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New Taipei Municipal Hsin Tien Senior High School

THE GLOBE PROGRAM TAIWAN
Global Learning and Observations to Benefit the Environment

Investigation of Water Quality and Microplastic Distribution in the Jingmei and Xindian Rivers

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Abstract

This study aims to investigate the differences in water quality and microplastic distribution between the Jingmei and Xindian Rivers, while analyzing the impacts of rainfall events and urbanization levels (population density) on the fluvial environment. Sampling was conducted at Jingmei Bridge and Gongguan, with monitoring indicators including water temperature, pH value, dissolved oxygen (DO), and electrical conductivity (EC). Microplastic content was further analyzed using microscopic observation. The results indicate that rainfall significantly reduces the dissolved oxygen levels in both rivers. Furthermore, due to the influence of surface runoff, the increase in electrical conductivity following rainfall was more pronounced in the Xindian River than in the Jingmei River. Regarding microplastics, the abundance measured in the Daan District (Xindian River sampling site), which has a higher population density, was generally higher than that in the Wenshan District (Jingmei River). This suggests a positive correlation between microplastic abundance and human activity as well as urban development.

Research motivation

In recent years, river pollution has become a major global environmental concern. Rivers are crucial interfaces connecting terrestrial and marine environments. Their water quality and microplastic content not only reflect the extent of human impact but also influence the health of aquatic organisms and ecosystems.

Methodology

Understanding the Water Quality of Xindian River and Jingmei River
(1) pH
(2) Dissolved Oxygen (DO)
(3)Electrical Conductivity (EC)
(4)MicroPlastics (MP)

Figure 1. Geographic Location of Taiwan

Figure 2. Taipei, Taiwan

- Site A (Jingmei River): Downstream section near Jingmei Bridge (Coordinates: 121.5421 / 24.9877). This area is characterized by residential zones and green spaces.

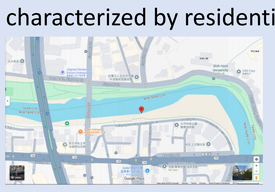


Figure 3. Jingmei River Sampling Site

Figure 4.Sampling point environment

- Site B (Xindian River): Near Gongguan Watergate (Coordinates: 121.5318 / 25.0094). This area is adjacent to the densely populated Daan District and commercial zones.

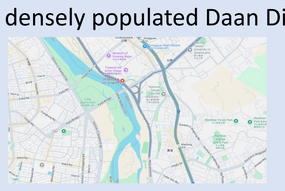


Figure 5. Xindian River Sampling Site

Figure 6.Sampling point environment

Discussion

- **The Impact of Environment on Water Temperature**

The water temperature of the Jingmei River was more stable than that of the Xindian River. The Jingmei sampling site is surrounded by residential areas and riverbank vegetation, which may provide a buffering effect. In contrast, the Xindian River site is located in a highly urbanized zone (Gongguan) with concrete embankments, drainage outfalls, and high traffic. These anthropogenic factors likely contribute to the greater temperature fluctuations observed in the Xindian River.

- **Influence of Rainfall on River Water Quality (pH & DO)**

While typhoon rainfall is typically slightly acidic, river water generally has a buffering capacity. However, on October 19, the Xindian River showed a significant drop in pH (to 4.73), suggesting that local surface runoff in this urbanized area might carry acidic pollutants. Regarding Dissolved Oxygen (DO), heavy rainfall (Oct 19) caused DO levels to drop in both rivers. This is attributed to:
(1)Turbidity: Runoff increases turbidity, blocking sunlight and reducing algal photosynthesis.
(2)Organic Load: Rain washes organic matter into the river, stimulating microbial decomposition which consumes oxygen. By November 6, the Jingmei River's DO recovered more effectively than the Xindian River. The Jingmei River's faster flow and narrower channel likely facilitate better aeration and self-purification compared to the wider, slower-moving Xindian River.

- **Rainfall Effects on Electrical Conductivity (EC)**

Rainfall impacts EC in two opposing ways: dilution (lowering EC) and surface runoff transport (raising EC).
(1)In the Jingmei River, EC decreased on the rainy day (Oct 19), suggesting the dilution effect dominated.
(2)In the Xindian River, EC increased on the rainy day, suggesting that surface runoff from the urban area flushed dissolved ions and pollutants into the river, overriding the dilution effect.

- **Urbanization and Microplastic Pollution**

Throughout the study, the Xindian River (adjacent to Daan District, Pop: ~289,000) consistently showed higher microplastic counts than the Jingmei River (Wenshan District, Pop: ~258,000). Microscopic analysis revealed that the Xindian River samples contained various synthetic fibers and potential textile fragments. This correlates with the higher population density and commercial activity in the Daan District. The results support the hypothesis that microplastic abundance is positively correlated with urbanization levels, as surface runoff transports plastic waste and synthetic fibers (from laundry and wastewater) into the river system.

