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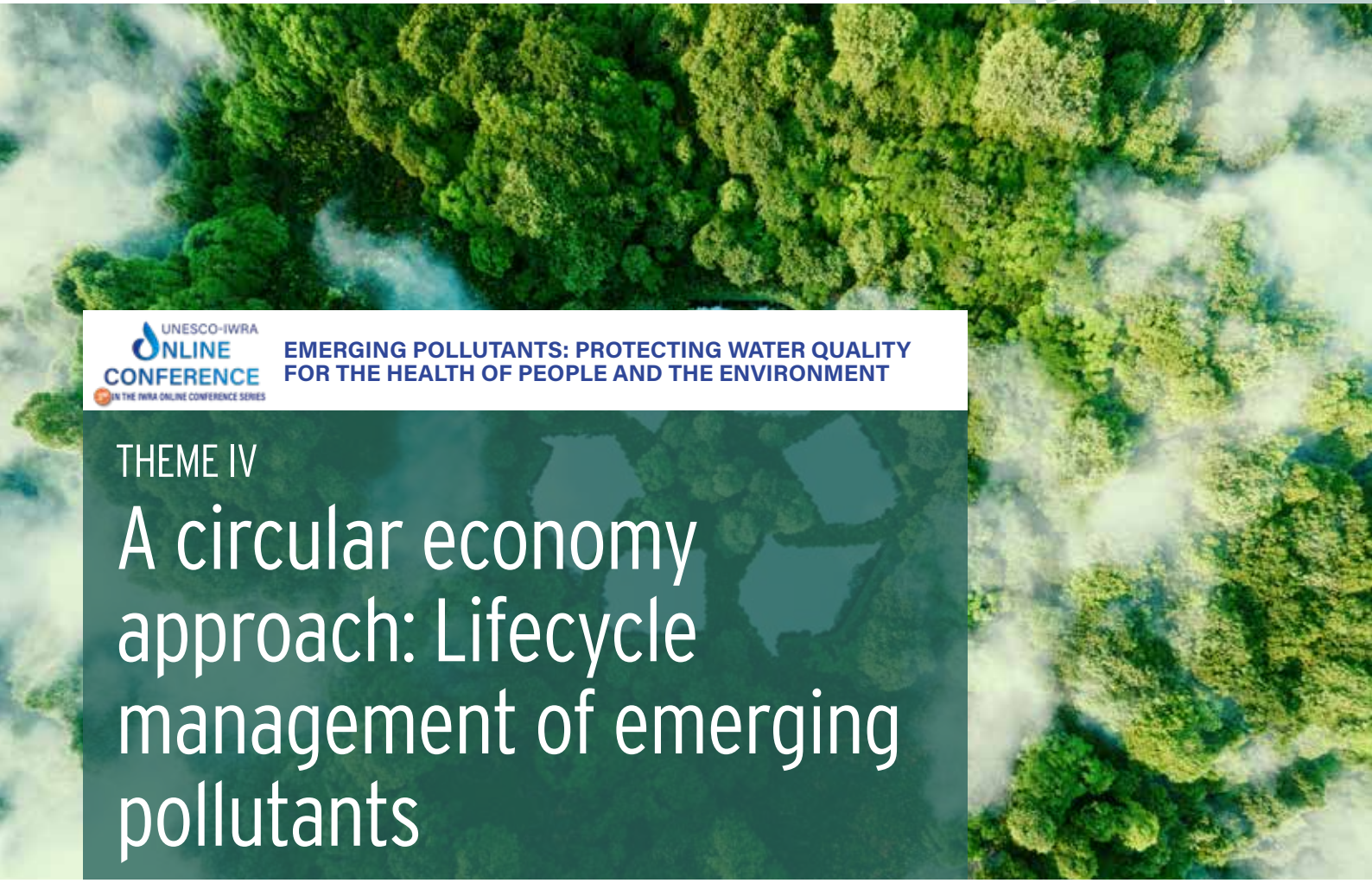

UNESCO-IWRA ONLINE CONFERENCE
IN THE IWRA ONLINE CONFERENCE SERIES

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

THEME IV

A circular economy approach: Lifecycle management of emerging pollutants

KEY POLICY MESSAGES

- To reduce the risk of emerging contaminants accumulating in water, policy interventions should target all stages of the lifecycle of a product.
- With a circular economy approach, byproducts that would become pollutants can be processed to produce other products or to biodegrade after use (e.g., colorants produced from fungi that can be dehydrated and composted after use).
- Governments play a crucial role in stimulating research and innovation to transform byproducts into resources and to redesign processes to avoid pollutants that cannot be repurposed.
- Multidisciplinary teams, including academics and regulators, are an effective mechanism to bring knowledge together and identify novel policies and technological approaches to support a circular economy approach.

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Managing pollutants successfully requires the consideration of the full lifecycle of products that generate pollutants, meaning that it is not only the sources of the pollutants and their fate in water that matter, but also product design, materials used to produce products, recyclability or biodegradability of materials used, disposal options after use, and any residual pollutants' afterlives. Who uses these materials before we mark them as pollutants?

Research and models are being developed to systematically consider the inputs and outcomes of supply chains, including of food supply chains. The MICRON model is a circular economy assessment framework targeted at helping companies measure how well they are doing regarding the use of water and energy, the production of waste and emissions and the durability of their product. The model seeks to provide insights into solutions and prioritization, and to accelerate the transition to a circular economy. The production process for coffee was used to explain the model.

