IIT Indore develops new water quality monitoring tool to protect India's wetlands

Researchers at the Indian Institute of Technology Indore have created a new digital application that can monitor the health of wetlands in near real-time, helping protect these vital ecosystems from pollution and other threats.

The tool has been developed by Prof. Manish Kumar Goyal and his research scholar Mr. Vijay Jain from the Department of Civil Engineering. It uses satellite images and cloud-based computing to keep a close watch on water quality, identifying problems like excess nutrients (eutrophication) and cloudiness (turbidity) before they become serious.

Wetlands are nature's lifelines – they clean water, control floods, store carbon, and provide shelter to countless plants and animals. Though they cover only about 9% of the Earth's surface, wetlands contribute more than 23% of global ecosystem services. India has 15.98 million hectares of wetlands, nearly 5% of its geographical area, and is a signatory to the Ramsar Convention since 1982. The country has 93 Ramsar-designated wetlands spread over 1.36 million hectares, all critical for biodiversity. However, these wetlands are under pressure from urbanization, pollution, climate change and invasive species.

Traditionally, wetland monitoring has depended on manual water sampling and lab testing – processes that take time and often delay corrective action. This application solves this problem by using freely available Sentinel-2 satellite data, with a 10-meter spatial resolution and five-day temporal resolution, combined with cloud-based computation. It calculates four key indices: NDCI (chlorophyll content, for detecting eutrophication), NDTI (turbidity levels), NDWI (freshwater availability), and NDMI (moisture in aquatic vegetation). Together, these indices give a near-complete picture of wetland health, covering nutrient levels, water clarity, seasonal fluctuations, and vegetation condition.

The advantages of the tool:

- Real-time updates: Detects pollution, algae growth, or water quality issues faster than manual testing.
- Cost-effective: Uses free satellite data and open-source platforms, reducing the need for expensive equipment.
- User-friendly: Designed so that even local communities, NGOs, and non-specialists can use it.
- Early warning system: Can help predict and prevent serious problems like algal blooms, invasive species spread, or pollution events.
- Scalable: Can be applied across all of India's wetlands.

Prof. Suhas Joshi, Director of IIT Indore, said "This innovation reflects IIT Indore's commitment to developing technology for societal and environmental impact. By combining science, technology, and sustainability, this tool empowers authorities and communities to protect our vital wetland ecosystems."

“Our tool provides real-time data that can be used as an early warning system for emerging threats. It enables quicker action, ensuring that wetlands can be protected and preserved for future generations.” said Prof. Manish Kumar Goyal. He further added “Our near real-time water quality monitoring application empowers wetland managers and stakeholders with timely, satellite-based insights to detect pollution, eutrophication, and turbidity, enabling rapid intervention and informed decision-making to protect India’s Ramsar Wetlands.”

Looking ahead, the researchers plan to enhance the tool by including more water quality parameters and enabling instant alerts on pollution events. Importantly, the application is free for all users, making it accessible for governments, conservation groups, and citizens alike.

This breakthrough is a significant step toward safeguarding India’s wetlands, protecting biodiversity, supporting climate regulation, and ensuring water security for the future.