, 1983).

Body parts	Mercury		Cadmium		Lead	
	Range	Average	Range	Average	Range	Average
Muscle	ND-0.36	0.07	ND-3.24	0.59	1-3.43	1.11
Liver	ND-0.04	0.01	1.2-87.3	20.18	1-17.62	3.80
Gills	ND-0.03	0.016	ND-0.76	0.42	1-7.00	3.14
Heart	ND-0.08	0.026	ND-1.91	0.54	1-3.40	1.36
Kidney	ND-0.04	0.015	0.38-36.69	9.02	1-69.46	8.61
Gonads	ND-0.03	0.015	ND-8.06	1.25	1-4.76	1.36

ND = Not Detectable.

Table 3 Mean concentration of different chlorinated hydrocarbons in the Indian ocean (ppb wet weight). Source – Sen Gupta and Qasim 2001.

Sample	HCH	Addrin	Dildrin	Endrin	DDT	PCBs	Reference
Fish	N.D	N.D	N.D	2.50	5.90	N.D	Sarkar Sengupta 1992
Zooplankton	N.D	N.D	N.D	N.D	500.00	N.D	Sarkar Sengupta 1992
Water	2.72	4.43	20.75	N.D	115.20	N.D	Sarkar Sengupta 1992
Sediment	5.03	8.72	0.88	N.D	48.31	N.D	Sarkar Sengupta 1992
Fish	N.D	N.D	N.D	N.D	110.00	95.00	Rajendran et al 1992
Rock oyster	–	–	–	–	13.02	55.93	Fowler, 1990
Mussel	6.70	–	–	–	14.10	3.20	Ramesh et al, 1990

N.D – Non Detectable.

because of their persistence in the environment and accumulation in the food chain. PCBs and DDTs are a kind of toxic chemicals that are persistent and able to last several years before breaking down . The concentration of these compounds in the marine environment is given in Table 3. The total DDT (and its derivatives) have been reported from the northern Indian Ocean. (Shailaja and Sarkar, 1996). The values are in the range of 0.1 to 0.44 ppb in water, 50.0 to 1630.0 ppb in zooplankton, and 7.4 to 179.1 ppb in sediment from the Arabian Sea. For the Bay of Bengal these values are 4.0 to 5.9 ppb in zooplankton, 0.3 to 8.6 ppb in fish and 0.02 to 720.0 ppb in sediment.

Oil spill in the Indian seas: Indian coastal waters are located at a vulnerable position to oil pollution, since 45% of the world's oil transport originates from Middle East countries and passes through India 's Exclusive Economic Zone (EEZ). On an average, 40 super tankers pass through Indian coastal waters daily. In addition, Indian Ports and Harbours handle about 3810 tankers carrying about 84 million tonnes of petroleum/oil/lubricants every year. The present consumption of petroleum product in India is around 110 million metric tones per annum. The indigenous production is expected to be around 40 MMTPA by 2024-2025 mostly from offshore or deep sea. Thus import of about 400 MMTPA of crude oil will be required by the year 2025.

Impact of oil spill on marine environment: Crude oil and its refined products spilled during handling may affect organisms, both directly - through physical and toxicological processes, and indirectly – through habitat impacts, food chain disruption and alteration to their community (Farshchi, 1995). Weathering is a natural process that breaks down the oil through physical and chemical changes: spreading, evaporation, dispersion emulsification, biodegradation, dissolution, oxidation and sedimentation. The extent of damage caused by an oil spill depends upon the quantity of oil spilled, the type of oil and the prevailing oceanographic and the meteorological conditions. Available information suggest that different phytoplankton species response differently to different oil (Patharpekar and Ansari 2000).

Plastics pollution : Plastic pollution involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, or humans. Plastics contain many different types of chemicals, depending on the type of plastic and its toxicity varies according to its chemical composition. In India approximately 12 Million tonnes plastic

Table 4 The Inventory of Marine Biodiversity in India.

