

Land based nutrient pollution and its consequences to coastal and marine

Ecosystems

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The region of South Asian Seas (SAS) is physio-graphically diverse and ecologically rich, with rich natural and crop-related biodiversity. Although the present population of the region is principally rural, South Asia has seven of the 25 largest cities in the world. Agriculture is the main industry in several countries in this region. South Asia is blessed with several major rivers, which are critical for the economy of the region. Further, there are many services provided by these rivers, especially in communication, transportation and agriculture. Dams built across rivers are also be used to produce hydro-electricity. However, some of the developmental projects in the river valleys have their own negative impacts, especially on the biodiversity and on its ecosystem services. Despite their various benefits, rivers can also destroy properties and cause loss of human life through flooding. They are therefore, critical in climate change adaptation and its effects in the region.

Over the last few decades since the era of intensive agriculture, the dependence on fertilizer N and P to enhance agricultural productivity has led to massive increase in the production and application of fertilizers to farm land. The often inefficient use of this fertilizer has led to substantial run-off and release of nutrients to the waterways ultimately reaching the oceans. The link between intensive agriculture and reactive N pollution is well-established with impacts on drinking water (Powlson *et al.*, 2008; Galloway *et al.*, 2008) and the eutrophication of aquatic ecosystems.



Fig: Industrial Pollutants to sea

South Asia's topography consists of an amazing variety of mountains, plateaus, dry regions, intervening structural basins, beaches, etc. South Asia consists of Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. However, more pollutant is coming from coastal region, the five South Asian maritime countries viz., Bangladesh, India, the Maldives, Pakistan and Sri Lanka.

Inputs of pollutants in the coastal environment of India (Nayak *et al.* 2004)

S. No.	Input / pollutant	Quantum –Annual
1	Sediments	1600 million tones
2	Industrial effluents	$50 \times 10^6 \text{m}^3$
3	Sewage -largely untreated	$1.41 \times 10^9 \text{m}^3$
4	Garbage and other solids	$34 \times 10^6 \text{tonnes}$
5	Fertilizer –residue	5×10^6
6	Synthetic detergents –residue	1,30,000 tonnes
7	Pesticides –residue	65, 000 tonnes
8	Petroleum hydrocarbons (Tar balls residue)	3,500 tonnes
9	Mining rejects, dredged spoils & sand extractions	$0.2 \times 10^6 \text{tonnes}$

Several nutrients, especially reactive nitrogen and phosphorus are essential to growth and development of all life forms, both terrestrial and marine, beginning with the primary producers including the free-living phytoplankton up to the consumers. Reports of excessive growth of algae, degradation of aquatic ecosystems and depleted oxygen levels in water causing mass fish kills have been traced to the loading of excess of nutrients in the coastal waters due to anthropogenic activities in the hinterland. While nutrients are chemicals essential for the growth of organisms, nutrient pollution refers to the contamination by excess inputs of nitrogen and phosphorus into aquatic systems. This nutrient enrichment, eutrophication, initially stimulate growth of phytoplankton, microalgae and macroalgae, which in turn can lead to other impacts such as:

- Loss of subaquatic vegetation as excessive phytoplankton, microalgae, and macroalgae growth reduce light penetration.
- Change in species composition and biomass of the benthic (bottom-dwelling) aquatic community, eventually leading to reduced species diversity and the dominance of gelatinous organisms such as jellyfish.
- Coral reef damage as increased nutrient levels favour algae growth over coral larvae. Coral growth is inhibited because the algae outcompetes coral larvae for available surfaces to grow.
- A shift in phytoplankton species composition, creating favourable conditions for the development of nuisance, toxic, or otherwise harmful algal blooms.
- Low dissolved oxygen and formation of hypoxic or “dead” zones (oxygen-depleted waters), which in turn can lead to ecosystem collapse due to mass fish kills.

References

- Powlson, D.S., Addiscott, T.M., Benjamin, N., Cassman, K.G., de Kok, T.M., Grinsven, H.V., L'hirondel, J.L., Avery, A.A., van Kessel, C. (2008) When Does Nitrate Become a Risk for Humans? *J. Environ. Qual.* 37:291–295 (2008).
- Galloway, J.N., Townsend, A.R., Erisman, J.W., Bekunda, M., Cai, Z.C., Freney, J.R., Martinelli, L.A., Seitzinger, S.P. and Sutton, M.A., 2008. Transformaton of the nitrogen cycle: Recent trends, questions and potential solutions. *Science* 320, 889-892.
- Nayak, B.K., Acharya, B.C., Panda, U.C., Nayak, B.B. and Acharya, S.K. (2004) Variation of water quality in Chilika Lake, Orissa. *Indian J. Mar. Sci.* 33: 164-169.

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