



BIOREMEDIATION - GS III MAINS

Q. Bioremediation offers significant hope to India's waste management along with its own challenges. Examine (10 marks, 150 words)

News: *Bioremediation Rejuvenates Dying Lakes, Good Bacteria Does Miracles*

What's in the news?

- In a bid to clean the polluted lakes in the city, over the years the government hired NGOs to try out bioremediation to treat the water. This long-term pilot project has yielded positive results throughout the years.

Key takeaways:

- Bioremediation is a process of **introducing 'good' bacteria and microbes** to treat polluted water. Lakes such as Chinna Cheruvu in Neknampur, Yerrakunta in Shaikpet and Novotel Lake in Kothaguda have seen its Biological Oxygen Demand (BOD) and Dissolved Oxygen (DO) levels drastically come up due to this process.

Bioremediation:

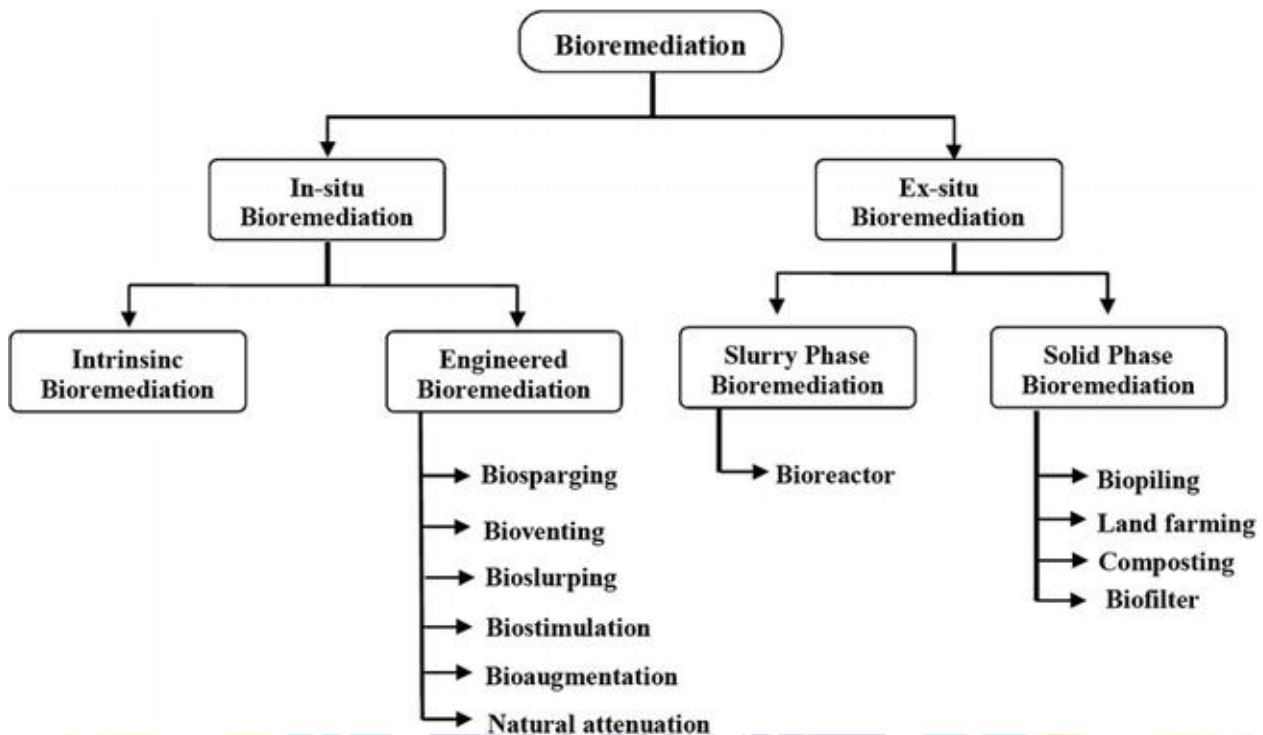
- It is defined as the process whereby (mostly) **organic wastes can be biologically degraded under controlled conditions** to an innocuous state, or to levels below the respective concentration limits, as set by the controlling authorities.

Features:

- It uses mainly **microorganisms (Bacteria, Fungi), plants or plant enzymes**, to detoxify contaminants in the soil and other environments.
- It also involves **either aerobic or anaerobic microorganisms** that often use this breakdown as an energy source.
- As it relies on the microbial growth and activity, its effectiveness is highly dependent on the applied environmental parameters that influence the microbial growth and the degradation rate.
- It can mineralize waste material into water, carbon dioxide, biomass, or other nonhazardous products and thus obviate the need for further treatment.



Types of Bioremediation:



Advantages of Bioremediation:

- The **use of naturally available sources** for bioremediation increases the efficacy of this process. It imparts **socioeconomic as well as environmental benefits** to ecosystems.
- It is a **natural waste treatment process**. The treatment products are commonly harmless including cell biomass, water, and carbon dioxide.
- It needs to be very **less laborious** and can commonly be carried out on-site, regularly without disturbing normal microbial activities. This also eradicates the transport amount of waste off-site and the possible threats to human health and the environment.
- It is a **cost-effective process** in comparison to other conventional methods that are used for clean-up of toxic hazardous waste regularly for the treatment of oil-contaminated sites.
- It also supports **complete degradation of the pollutants** - many of the toxic hazardous compounds can be transformed into less harmful products and disposal of contaminated material.
- It is **chemically benign**. Enzymes of microorganisms decontaminate the environment without the addition of toxicants in the environment.
- It is an **eco-friendly and economically sustainable approach** with use of microorganisms instead of harmful chemicals.
- Complete remediation of harmful contaminants presents in the environment instead of transferring contaminants from one site to another.
- Minimum site destruction and disruption.
- **Low energy consumption.**



Limitations of Bioremediation:

- **Only limited to biodegradable waste and contaminants.**
- Requires extensive monitoring.
- Being a biological process, specificity is a major drawback in terms of factors like type of environmental growth conditions, types of microorganisms, type of nutrient requirements and type of contaminants.
- Possibility of production unknown and potentially toxic byproducts.
- **Genetic engineering of the microbes** is needed in order to enhance the efficacy of the bioremediation process.
- Comparatively a time consuming process.