S. No.	Faunal groups	Number of species in the marine environment
1	Algae	624.00
2	Protista	750.00
3	Porifera	486.00
4	Cnidaria	790.00
5	Ctenophora	12.00
6	Platyhelminthes	350.00
7	Gastrotricha	88.00
8	Kinorhyncha	99.00
9	Annelida	840.00
10	Mollusca	3370.00
11	Bryozoa	170.00
12	Enteropracta	10.00
13	Phoranida	3.00
14	Brachiopoda	3.00
15	Arthropoda Crustacea Pycnoodia	 2430.00 16.00
16	Targigrada	10.00
17	Chetognatha	30.00
18	Echinodermata	765.00
19	Hemichordata	12.00
20	Chordata Protochordata Pisces Amphibia Reptilia Aves Mammalia	 116.00 1800.00 3.00 26.00 145.00 29.00

products are consumed every year. The use of plastic in western and European countries is averaging 70 kg per person per year, while in India it is 4 kg per person per year. Disposal of plastic waste is a serious concern in India and as such no technology has been validated. According to available information India has the highest rate of plastic recycling of 60 percent, followed by South Africa 16 percent, Japan 12 percent, China 10 percent, USA 10 percent and Europe 7 percent. By the end of the 20th century, plastics were found to be persistent polluters of many environmental niches, from Mount Everest to the bottom of the sea. It has been estimated that 6.4 million tons of debris end up in the world's oceans every year and that some 60 to 80 percent of that debris, or 3.8 to 5 million tons, is improperly discarded plastic litter.

Fisheries: Fisheries have evolved rather parallel to agriculture. Fish makes up 16% of the world's supply of proteins for human use. Fisheries occupies a very important place in the socio-economic development of India. This sector has been recognized as a powerful income and employment generator. It provides livelihood for a large section of economically backward population of the country. Over 6 million fishermen depend on fisheries and aquaculture for their livelihood. It is a major contributor of foreign exchange earnings through export.

The fisheries have changed rapidly during the last few decades due to new technological development and expansion. The ever increasing population and demand for food had put extra pressure on the fishery sector. It has enhanced the fishing pressure on the coastal resources, leading to overcapitalization and overfishing of some of the fish stocks. The exploitation has exceeded the natural rate of renewal resulting in over-fishing and decline catches (Ansari *et al,* 2006). The management of this sector is required to stimulate, control and regulate the resources. Then only we will ensure proper and balanced utilization of various fishery and provide the maximum benefit without causing damage to the resources and the environment (Sivasubramanian, 1999). India ranks sixth in the world capture fish production by contributing about 4 million tones

(FAO, 2010). Marine fish production of 2.97 million tones was recorded during 2008-09 from the Indian Exclusive Economic zone. The potential yield of the Indian EEZ has been revalidated as 4.42 million tons by the Revalidation working group of the experts of 2011.

Effect of anthropogenic activities on fisheries and its control: There is a recognized connection between fisheries and marine ecosystem but gaps exist in the scientific knowledge of the impact of fisheries upon the ecosystem and of the impact of the environmental changes and pollution on fisheries. About 75% of world marine fish stocks are declining due to anthropogenic activities. Fish may be impacted by all human activities that alter the marine environment such as pollution by hazardous substances, industrial effluents and radioactive substances, excessive input of nutrients, introduction of alien species The responsible factors attributed are over-fishing, loss of spawning ground and introduction of anthropogenic material. The regulatory measures such as declaration of closed season, protection of endangered species and prohibition of destructive fishing methods by all maritime states will help in protecting the fishery resources for future generation (Shenoy and Biradar, 2005).

