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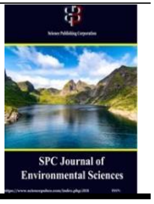
Short communication



Preliminary Assessment of the Pollution Status of Sapang Balen River, Mabalacat City, Philippines

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Abstract

Scarcity of freshwater is a significant global threat, particularly in ecosystems like rivers, which are crucial for biodiversity, drinking water, and community sustenance. This study evaluates the ecological health of the Sapang Balen River in Mabalacat City, Pampanga, Philippines, by examining plant species, solid waste accumulation, heavy metals, coliform counts, and physicochemical parameters. Field measurements and laboratory analyses revealed low biodiversity in the river, characterized by many fast-growing and invasive plants that threaten ecosystem balance. Water quality assessments indicate alarmingly high levels of microbial contamination, with coliform counts significantly exceeding safe limits, likely due to urbanization and domestic waste. Despite these challenges, ongoing remediation efforts, such as bioflocculants, filtration systems, and water revetments, show promise for improving water quality. The study highlights the importance of continuous monitoring and adaptive management to restore and sustain the health of the Sapang Balen freshwater ecosystem.

Keywords: *Bioflocculants; Coliform counts; Physicochemical; Sapang balen*

1. Introduction

Access to potable water is a global challenge and a key focus of the Sustainable Development Goals (SDG). Freshwater, comprising only about 0.001% of Earth's water resources, is essential for ecological balance and human life. Rivers and other freshwater ecosystems provide crucial services, including drinking water and biodiversity support. However, these ecosystems are threatened by pollution, habitat alteration, species introduction, and climate change. Conservation and restoration efforts are vital to protect freshwater resources and promote sustainability (Aylward et al. 2005; Carpenter et al. 2011; Allan et al. 2021).

Sapang Balen, also known as Dolores River, is one such freshwater ecosystem facing these challenges. Located in Mabalacat City, Pampanga, it flows through multiple barangays and plays a significant role in the local community, covering 485.20 hectares of the city's land area (Sapang Balen, 2020). As part of the Pampanga River Basin, it is crucial to the region, nevertheless, recent reports from the Department of Transportation (DOTr) revealed alarming levels of biological oxygen demand (BOD), fecal coliform, total coliform, phosphate-phosphorus, and copper, all of which fail to meet the DENR Class C guidelines (Nuguid, 2021). These findings highlight the urgent need for intervention and ongoing evaluation to address the sustainability challenges of the river's ecosystem.

A key aspect of freshwater ecosystem health is understanding its flora, as plants play vital roles in nutrient removal, carbon storage, and as food sources (Pan et al. 2023). Proper plant identification and monitoring are crucial for evaluating the health of Sapang Balen's freshwater ecosystem. Additionally, factors like solid waste, heavy metal contamination, coliform levels, and physico-chemical parameters must be continuously assessed. This study aims to evaluate Sapang Balen’s freshwater ecosystem health by examining plant species, solid waste, heavy metals, coliforms, and physico-chemical parameters. However, it will be limited to assess macro- and microplastics or propose treatment actions.

2. Materials and Methods

2.1. Study Area

The location of the study was on the Sapang Balen, Mabalacat City, Pampanga, Philippines. The subareas of the conduction were divided into headstream and middle stream. The coordination of river, *15°14'37"N·120°36'42"E·15.24376,120.61175* was obtained using a GF-07 GPS tracker. The certificate of conduction was issued by City Environment and Natural Resources (CENRO) of the Mabalacat City LGU.

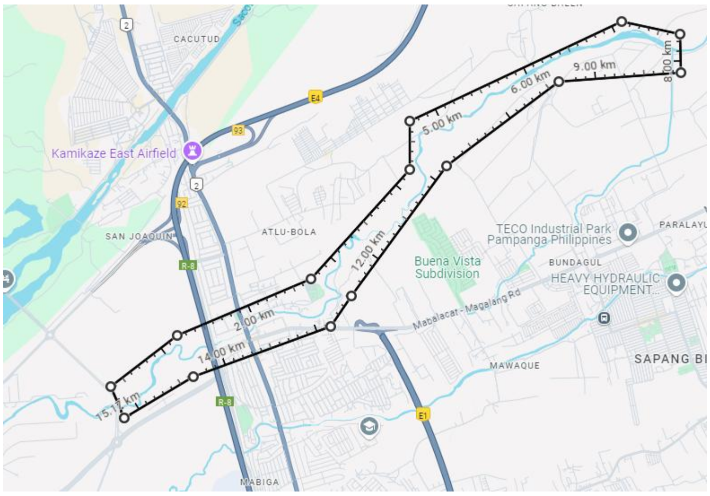

Fig. 1: Map Showing the Covered Area of the Sapang Balen River, including the Riparian section.

