HOW DEAD ZONES FORM DUE TO NUTRIENT POLLUTION

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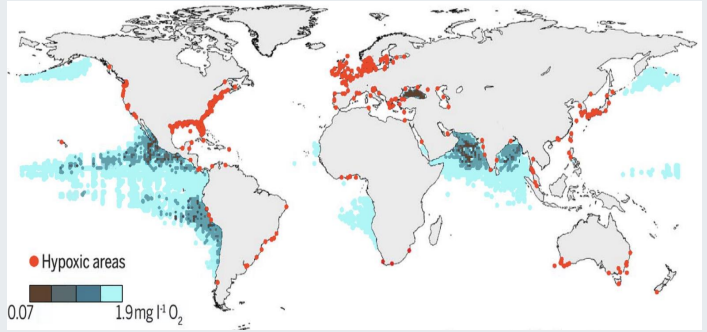
Industrial sources
→ Burning fossil fuels releases nitrogen oxides into the atmosphere.
→ It gets into water and onto the fields through the rain.

Aquacultural sources
→ Excess feed leads to high levels of organic compounds.

Agricultural sources
→ Nutrient sources and Chemical fertilizers:

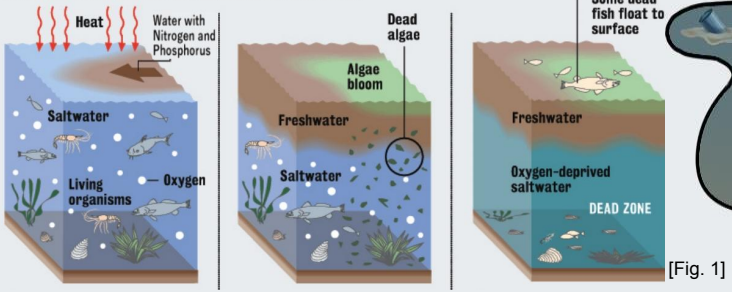
- Nitrogen:
  - 20% loss through surface runoff.
  - 60% loss through atmosphere volatilization.
- Phosphorus:
  - Binds to soil, loss through erosion.

RUN OFF



Anthropogenic nutrients caused O_2 to decline to <2 mg liter^{-1} (red dots), as well as ocean oxygen-minimum zones at 300 m of depth (shaded regions) from 2018 [Fig. 2]

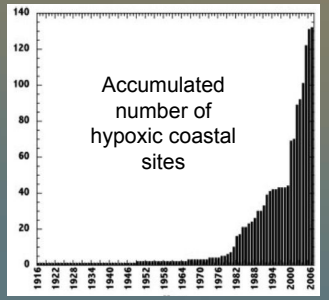
HOW THE DEAD ZONE FORMS



[Fig. 1]

Impacts

1. Nutrient runoff encourages the massive growth of algae through the process of eutrophication.
2. Once the algae dies, it sinks and starts to decay.
3. This decomposition process removes a great amount of oxygen from the water creating hypoxia (Fig. 2 & 3).
4. This leads to conditions in which most marine organisms cannot survive. These regions are then known as **dead zones** (Fig. 1).



[Fig. 3]

Nutrient sources references:
UNDESA. 2017. World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. United Nations, Department of Economic and Social Affairs, Population Division
FAO. 2006. Livestock's long shadow. Rome, Food and Agriculture Organization of the United Nations (FAO).

[Fig. 1] How do you solve a problem like the dead zone?, accessed May 2021, https://iiseagrant.org/how-do-you-solve-a-problem-like-the-dead-zone/
[Fig. 2] Breitburg, D. et al., (2018). Declining oxygen in the global ocean and coastal waters. *Science* 359: eaam7240.
[Fig. 3] Vaquer-Sunyer, R. and Duarte, C. M., Thresholds of hypoxia for marine biodiversity. PNAS October 7, 2008 105 (40) 15452-15457.