ANTIBIOTIC POLLUTION: SCIENCE & TECHNOLOGY

NEWS: Human antibiotic use polluting rivers, fuelling drug resistance: Study

WHAT'S IN THE NEWS?

A global study warns that nearly one-third of human-used antibiotics pollute rivers annually, especially in Southeast Asia, fueling antimicrobial resistance and threatening both aquatic ecosystems and public health.

Context:

- A recent study published in the journal PNAS Nexus warns that antibiotics consumed by humans are significantly polluting global rivers, contributing to the rising threat of antimicrobial resistance (AMR) worldwide.

Key Findings of the Study:

1. Scale of Antibiotic Pollution:

- Nearly 8,500 tons of human-consumed antibiotics enter river systems annually, accounting for about one-third of total human antibiotic consumption.
- Antibiotics reach rivers primarily through sewage systems, improper disposal, and wastewater discharge.

2. Failure of Current Wastewater Treatment:

- Conventional wastewater treatment plants are often ineffective at removing pharmaceutical residues.
- Even after treatment, antibiotic residues persist in discharged water, entering freshwater ecosystems.

3. Geographic Hotspots:

- Southeast Asia is identified as the most vulnerable region due to:
    - High population density
    - High antibiotic usage
    - Low investment in wastewater infrastructure

4. Leading Pollutants Identified:

- Amoxicillin, the most-used antibiotic globally, was found most frequently in ecologically harmful concentrations.
- Other commonly detected antibiotics include ciprofloxacin, azithromycin, and metronidazole.

Understanding Antibiotic Pollution:

1. Definition:

- Antibiotic pollution refers to the presence of antibiotic residues in the natural environment, particularly in rivers, lakes, and soils.

2. Sources of Pollution:

- Human waste (urine and feces)
- Hospital and pharmaceutical waste
- Agricultural runoff (from antibiotic-treated livestock)
- Improper disposal of unused medicines

Impact on River Ecosystems:

1. Threat to Aquatic Biodiversity:

- Continuous exposure to low levels of antibiotics disrupts aquatic microbial balance.
- Affects fish reproduction, invertebrate development, and ecosystem health.

2. Bioaccumulation and Ecological Stress:

- Repeated exposure leads to accumulation of antibiotics in sediments and biota.
- Causes long-term ecological imbalance, reducing biodiversity.

3. Microbial Disruption:

- Alters microbial composition in river sediments, affecting:
    - Decomposition processes

    - Nutrient cycling
    - Water purification capacity

Implications for Human Health:

1. Rise in Antimicrobial Resistance (AMR):

- Residual antibiotics in water encourage the evolution of resistant bacterial strains.
- These bacteria may become untreatable with standard antibiotics, posing major public health threats.

2. Human Re-exposure Routes:

- Polluted river water may return to humans through:
    - Irrigation of crops
    - Drinking water sources
    - Bathing and recreational use
- Increases risk of human contact with resistant pathogens.

3. Global Health Concern:

- AMR is already responsible for millions of deaths annually, and environmental exposure accelerates the crisis.

Way Forward:

1. Policy and Infrastructure Reform:

- Upgrade sewage treatment plants (STPs) with advanced filtration and pharmaceutical residue removal technologies.
- Enforce strict effluent discharge norms for hospitals and pharma industries.

2. Strengthened Monitoring Systems:

- Develop nationwide water quality monitoring programs, especially in hotspot regions like South Asia.

- Encourage real-time surveillance of river ecosystems for antibiotic residues.

3. Need for Holistic Regulation:

- Enact international protocols on antibiotic discharge limits, including:
    - Pharmaceutical manufacturing
    - Hospital waste management
    - Agricultural use controls

4. Broadening Research Scope:

- Current estimates only account for human use; incorporating:
    - Veterinary antibiotics
    - Poultry and cattle industry emissions
    - Industrial discharge
- Would provide a more accurate risk assessment.

Conclusion:

- The study reinforces that environmental antibiotic pollution is a growing global health and ecological concern.
- Tackling it requires integrated approaches involving health policy, waste management, industrial regulation, and public awareness.
- If left unaddressed, antibiotic contamination of rivers may undermine modern medicine, accelerate drug resistance, and endanger aquatic biodiversity.

Source: https://www.business-standard.com/world-news/human-antibiotic-use-polluting-rivers-fuelling-drug-resistance-study-125051300022_1.html