A STUDY ON INDUSTRIAL POLLUTANTS DISCHARGED INTO THE DOWNSTREAM OF THE KELANI RIVER

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Sri Lankan economic growth and ecosystem collapse are interconnected issues as countries around the world struggle to establish an effective regulatory regime to control the discharge of industrial effluents into their ecosystems. This research aimed to assess the impact of industrial wastewater from various industries on the Kelani River. To determine the degree of chemical pollution in a receiving river as impacted by industrial effluents, the study was conducted in Kelani River. The study included 25 industries from food, textile, beverage, tile, chemical, and leather manufacturers, industrial zones, and service centers located in Colombo and Gampaha districts. Specific sites were selected to evaluate the water quality and extent of pollution, and water samples were collected and analyzed for several physicochemical factors, including pH, dissolved oxygen, total suspended solids (TSS), total dissolved solids (TDS), and the presence of heavy metals where some parameters were measured directly in the effluent using a pH meter, conductivity meter, DO meter, and COD reactor, respectively. The flow rate of treated wastewater was measured using flow meters or V-notch flow rate measurements. The findings revealed that all industries were discharging large amounts of pollutants into rivers, exceeding the permitted limits established by Sri Lanka's Central Environmental Authority. Particularly, high COD levels indicate significant organic matter and chemical pollution. The findings suggested that the river's water was contaminated and unfit for human consumption. Therefore, it is advised that improper waste disposal be discouraged. Although some values were below the allowable limits, the continued discharge of effluents into rivers may result in a serious buildup of contaminants., Unless the authorities enforce the laws governing the disposal of wastes, this may have an impact on people's quality of life. The study highlighted the urgent need for proper monitoring and regulation of industrial wastewater discharge in the Kelani River basin to safeguard the river ecosystem and public health, Policymakers, regulators, and industry stakeholders can benefit from the study's findings to develop and implement strategies to reduce the environmental impact of industrial activities on the Kelani River and its ecosystem.

Keywords: COD, Flow Rate, Kelani River, Pollutant Load

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INTRODUCTION

The degradation of inland surface water quality is a significant environmental threat in Sri Lanka, with industrialization, urbanization, and anthropogenic activities contributing to water pollution (Bandara, 2003). The situation is further compounded by the lack of access to potable water sources, leading to people relying on untreated river water as a source of drinking water. The Kelani River, one of the most polluted rivers in the country, is the fourth longest and second largest watershed in Sri Lanka, and approximately 25% of the total population lives around the river basin.

Kelani River is a major source of water in Colombo, fulfilling 80% of the city's water requirement (Abeysinghe and Samarakoon, 2017). It is also an important source for transportation, hydropower generation, fisheries, irrigation, sewage disposal, and sand extraction. However, the river's pollution is harming the fragile ecosystems that depend on it, threatening the health and well-being of those who rely on it for their livelihood.

As a developing country, Sri Lanka needs to prioritize the management of existing water resources while achieving sustainable economic development (Liyanage and Yamada, 2017). The industrial wastewater effluent discharged by industries into the lower basin of the Kelani River will be the focus of research investigation. The amounts of pollutants discharged into the river as well as any potential effects on the environment and human health, and the legal framework in place to control wastewater discharge will be studied.

The investigation aims to identify sources and the extent of pollution, develop strategies and policies to reduce or eliminate the discharge, and raise awareness about the impacts of industrial pollution. Ultimately, the investigation aims to promote sustainable management of water resources and ensure the health and well-being of the people and the environment.

Dissolved oxygen (DO) and biological oxygen demand (BOD) are key indicators of water quality and the health of the river ecosystem. The fractionation of COD and evaluation of significant kinetic and stoichiometric coefficients are important processes in assessing the biological treatment of the river. The identification of inert and biodegradable chemical oxygen demand (COD) as well as quickly and slowly biodegradable fractions are all part of the process of COD fractionation. Mathematical models defining biological treatment should be compatible with the experimental methods developed or chosen for the assessment of COD fractions and produce consistent and trustworthy results.

The investigation results will provide important new information about the condition of the Kelani River, where numerous industries have reduced their operations due to rising electricity costs brought on by the current economic crisis. Some industries are compelled to discharge wastewater due to a lack of sufficient treatment facilities. According to the records of the Central Environmental Authority, approximately 30 million cubic meters of wastewater per year are generated by major industrial parks in Sri Lanka. The investigation aims to promote sustainable management of water resources and ensure the health and well-being of the people and the environment.

METHODOLOGY

This study aimeds to assess the impact of industrial wastewater on the Kelani River, specifically from significant industries such as food, textile, beverage, tile, chemical, and leather manufacturers, industrial zones, and service centers in Colombo and Gampaha districts. The study area's specific sites were chosen to evaluate the water quality and determine the extent of pollution caused by these industries.

The selection of industries was based on category-wise classification, proximity to Kelani River, direct wastewater discharges to Kelani River, and total volume. Data sheets were gathered during field visits to each industry, which included information on location, water usage quantity, water source, wastewater generation source and practices, industrial activities, wastewater treatment plant availability, mode of wastewater disposal method to Kelani River, laboratory testing availability, and feasible methods for measuring flow rate.

Water samples were collected from treated industrial wastewater discharge points to the Kelani River, and two samples were obtained from each sampling location. Before sample collection, sample bottles were cleaned with treated wastewater (TWW) and placed in a cooler box to maintain their integrity.

The chemical analysis of water samples included the measurement of pH, electrical conductivity (EC), and DO directly in the effluent. The COD test was conducted to determine the amount of organic pollutants in the water samples. The flow rate of treated wastewater was measured using flow meters in some industries, and in others, V-notch flow rate measurements were used (Bagatur, 2009).

