Eutrophication: Impact & Solutions

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Eutrophication

Process in which carbon and nitrogen contaminate the water that ends up in the coastal waters.

What Causes This?

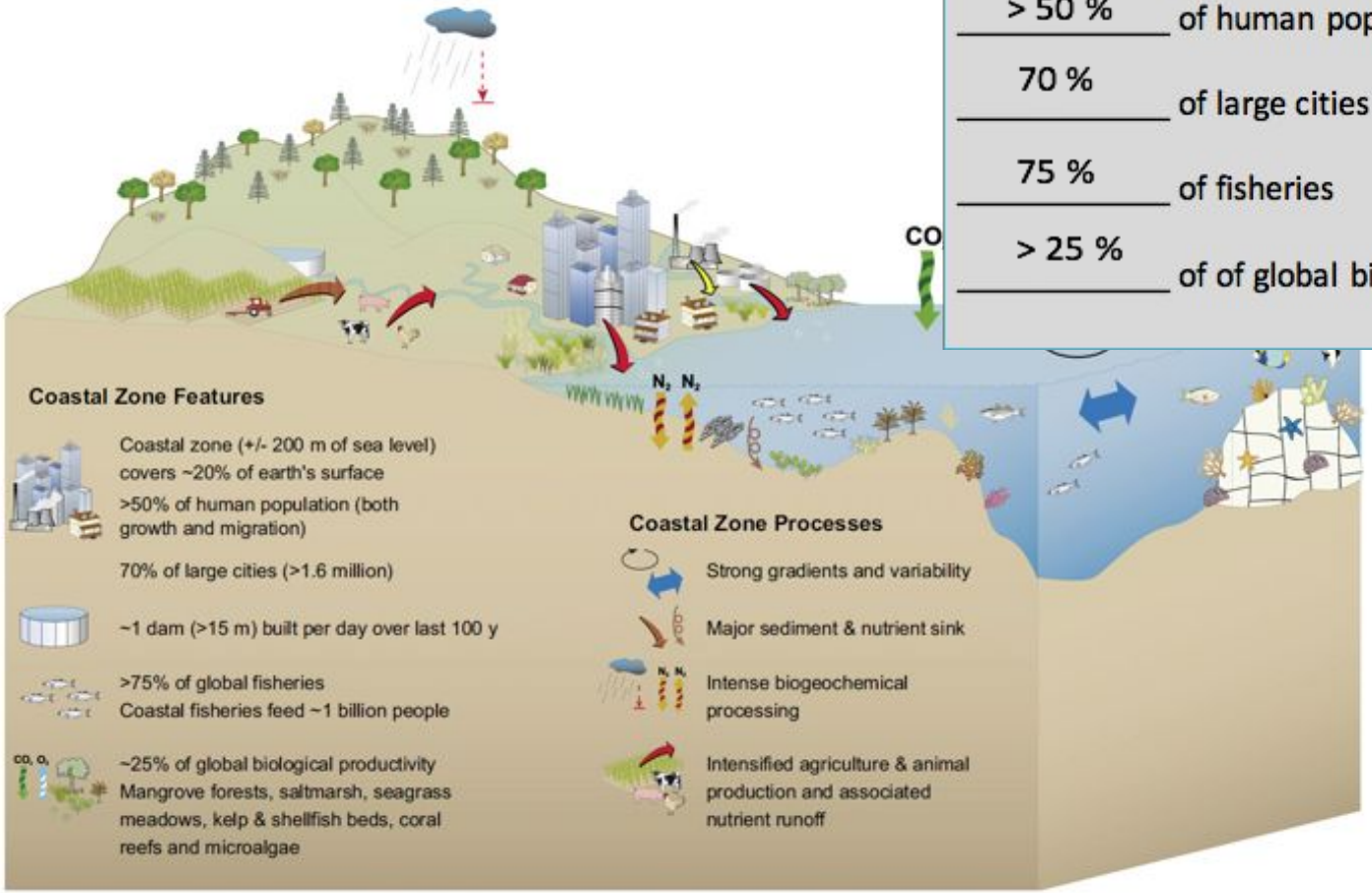
Main sources: 1) sewage
2) runoff from agriculture processes
3) industrial discharges

Why Should We Worry?