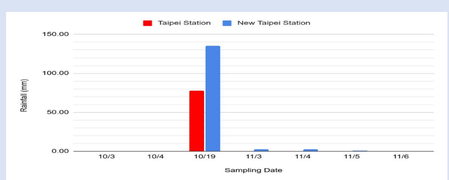


Figure 7.The relative location of the monitoring station and the sampling point, and rainfall data

Research Questions

(1) Is there a significant difference in water quality between the Jingmei River and the Xindian River?
(2) Do rainfall events influence water quality variations in these rivers?
(3) Is there a detectable difference in microplastic abundance between the two rivers?
(4) Do population density and the level of urbanization in the catchment areas influence microplastic concentrations?
(5) Do rainfall events correlate with changes in microplastic concentrations?

Equipment

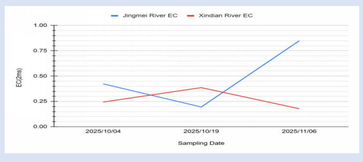
1.Thermometer
2.Glass bottles ×2
3.Portable pH meter
4.Dissolved Oxygen (DO) meter
5.Conductivity meter
6.Filter paper (5.0 μm)
7.Vacuum filtration apparatus
8.Microscope
9. Google Sheets
10.GLOBE Observer APP

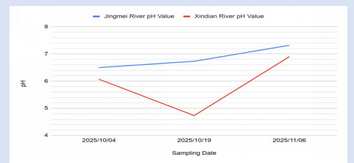
Experimental Procedure

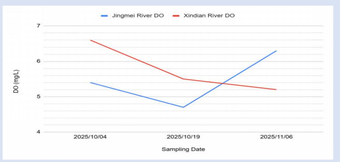
Water Sampling: Collect water samples from both sites on designated dates.
On-site Measurement: Measure water temperature immediately.
Laboratory Analysis: Measure pH, DO, and EC values.
Microplastic Extraction: Filter 250 mL of river water through 5.0 μm filter paper using a vacuum filtration device.
Microscopic Observation: Inspect the filter paper under a 60X microsc0ope. Identify potential microplastics based on physical characteristics (e.g., cellular structure, consistent diameter, color, and lack of biological segmentation) to distinguish synthetic fibers from natural cellulose or animal hairs.
Data Analysis: Correlate findings with rainfall data from the Central Weather Bureau and population density statistics.

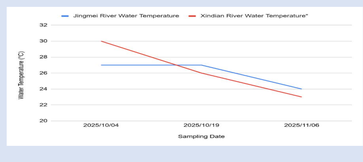
Results

Data was collected on October 4 (Sunny), October 19 (Rainy/Post-Typhoon), and November 6 (Overcast/Light Rain).
1. Water Temperature
Jingmei River: Relatively stable (24°C–27°C).
Xindian River: Greater variation (23°C–30°C), showing a clearer decreasing trend over the sampling period.
2. pH Value
Jingmei River: Remained neutral to slightly alkaline (6.5–7.32), showing a gradual increase.
Xindian River: Exhibited significant fluctuation (4.73–6.9), dropping noticeably to 4.73 after the heavy rainfall on October 19.
3. Dissolved Oxygen (DO)
Jingmei River: 4.7–6.3 mg/L. Lowest recorded on the rainy day (Oct 19).
Xindian River: 5.2–6.6 mg/L. Also dropped on Oct 19 but showed a different recovery pattern than the Jingmei River.
4. Electrical Conductivity (EC)
Jingmei River: Decreased after rain (Oct 19) due to dilution, then rose significantly on Nov 6.
Xindian River: Increased after rain (Oct 19), likely due to surface runoff carrying ions, then decreased.
5. Microplastics
Jingmei River: 3–5 particles per 250 mL.
Xindian River: 4–7 particles per 250 mL.
Observation: The Xindian River consistently contained a higher quantity of microplastics than the Jingmei River across all sampling dates.









Conclusion

Rainfall Impact: Heavy rainfall events lead to a decrease in dissolved oxygen (DO) due to increased turbidity and organic load.
Water Quality Stability: The Jingmei River generally exhibits more stable pH and temperature conditions compared to the Xindian River, which is more susceptible to fluctuations caused by urban runoff.
Urbanization & Microplastics: There is a clear positive correlation between population density and microplastic abundance. The Xindian River, located in a denser urban area, consistently contained higher levels of microplastics than the Jingmei River.
Self-Purification: The Jingmei River appears to have a better capacity for DO recovery after rainfall, likely due to its hydrological characteristics (faster flow) and lower baseline pollution load.