In Sri Lanka, wastewater quality parameters are regulated by the Central Environmental Authority (CEA). The CEA has established standards for various parameters to ensure the safe discharge of wastewater effluents. Acceptable COD limit is 250 mg/L.

The pollutant load was calculated by measuring the concentration of pollutants in the wastewater and multiplying it by the flow rate. This information can help improve treatment procedures and follow environmental regulations. The findings of this study can benefit policymakers, regulators, and industry stakeholders in developing and implementing strategies to reduce the environmental impact of industrial activities on the Kelani River and its ecosystem.

RESULTS AND DISCUSSION

The study measured the concentrations of parameters in the effluent of 25 different industries, and the results are presented in Table 1. The industry 3 had the highest flow rate value of 12000m^3/day, and Industry 8 had the lowest flow rate value of 0.2m^3/day. Industry 18 had the highest COD value of 1375 mg/l, while industry 14 had the lowest COD value of 13mg/l. Throughout these 25 industries, industry 18 exceeding the COD tolerance limit of 250 mg/l. Industry 1,2,3,13,16,22 and 24 exist within the 50mg/l tolerance limit. Industry 3 had the highest pollutant load of 3000 mg/day, while industry 25 had the lowest pollutant load of 3.71 mg/day.

The industry 3 has many manufacturing industries, including textile, electronics, and food processing, which produce a lot of wastewaters due to the large amounts of water used in their manufacturing processes. Additionally, the Industry 3 is located in a region with heavy rainfall, leading to more surface water flowing into the wastewater treatment facility, resulting in an increase in the flow rate of wastewater.

Industry 8's manufacturing process uses less water, resulting in a lower flow rate of wastewater. The company conforms to strict water usage and discharge regulations, which also reduces the flow rate of wastewater.

The textile industry frequently produces wastewater with high COD values due to the numerous processes used in the production of textiles, such as washing, dyeing, printing, and finishing, which use a lot of water and chemicals. In contrast, industry 14's wastewater may have a low COD value due to efficient pollution removal processes, the use of environmentally friendly chemicals, water reuse and recycling, and adherence to regulatory standards for wastewater treatment and discharge.

The industry 3 may have the highest pollutant load due to a high concentration of industries, poor waste management resulting in improper disposal of industrial waste, and lack of effective regulatory enforcement, resulting in businesses operating without the necessary pollution control measures.

Table 1 Results of 25 Industries' quantity(m^3/day), COD, pollutant load mg/day

No	Quantity (m^3/Day)	COD (Tolerance limit 250mg/l)	Pollutant Load mg /day	No	Quantity (m^3/Day)	COD (Tolerance limit 250mg/l)	Pollutant Load mg /day
Industry 1	170	250	42.5	Industry 14	300	13	3.9
Industry 2	0.5	250	0.125	Industry 15	375	134	50.25
Industry 3	12000	250	3000	Industry 16	144	250	36
Industry 4	30	19	0.57	Industry 17	4	154	0.616
Industry 5	2.5	114	0.285	Industry 18	500	1375	687.5
Industry 6	2	142	0.284	Industry 19	45	149	6.705
Industry 7	2	16	0.032	Industry 20	420	41	17.22
Industry 8	0.2	230	0.046	Industry 21	40	79	3.16
Industry 9	20000	128	2560	Industry 22	30	250	7.5
Industry 10	1000	28	28	Industry 23	5	179	0.895
Industry 11	500	42	21	Industry 24	0.6	250	0.15
Industry 12	730	110	80.3	Industry 25	35	106	3.71
Industry 13	7	250	1.75				

CONCLUSIONS / RECOMMENDATIONS

High pollutant load from industries: According to the findings the industry 1,3, & 9 are among the industries that discharge a high pollutant load into the Kelani River. This is caused by several

elements, including industrial activities, subpar waste management procedures, a failure to comply with regulations, and inadequate infrastructure.

The Kelani River, a major source of drinking water for the nearby communities, is being significantly impacted by the discharge of high levels of pollutants into the river. The pollutants may result in eutrophication, bacterial contamination, and toxicity to aquatic life, among other issues with water quality. The investigation focuses the urgent need for the industries that discharge a high pollutant load into the Kelani River to implement efficient pollution control measures. This could involve following environmental regulations, sourcing raw materials sustainably, and using reducing technology in manufacturing processes.

Stakeholder engagement is crucial in addressing the problem of the high pollutant load in the Kelani River, according to the investigation. This may entail working in tandem with businesses, public institutions, and regional groups to create pollution prevention strategies that are both effective and sustainable.

Overall, the study on the amount of pollutants discharged by industries into the lower basin of the Kelani River shows the urgent need for the implementation of efficient pollution control measures to safeguard the river's water quality and the health and wellbeing of the nearby communities.

REFERENCES

Abeysinghe, N. D. A., & Samarakoon, M. B. (2017). Analysis of variation of water quality in Kelani River, Sri Lanka. *International Journal of Environment, Agriculture and Biotechnology*, *2*(6), 238965.

Bagatur, T. (2009). Evaluation of preaeration with V-notch weir and cascade structures in clarifiers. *Journal of Environmental Engineering*, *135*(3), 176-184.

Bandara, N. J. G. J. (2003). Water and wastewater related issues in Sri Lanka. *Water science and technology*, *47*(12), 305-312.

Liyanage, C. P., & Yamada, K. (2017). Impact of population growth on the water quality of natural water bodies. *Sustainability*, *9*(8), 1405.