Affects: 1) wildlife
2) reduces our resources of freshwater
3) Dead zones

Importance of Coastal Zones

Coastal zone covers: 6% of the world's surface
But has...
> 50 % of human population
70 % of large cities
75 % of fisheries
> 25 % of of global biological productivity



Nutrients

Nutrients: chemical elements and compounds found in the environment that plants need to grow and survive. Main nutrients of interest (for water quality): nitrogen (N) and phosphorus (P).

Excess nutrients can come from many sources:

- fertilizers
- deposition of nitrogen from the atmosphere
- erosion of soil containing nutrients
- animal waste
- sewage treatment plant discharges

In healthy ecosystems

Nutrient inputs at a rate that stimulates a level of macroalgal and phytoplankton (chlorophyll *a*) *growth in balance with grazer biota.*

Water clarity high, allowing light to penetrate deep enough to reach submerged aquatic vegetation (SAV).

Dissolved oxygen levels most suitable for healthy fish and shellfish

Humans can enjoy the benefits that a coastal environment provides.

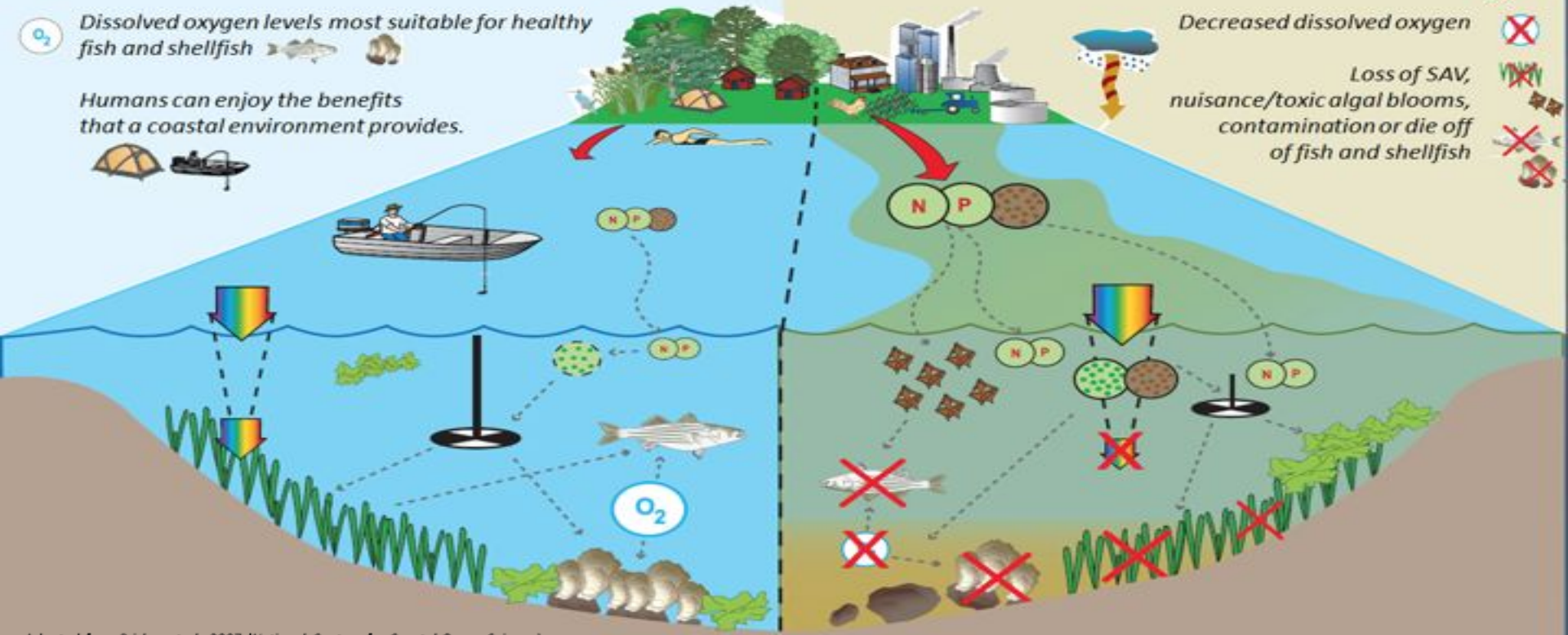
In eutrophic ecosystems

Increased sediment and nutrient loads from human activities, in combination with atmospheric nitrogen, help trigger both macroalgae and phytoplankton *blooms, exceeding the capacity of grazer control.*

Decreased water clarity, decreased light penetration

Decreased dissolved oxygen

Loss of SAV, nuisance/toxic algal blooms, contamination or die off of fish and shellfish



Adapted from Bricker et al., 2007 (National Centers for Coastal Ocean Science)

Consequences

Reduced sunlight penetration; decreased amount of oxygen in the water (hypoxia/anoxia); loss of habitat for aquatic animals and plants.

In many cases **hypoxic** waters do not have enough oxygen to support fish and other aquatic animals.

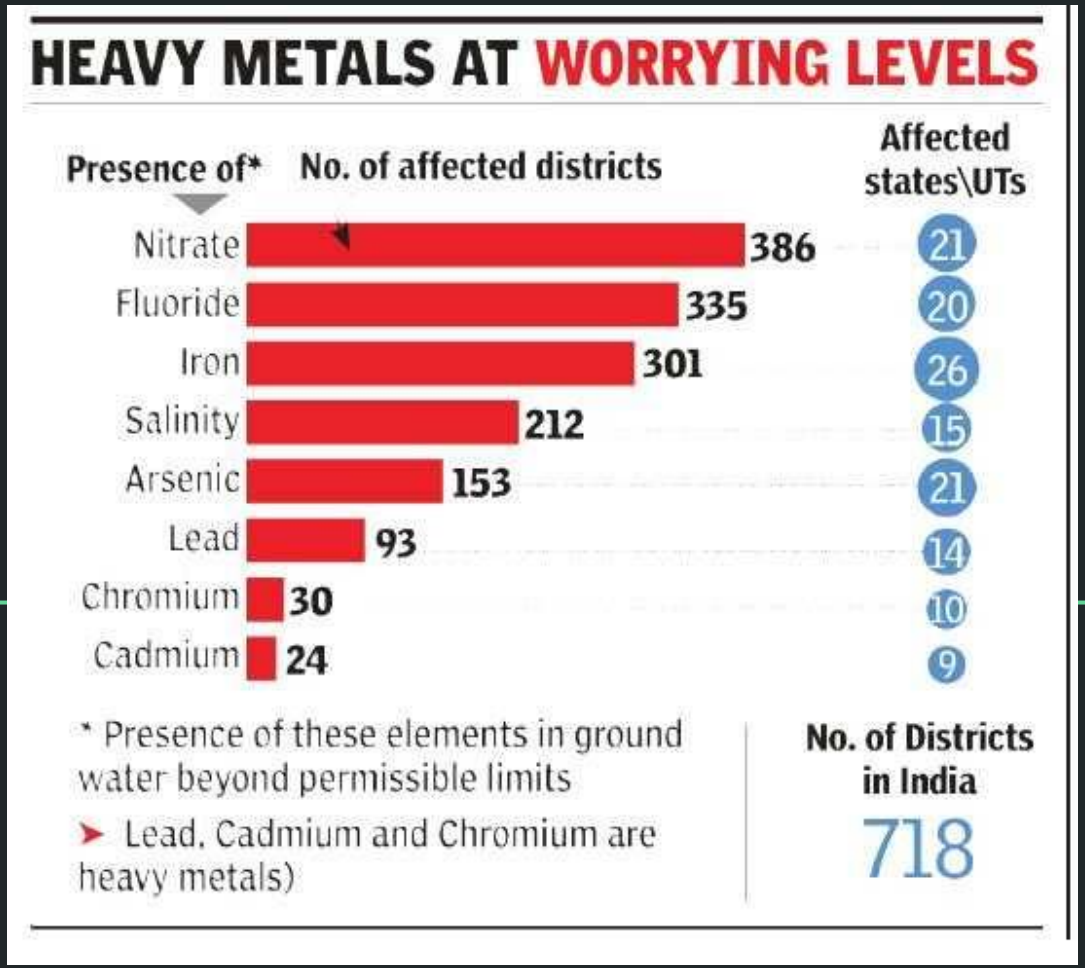
The decrease in dissolved oxygen is caused by the decomposition of dead plant material (algal), which consumes available oxygen.

