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## Geographical Study of Water Pollution in India

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### Abstract:

Most rivers, lakes and surface water in India are polluted due to industries, untreated sewage and solid wastes. Although the average annual precipitation in India is about 4000 billion cubic metres, only about 1122 billion cubic metres of water resources are available for utilization due to lack of infrastructure. Water pollution is a significant environmental issue in India, affecting the health and well-being of millions of people. This study examines the geographical aspects of water pollution in India, including the sources, effects, and spatial patterns of pollution. The study uses a combination of secondary data sources, including government reports, research articles, and satellite imagery. The results show that water pollution is a widespread problem in India, with significant variations in pollution levels across different regions and water bodies. The study highlights the need for effective policies and management strategies to address the issue of water pollution in India.

### Objectives:

To examine the sources and effects of water pollution in India.

### Introduction:

The National Institution for Transforming India (NITI Aayog), a think tank by the Government of India reported that 600 million people in India encounter extreme to high water stress and continued lack of effective interventions can lead to unrelenting water crisis [1]. With a decadal growth of 17 %, the expanding urban population largely contributes to water demand and water pollution from domestic and industrial wastewater discharges [2]. Extensive migration of rural population to cities has led to an upsurge in utility services resulting in overexploitation of groundwaters. Besides expanding population, industrialization accounts for about a 4 % rise in water demand annually resulting in a substantial increase in industrial wastewaters volume [3]. It is estimated that the total water demand for domestic, industrial and agricultural sectors will rise to 103 billion cubic metres (BCM) in 2025 and 1447 BCM by 2050 [3]. Disproportionate distribution of natural water resources due to diverse geographies, climate change and irregular monsoons, trade and commerce further challenge water management in India. Water pollution is a significant environmental issue in India, affecting human health, ecosystems, and the economy. India's rapid industrialization, urbanization, and agricultural growth have increased water resource pollution. This study aims to examine the geographical aspects of water pollution in India, including the sources, effects, and spatial patterns of pollution.

### Methodology:

This study uses a combination of secondary data sources, including, Government reports, Data from the Central Pollution Control Board (CPCB), the Ministry of Environment, Forest and Climate Change (MoEFCC), and other government agencies. Studies published in peer reviewed journals and conference proceedings. Imagery from satellites such as Landsat and MODIS to analyze spatial patterns of pollution and field observations.

### Sources of Water Pollution in India:

The main sources of water pollution in India are

1. **Industrial effluents:** Chemicals, heavy metals, and other pollutants from industrial processes.
2. **Agricultural runoff:** Fertilizers, pesticides, and manure from agricultural activities.
3. **Domestic sewage:** Untreated or partially treated sewage from urban and rural areas.
4. **Solid waste:** Improper disposal of solid waste, including plastics and other non-biodegradable materials.

### Spatial Patterns of Water Pollution in India:

The spatial patterns of water pollution in India vary significantly across different regions and water bodies. The study uses satellite imagery to analyze the spatial patterns of pollution in different regions.

One of the most polluted river basins in India, with high levels of industrial and domestic pollution. Another highly polluted river basin, with significant levels of industrial and domestic pollution and Coastal areas, such as the Gulf of Kutch and the Sundarbans, are vulnerable to pollution from industrial and domestic activities.

**Types of Water Pollution:****Chemical pollution:**

Chemical pollution occurs when chemicals from industrial processes, agricultural runoff, or domestic activities enter water bodies. Heavy metals Lead, mercury, arsenic, and cadmium can contaminate water through industrial processes, mining, and waste disposal. Chemicals used in agriculture can enter water bodies through runoff, affecting aquatic life and human health. Excess nutrients from fertilizers can lead to eutrophication, harming aquatic ecosystems. Solvents, dyes, and other chemicals used in manufacturing can contaminate water through industrial processes and waste disposal.

**Physical Pollution:**

Physical pollution involves the introduction of physical substances into water bodies, Soil erosion and sedimentation can cloud water, harming aquatic life. Heated water from power plants or industrial processes can alter aquatic ecosystems. Radioactive substances can contaminate water through nuclear power plant accidents, mining, or waste disposal. Microplastics, Small plastic particles can enter water bodies through litter, microbeads, or synthetic fibers.