Threat to marine biodiversity from anthropogenic activity: The seas around India have become quite vulnerable to man's destructive forces of pollution (Qasim and Kureishy, 1986). Where coastal land or waters are altered for human activities the habitat of other resident species (terrestrial, freshwater and marine) is also altered. Some of these habitat changes may completely remove resident species. Others may harm some species and benefit others, altering the ecosystems themselves. Pressures from coastal pollution may affect the quality of life of estuarine and coastal waters. Large inputs of wastes of domestic and industrial nature including oil pollution has burdened the marine environment, the effect of which can be seen in reduced biodiversity at several hot spots and decline in fish catches. Coastal developmental activities contribute to habitat loss in a number of ways (Menon and pillai, 1996). A number of exotic species, their larval and larger forms are brought and introduced to our water bodies through ballast water. The projected climate change could have multiple effects, including changes in ocean currents, salinity and surface temperature. Marine environment and its associated fauna and flora needs constant vigil and monitoring.. The following points appears to be important in this regard

Effect of Tourism and Recreation on coastal environment: Coastal areas provide many opportunities for leisure and recreation that attracts both local people and tourists from inland and abroad. Camping and bathing, sailing, recreational fishing, beach volleyball, surfing, scuba diving and bird and dolphin watching are among the most popular activities. There is some information available on case studies of Goa (Sawkar *et al* 1998). Goa is known for its scenic beauty and attracts millions of national and international tourists every year. The growth of tourism has also its negative effect on the environment. The coastal waters including bay, estuary backwater and creek are home for a number of fauna and flora. In the absence of stringent planning controls and sensitive development policies, the attributes of coastal areas that are most attractive to visitors such as clean beaches of east and west coast, sea water fit for bathing and wildlife refuges, can be harmed by the shear numbers of visitors, construction and excessive vehicles and pedestrian traffic. In a case study Ingole (2002) reported the negative effect of tourism on Miramar beach fauna in Goa. Such beaches need to be regularly monitored.

River sand mining and its effect: Removal of sand from their natural habitat for construction work is the sand mining. This practice is an age old practice followed every where. Sand mining is of great importance to our economy. It should however, be recognised that it has great potential for disrupting the natural environment (Rabie *et al,* 1994). In some of the coastal states of India it is a booming business

of illegal activity. In Goa, it has been reported that uncontrolled sand extraction along major rivers is posing ecological disaster. An example of ecological impact of sand mining can be seen in colvale river of Goa. This river estuary had, once, rich bed of a benthic bivalve, *villorita cyprinoides. D*ue to excessive sand extraction the clam bed had disappeared. Sand mining has directly affected the physical processes and biological communities.

Effect of global warming and climate change: Global warming is "an increase in the average temperature of Earth's atmosphere," either by "human industry and agriculture" or by natural causes. Burning of fossil fuels produces billions tones of CO_2, that contribute to global warming and climate change. Today Global warming has become a synonym with environmental change. Around the globe, seasons are shifting, temperatures are climbing and sea levels are rising. Hotter days, more severe storms, floods, snowfalls, droughts, fire and higher sea levels are expected in the foreseeable future. These changes threaten jobs, agricultural production, water supplies, industries, human lives and, ultimately, the survival of species and entire ecosystems. Scientists predict that a global temperature rise of close to 2°C (above pre-industrial levels) could result in 25% of the Earth's animals and plants disappearing because they can't adapt fast enough.

Solving global warming will improve our lives by cleaning up air pollution while investing in clean energy, green jobs and smart energy solutions. We need to drive smarter cars, save money with energy efficient homes and offices, and build better communities and transportation networks. See how we can solve the climate crisis today The coastal zones cover those areas of land, sea and atmospheric interface and the underlying seabed and coastal terrestrial areas including the biota as well as abiotic resources. The marine and coastal areas are of great environmental, economic, social, cultural and recreational importance for the coastal people. Due to recent human activities the coastal zone are subjected to anthropogenic impacts that has led to serious consequences in many parts of the world. The negative effect of ecological, and socio-economic nature are visible. The coastal marine environment is in need of constant vigil and monitoring. The protection requires special planning and approaches of management of human activities. A high degree of preparation and competences is needed by the various academicians, scientific organization to achieve the desired goal under integrated marine and coastal development.

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