Leads to a complete absence of dissolved oxygen

Results in anoxic environments

= DEAD ZONES

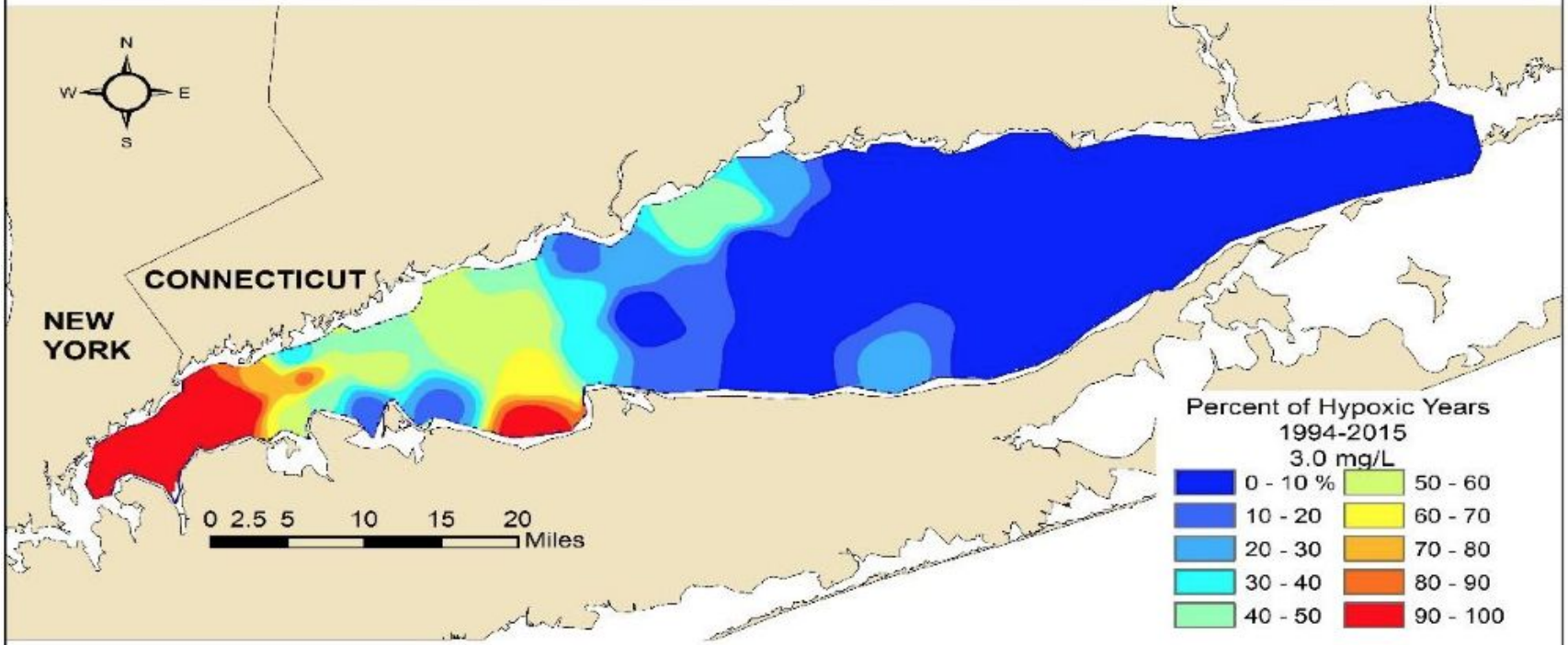
Health of Coastal Zones



Heavy metal water contamination in India

In Australia, Nutrients in coastal waters trigger harmful algal blooms.

THE FREQUENCY OF HYPOXIA IN LONG ISLAND SOUND BOTTOM WATERS



EPA Memorandum

The first elements in EPA's recommended framework are

1. Prioritize watersheds on a statewide basis for nitrogen and phosphorus loading reductions
2. Set watershed load reduction goals based upon best available information

Eutrophication relief

1. The modeling project in Long Island Sound showed that the oyster aquaculture industry in Connecticut provides $8.5 – $23 million annually in nutrient reduction benefits. The project also showed that reasonable expansion of oyster aquaculture could provide as much nutrient reduction as the comparable investment of $470 million in traditional nutrient-reduction measures, such as wastewater treatment improvements and agricultural best management practices

2. The NOAA scientists used aquaculture modeling tools to demonstrate that shellfish aquaculture compares favorably to existing nutrient management strategies in terms of efficiency of nutrient removal and implementation cost.

Solutions:

Better farming practices:

- Encourage farmers to use organic, and/or slow-release fertilizers

  Through mandatory annual classes, inform farmers of alternative technologies (Pivot Bio Closes $70 Million, 2018) and crop rotation techniques (Brush, 2008, p. 22)