**Biological Pollution:**

Biological pollution occurs when living organisms or their byproducts enter water bodies, including Pathogens can contaminate water through sewage, agricultural runoff, or human waste. Fungi and algae: Excess nutrients can lead to algal blooms, harming aquatic ecosystems. Parasites and protozoa: Microorganisms can contaminate water through human waste, sewage, or animal waste. Invasive species: Non-native species can outcompete native species, altering aquatic ecosystems.

**Nutrient Pollution:**

Nutrient pollution happens when excess nutrients, such as nitrogen and phosphorus, enter water bodies, leading to: Eutrophication: Excess nutrients can stimulate algal growth, depleting oxygen and harming aquatic life. Algal blooms: Excess nutrients can lead to toxic algal blooms, harming aquatic life and human health.

**Dead zones:** Excess nutrients can create "dead zones" where aquatic life cannot survive.

**Agricultural Pollution:**

Agricultural pollution arises from farming activities, including Fertilizer and pesticide runoff: Chemicals used in agriculture can enter water bodies through runoff. Manure and livestock waste: Animal waste can contaminate water through runoff or direct discharge. Irrigation water pollution: Irrigation systems can leak or overflow, contaminating water bodies.

**Industrial Pollution:**

Industrial pollution comes from various industrial processes, including Chemical manufacturing:

Chemicals used in manufacturing can contaminate water through industrial processes and waste disposal.

**Mining and smelting:**

Mining and smelting processes can release heavy metals and other pollutants into water bodies. Oil refining and spills: Oil spills and refining processes can contaminate water bodies.

**Domestic Pollution:**

Domestic pollution originates from household activities, such as Sewage and wastewater: Untreated or poorly treated sewage can contaminate water bodies.

Trash and litter: Improperly disposed trash and litter can enter water bodies through storm drains or runoff. Cleaning products and chemicals: Chemicals used in household cleaning products can contaminate water through wastewater or runoff.

**Radioactive Pollution:**

Radioactive pollution occurs when radioactive substances enter water bodies, often due to: Nuclear power plant accidents: Accidents at nuclear power plants can release radioactive substances into water bodies. Mining and processing of radioactive materials: Mining and processing of radioactive materials can release radioactive substances into water bodies. Medical and industrial waste: Improperly disposed medical and industrial waste can contaminate water bodies.

**Micro-plastic Pollution:**

Microplastic pollution involves the introduction of small plastic particles into water bodies, often through: Plastic debris and litter: Plastic debris and litter can enter water bodies through storm drains or runoff. Microbeads in personal care products: Microbeads used in personal care products can enter water bodies through wastewater. Synthetic fibers from clothing: Synthetic fibers from clothing can enter water bodies through wastewater.

**Thermal Pollution:**

Thermal pollution occurs when heated water or materials are released into water bodies, often due to: Power plant cooling systems: Power plants can release heated water into water bodies, altering aquatic ecosystems. Industrial processes: Industrial processes can release heated water or materials into water bodies. Urban runoff and storm water management systems: Urban runoff and storm water management systems can release heated water into water bodies.

**Effects of Water Pollution in India:**

The effects of water pollution in India are widespread and significant, including: Human health risks: Waterborne diseases, such as cholera and typhoid fever, can be caused by contaminated

water. Environmental impacts: Water pollution can harm aquatic ecosystems, affecting plants, animals, and entire food chains. Economic consequences: Water pollution can damage fisheries, tourism, and other industries that rely on clean water.

#### **Solutions to Water Pollution:**

##### **Reduce, Reuse, Recycle:**

Minimize waste, reuse materials, and recycle to reduce the amount of waste that enters waterways.

##### **Implement sustainable agricultural practices:**

Use eco friendly farming methods to reduce chemical runoff. Invest in wastewater treatment: Upgrade infrastructure to properly treat and manage wastewater.

##### **Promote education and awareness:**

Educate communities about the importance of protecting water sources and the simple actions they can take to make a difference.

##### **Conclusion:**

Water pollution is a significant environmental issue in India, with widespread impacts on human health, ecosystems, and the economy. The study highlights the need for effective policies and management strategies to address the issue of water pollution in India. These strategies should include: 1. Improved wastewater treatment and management. 2. Enhanced regulations and enforcement. 3. Increased public awareness and education. 4. Sustainable agricultural and industrial practices.

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