2.2. Physicochemical Parameters

The physical attributes of the Sapang Balen River, including its depth and width, were measured using a meter stick and a measuring tape, with assistance from the City Environment and Natural Resources Office (CENRO) to ensure accuracy and compliance with environmental protocols. Solid waste collection and classification were performed from August 2023 to January 2024, following CENRO guidelines, with personal protective equipment worn for safety. After classification, waste was transported to a landfill. The river's pH and temperature were measured *in-situ* using a Smart Water Quality Tester 6-in-1 Meter Monitor, with tests conducted in three regions within each subsite between 8:00 AM and 11:00 AM to ensure accurate and representative data.

2.3. Water Quality Analysis

Water samples were collected from two designated subareas, with three replicates taken from each subsite. The replicates were drawn from the epilimnion, metalimnion, and hypolimnion layers of the river, as outlined by the CRL Environmental Corporation, to provide a comprehensive profile of water quality at varying depths. All samples were immediately stored in sterilized sample bottles. The samples were then promptly transported to CRL Environmental Corporation for fixation and detailed analysis, focusing on the assessment of Total Coliforms, Heterotrophic Plate Count, and Thermotolerant Coliforms

2.4. Plant Preparation and Identification

Plant specimens were collected from the riparian zones of the designated subsites along the Sapang Balen River. After collection, the specimens were carefully placed in plastic bags during transport and promptly taken to the Biology Laboratory at Mabalacat City College, Pampanga, Philippines for preparation and fixation. The protocol for specimen fixation and preparation followed the guidelines established by the University of the Philippines (Nolasco et al. 2023). Once fixed, the specimens were transported to the Jose Vera Santos Memorial Herbarium at the Institute of Biology, College of Science, University of the Philippines, Diliman, Quezon City for taxonomic classification.

2.5. Statistical Analysis

This study utilized descriptive statistics to analyze the data collected from the study area, providing a comprehensive summary of the observed parameters. To benchmark the findings, the study compared results against the Philippine National Standards for Drinking Water 2017 (PNSDW) parameters, ensuring alignment with established environmental standards. Additionally, arithmetic mean calculations were performed on the data to determine central tendencies and facilitate further analysis.

3. Results and Discussion

3.1. Plant Identification

Various species of flora, belonging to different families, have been observed and identified situated on the riverbanks of Sapang Balen (Figure 2). The identified plants in the riparian system of Sapang Balen have both positive and negative impacts on its freshwater ecosystem. Certain species, such as *M. cordata*, *C. capsularis*, *E. prostrata*, can provide control to soil erosion through roots, fibers (Raman et al. 2018), and symbiotic relationship (Duc et al. 2021). Other plants, such as *C. mucunoides* and *M. pudica*, contribute to nitrogen fixation that can improve soil fertility (Ferreira et al. 2016). However, most of the plants are fast-growing often leading to competition for space and resources. Some are also known to release allelochemicals (*M. cordata*) (Hossain et al. 2016) and toxic compounds (*R. communis*) (Landoni et al. 2023) that can alter the ecosystem balance. It can also be noted that the plants are classified as weeds, mainly from disturbed areas of Sapang Balen, showing low biodiversity of the riparian area. Riparian areas invaded by weeds indicate a threat to ecosystem health. A healthy riparian system is crucial to maintaining the health of freshwater system and therefore effective weed management must be implemented (Sheley et al. 1995).