- Crop Rotation
- Reducing the use of excess fertilizers
- Source-area management

Crop rotation

Alternating a deep-rooted broadleaf with a shallow-rooted grass species will help in mining nutrients from different layers of the soil.

- Helps reduce compaction by loosening subsurface soil.
- Improve soil structure, aeration and drainage, particularly with deep-rooted taproot crops.
- Reduce surface crusting and water runoff, thereby improving soil moisture content for the succeeding crop.

Cover crops that are legumes will have the same benefits of weed, insect and disease control, as well as improve fertility of soil by nitrogen fixation.

Cover crops will also act as a barrier to reduce wind and water erosion.

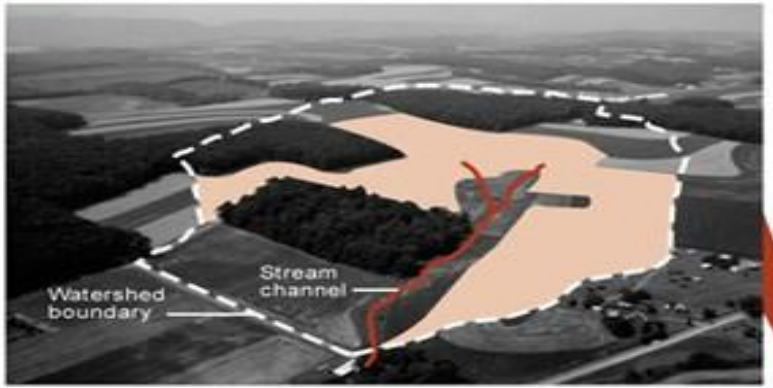
Policies that Should Change

- Farmer’s use vast amounts of fertilizers ⟹ Implement a policy that makes farmer go for mandatory classes

- Outdated regulations on phosphorus in ln detergents ⟹ Needs to be changed and updated

Source-area management

= areas with high soil P content



= areas with high transport potential

= critical source areas with high vulnerability for P loss

From Penn state nutrient management

Conclusion

Eutrophication continues to be a threat to potable water not only in U.S but also on a global scale.

The solutions we proposed are of paramount importance if we want to reduce the rate of coastal zone damage.

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