1) **Identify and consider alternative production paths. Coffee may be produced and processed using a "wet" method, which requires lots of energy and water, or a dry method, which requires less water and energy but relatively more time and space.**
2) **Collect wastes from all stages of the supply chain and figure out how to use them. Coffee waste may be used for many purposes, including to produce biofuels, animal feed, and activated carbon; as composting material, and for use in particle board and dietary fiber.**
3) **Develop network mapping pathways for processing within the coffee supply chain.**
4) **Develop mathematical optimization model to minimize waste and GHG emissions, minimize use of natural resources, and maximize energy efficiency and profit of the system.**
5) **Analysis of demand scenarios produce potential solutions that can inform decision making based on objectives. The production of instant coffee requires far more water and coffee cherries, and it emits far more GHG than a mix of whole bean coffee and coffee beverages.**

ADOPT A CIRCULAR ECONOMY APPROACH

The circular economy refers to an economic system based on redesigning, reusing, and regenerating materials or products and the processes that create them to improve sustainability. Essentially, the circular economy is a model of production and consumption that seeks to extend the lifecycle of a product indefinitely through means such as redesigning, sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products. The classical linear economy generates waste that eventually makes its way into water and other environmental media, causing environmental and drinking water pollution. In a circular economy approach, 'waste' created in every step of the production and use processes becomes an input for reuse as part of an alternative product needed in the economy or degrades safely into compostable material.

The concept of circular economy has received increasing attention as growing human populations and increased consumption levels place pressure on natural resources around the globe, increase waste streams, threaten water supplies, and pollute and harm the natural environment. The Organization for Economic Cooperation and Development has noted that "[t]hrough more efficient use of resources, eco-design, reuse, repurpose and remanufacturing, the circular economy is an opportunity for a new way of thinking and an example of resilience in the face of future crises" (OECD, 2020). Further, Sustainable Development Goal 12 calls for responsible consumption and production, objectives inherent in and served by the circular economy model. Water experts are already familiar with circular approaches, as the hydrological cycle is inherently circular, and the sector has long applied circular economy principles in technical and institutional aspects of water resource management.

A circular economy approach may be used to redesign products and to repurpose residual "pollutants" to give them a new life.

APPLY A CIRCULAR ECONOMY CONCEPT TO EMERGING POLLUTANTS

Policy interventions to reduce the risk of emerging pollutants accumulating in water should target all stages of the lifecycle of a product:

- Avoiding pollution at the source. The supply chain of a product can be modelled to identify part(s) of the process that can be improved to reduce the production of residuals, decrease emissions and the use of natural resources, increase the use of renewable energy, and extend the lifespan of products. Learning from modelling can help move toward sustainable development and decrease water pollution overall.
- Avoiding or reducing pollution during product use. Proper storage of a product during use can help reduce pollution as well. For example, reduced packaging, and reusable or biodegradable containers, reduce waste generated by product shipping and storage.
- Minimizing pollution at end-of-pipe destinations: Wastewater treatment processes remove some pollutants from water but transfer them to sludge or biosolids, while residual substances still end up in wastewater, which is released to ambient water and potentially withdrawn for drinking water. Conventional wastewater and drinking water treatment processes were not designed for emerging, persistent contaminants. For example, in Brazil, the antibiotics azythromicin and amoxicillin are commonly found in wastewater even after treatment because of the low efficacy of wastewater treatment processes for these substances and the societal overuse of antibiotics. Legislation to reduce the sources of pollutants at source or to manage the use of products that cannot be eliminated (such as some pharmaceuticals) is essential to move to a circular economy.

GENERATE RESOURCES FROM POLLUTANTS

In addition to lessening and improving the management of pollution generated by consumption and released into the natural environment, the circular economy approach can also contribute to active recovery and supply of resources for reuse. Research has investigated some of these opportunities.

- Lake Tegel in northwestern Berlin, Germany, is polluted with algae cyanobacteria due to wastewater residue, pharmaceutical micro-pollutants, and climate change. To remediate to this problem in a circular economy approach, a German start-up company is designing a process to separate the toxins generated by cyanobacteria from the nutrients provided by the microalgae. The microalgae can then be used as biofertilizer.
- Colorants today represent a $68 billion industry that is based mostly on synthetic colorants. Using fungi to produce colorants has the potential to make the industry sustainable; however, while promising, the necessary energy demand of the process presents a challenge.

PROPER GOVERNANCE IS CRITICAL

Governments have a key role to play in supporting the development of circular economy approaches. Authorities should consider interventions to enable more effective recycling and reuse, the enactment of stricter regulatory standards to require compliance with production and pollution prevention rules, facilitating lifecycle approaches involving actors all along the supply chain, and investments to stimulate innovation. Consultation between innovators, such as research labs and academic institutions, and regulators, who are often well informed about the presence and effects of pollutants in water, can help to create and implement new and more effective policies and technologies. Multidisciplinary teams can be effective in bringing knowledge together and implementing novel policies and technological approaches to support a circular economy approach.

Sustainable Development Goal 12 calls for responsible consumption and production

REFERENCE
OECD (2020). The Circular Economy in Cities and Regions Synthesis Report

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