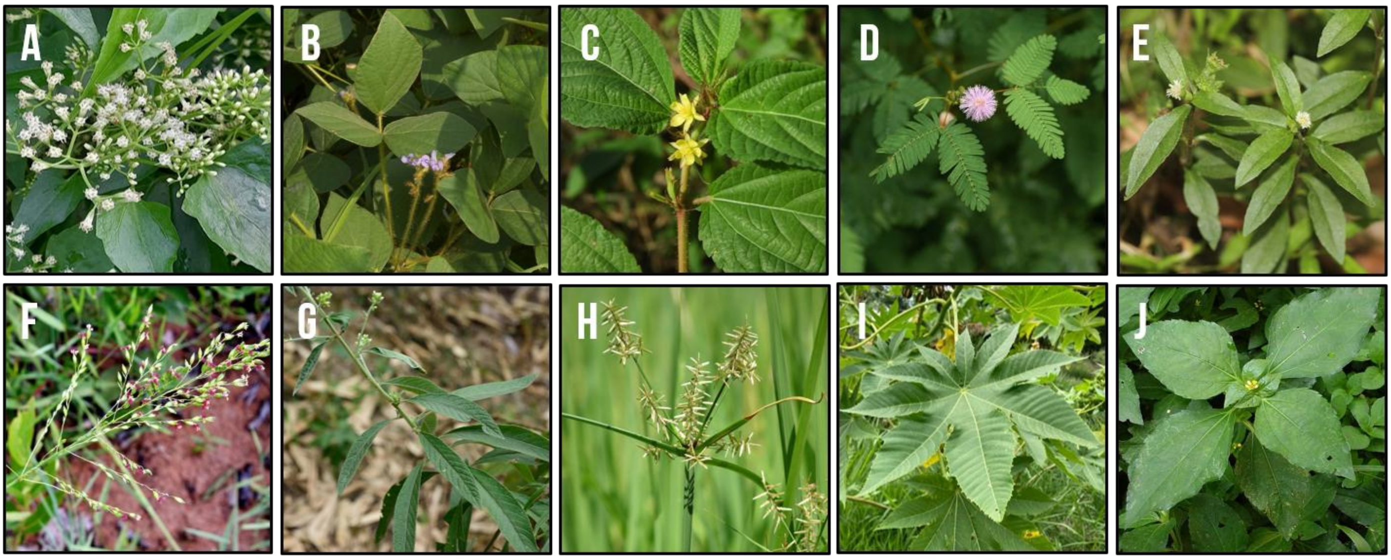

Fig. 2: Identified Plants in Sapang Balen. A. *Mikania cordata*. B. *Calopogonium mucunoides*. C. *Corchorus capsularis*. D. *Mimosa pudica*. E. *Eclipta prostrata*. F. *Panicum* sp. G. *Blumea* sp. H. *Cyperus rotundus*. I. *Ricinus communis*. J. *Synedrella nodiflora*

3.2. Physicochemical Parameters

Table 1 provides the following data: The width of the upstream is 13.63 meters, with a depth of 0.20 meters, while the middle stream is 21.92 meters wide, with a depth of 0.28 meters. The substrate texture of the upstream is sandy and gray in color, whereas the middle stream has a fine coarse substrate, also gray in color. This substrate texture suggests materials expelled by the Mt. Pinatubo eruption persist in the study area. The pH level in the upstream is slightly lower at 7.1, compared to 7.29 in the middle stream. This minor variation could be attributed to the presence of domestic waste in the middle stream, which is more industrialized than the less disturbed upstream area. In terms of temperature, the upstream measures 29.6°C, while the middle stream is slightly warmer at 30.25°C. This is likely because the upstream has more canopy cover, while the middle stream is more urbanized, with fewer plants and perennial trees (Dugdale et al. 2018).

Table 1. The Results of Physicochemical in Sapang Balen River.

Sub-area	Width (m)	Depth (m)	Substrate Texture	pH Level	Temp (°C)
Up stream	13.63	0.20	Sandy / gray	7.1	29.6
Middle Stream	21.92	0.28	Fine course / gray	7.29	30.25

3.3. Water Quality Parameters

The table 2 shows the water quality analysis indicating high contamination levels in both the upstream and middle stream sections of the Sapang Balen River. Total coliform counts were measured at 54,000 MPN/100mL in the upstream and 35,000 MPN/100mL in the middle stream, while heterotrophic plate counts reached 21,000 CFU/mL and 20,000 CFU/mL, respectively. Thermotolerant coliform levels also surpassed safe limits, with 4,600 MPN/100mL in the upstream and 4,900 MPN/100mL in the middle stream. These values exceed the permissible thresholds outlined by the Philippine National Standards for Drinking Water (PNSDW), indicating severe pollution and a potential public health risk. The high levels of microbial contamination suggest significant challenges in restoring the ecological health and water quality of the Sapang Balen River. However, ongoing remediation efforts, including the installation of water revetments, the administration of activated carbon and bioflocculants, and the implementation of built-in filtration systems, offer promising solutions. These methods aim to reduce bacterial load and improve water quality, potentially restoring the river to its pre-disturbed state. Further monitoring and adaptive management will be critical in determining the long-term success of these interventions in rehabilitating the river's ecosystem.

Table 2. The Results of Water Quality in Sapang Balen River.

Sub-area	TC (MPN/100mL)	HPC (CFU/mL)	EC (MPN/100mL)	PNSDW
Up stream	54,000	21,000	4,600	**TC**: <1.1 MPN/100mL **HPC**: <500 CFU/mL **EC**: <1.1 MPN/100mL
Middle Stream	35,000	20,000	4,900	

*Note: **TC**-Total coliform; **HPC**-Heterotrophic plate count; **EC**-Thermotolerant coliform / E.coli; **PNSDW**- Philippine National Standards for Drinking Water.*

4. Conclusion

The ecological assessment of Sapang Balen's riparian system highlights both the beneficial and detrimental effects of its flora on the ecosystem. Species like *M. cordata* and *C. capsularis* aid in soil erosion control, while *C. mucunoides* and *M. pudica* enhance soil fertility. However, the rapid growth of certain plants and the release of allelochemicals pose threats to biodiversity, with the presence of weeds indicating ecosystem disturbance. These findings, however, require follow-up and confirmatory tests.

Water quality analysis reveals alarming microbial contamination, with coliform levels far exceeding safe limits, likely due to urbanization and domestic waste. Despite this, future remediation efforts, such as bioflocculants, filtration systems, and water revetments, are expected to significantly improve the river's water quality. Continuous monitoring and adaptive management will be essential to restoring the river's ecological balance and sustaining its freshwater ecosystem.

Acknowledgement

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Conflict of Interest

Authors declared that there is no potential conflict of interest.

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