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EMERGING POLLUTANTS: PROTECTING WATER QUALITY FOR THE HEALTH OF PEOPLE AND THE ENVIRONMENT

THEME III

Emerging pollutants and managing wastewater and waste

KEY POLICY MESSAGES

- The best treatment for emerging water pollutants is to avoid the discharge of the pollutants in the first place.
- Once discharged, wastewater treatment technologies are vital in mitigating the effects of emerging pollutants, but there are limitations to their effectiveness.
- Sampling and analysis of emerging pollutants is expensive and limited, necessitating new analytical approaches using existing data.
- Potential shifts in strategy to improve wastewater treatment processes and technologies include (1) decentralizing treatment processes; (2) developing and improving advanced approaches; (3) the innovative use of locally available materials; and (4) the use of non-traditional approaches such as soil aquifer treatment systems.
- Research should address (1) the effectiveness of wastewater treatment technologies in removing emerging pollutants; (2) the fate of emerging pollutants in wastewater treatment process byproducts such as sludge and biosolids; (3) health concerns about the reuse of treated wastewater and it byproducts on health; and (4) treated wastewater reuse for groundwater recharge and agricultural production.

Wastewater discharge from an industrial plant
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This Policy Brief presents the summary and key policy messages of research findings presented in the sessions under Theme 3 "Emerging pollutants and managing wastewater and waste" of the UNESCO-IWRA Online Conference on Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment, held online from 17-19 January 2023.

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Widespread use of plastic, pharmaceuticals, and chemical pathogens has added worrisome levels of emerging pollutants to the world's waters.

WASTEWATER TREATMENT TECHNOLOGIES ARE EXPENSIVE, COMPLEX AND LIMITED IN THEIR EFFECTIVENESS

Wastewater treatment technologies are vital in mitigating the effects of emerging pollutants, but there are limitations to the effectiveness of treatments in removing emerging water pollutants from wastewater and freshwater resources. The best treatment is to avoid or prevent the discharge of the pollution in the first place, which avoids the need for expensive and complex wastewater treatment processes. Rigorous source control systems can prevent many emerging pollutants from contaminating waterbodies and protect ecosystems and human health.

MONITORING EMERGING POLLUTANTS IS COMPLEX, EXPENSIVE AND LIMITED

Where discharge cannot be avoided or reduced, treatment of pollutants in wastewater is essential. The variety of pollutants is wide due to the advancement of science and technology, which has led to the development of new substances for healthcare and in the economy more broadly. The amount of pollutant generation depends on the specifics of product uses, but the quantity generally increases with population size. For example, pharmaceutical drug use has increased due to population growth, life expectancy, and changes in human consumption patterns. Monitoring emerging pollutants in wastewater and within wastewater treatment facility processes is a highly complex and challenging task. Adequate sampling and analysis incur continuous costs and pose detection limitations.

A HOPEFUL NOTE: CHANGING WASTEWATER TREATMENT STRATEGIES CAN IMPROVE PERFORMANCE

Emerging pollutants occur in many combinations, have multifaceted origins, and a variety of chemical structures. Conventional biological wastewater treatment processes were not designed to remove these contaminants, although some removals may occur. A single additional treatment system will likely not be sufficient for removal of all emerging pollutants. Further, there are many information and research gaps on emerging contaminants' fate in sludge, biosolids

Wastewater treatments are of limited effectiveness in removing emerging pollutants.

To advance understanding of how to mitigate emerging pollutants in Brazil, data analytics was applied to data from publicly available sources, including pharmaceutical sales data in Brazil. With a better understanding of the mass of pharmaceuticals sold and trends of their use in major metropolitan areas, monitoring can be targeted, thus reducing resource-intensive data collection. Also, study results compiled from available literature on the behavior of emerging pollutants before and after wastewater treatment will help to further inform future monitoring programs in urban waterways. The comparative analysis has shown that open-source data can provide important contributions to development of monitoring programs.

and other wastewater treatment process wastes. Research into new and improved strategies for wastewater treatment to address emerging pollutants is on-going but additional work is greatly needed. Three broad categories of changed strategies are discussed below.

Treatment at decentralized locations

New strategies for wastewater treatment can improve the performance of treatment processes. One option is to treat wastewater before it is released to the public sewerage system. As wastewaters from different sources are aggregated into a centralized treatment facility, the effectiveness of pollutant removal decreases, particularly for substances in trace amounts, such as emerging pollutants. Implementing wastewater treatment systems that are tailored for specific contaminants at sites where the contaminants originate can provide promising results. For example, hospital wastewater discharge contains pharmaceuticals and epidemiological vectors that pose potential human health risks. Treatment of wastewater at hospital sites may lessen the release of these contaminants into local water systems. Organic water treatment methods, for instance, when applied on a localized scale, are potentially more efficient and cost-effective than when part of a centralized facility.

New methods and materials

Research is taking place on a range of innovative treatment options and their effectiveness for removing various emerging contaminants from water, including the use of low-cost, locally available materials. Ceramic filters made of clay have been used for treating wastewater, stormwater, and drinking water. This method is best suited for lower water flow rates in combination with increased process retention times. Also, chemically-activated carbon derived from bamboo sawdust has successfully removed the pharmaceutical paracetamol from water. In India, use of a symbiotically functioning algal-bacterial community has been demonstrated to remove some emerging contaminants from hospital wastes.

Other advanced treatment methods under examination for emerging contaminant effectiveness include catalytic ozonation, activated carbon adsorption, Ultra-violet Advanced Oxidation Processes (UV-AOPs), and the heterogeneous photo Fenton process. These processes have the potential to remove emerging water pollutants from wastewater. Further research is required to seek low-cost, sustainable technologies to remove pollutants from wastewater.

Non-traditional solutions to wastewater treatment

Soil Aquifer Treatment System (SAT) is a powerful technology for water reuse and large-scale treatment using sorption barriers (materials like compost, woodchips, biochar, clay, or zeolite that take-up pollutants better than many soils alone). Trace organic contaminants (pharmaceuticals, personal care products, viruses, bacteria, and micro- and nano-plastics), which are frequently found in treated wastewater, can be removed as water infiltrates soils supplemented with sorption barriers. SAT is especially desirable where wastewater can be used to supplement groundwater resources through aquifer recharge.

The increasing occurrence of emerging pollutants in wastewaters globally urgently requires new regulatory and technological strategies, incorporating government regulations, research, and an increase in public awareness.

RESEARCH NEEDS

- **Evaluate the effectiveness of wastewater treatment technologies in removing emerging pollutants**
- **Determine the fate of emerging pollutants in sludge and wastewater treatment process byproducts**
- **Make risk assessments of the reuse of treated wastewater and sludge, especially for groundwater recharge and agricultural production.**

Sampling and analysis are costly.

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