SRI LANKA JOURNAL OF GEOGRAPHY AND ENVIRONMENTAL MANAGEMENT

SLJGEM (2025), Vol. 02 (01)

Journal homepage: www.sab.ac.lk/sljgem

GEOSPATIAL ANALYSIS OF EFFECTS OF URBANIZATION ON SURFACE WATER QUALITY OF MAHAWELI RIVER, KANDY CITY, SRI LANKA

*Dissanayake NWW[1], Yapa LGDS [2] *, Hemakumara GPTS [3]*

[1,2,3]Geography Department, University of Ruhuna, Sri Lanka

ARTICLE INFO

Article History:
Received 26 Mar 2025
Accepted 02 Jun2025
Issue Published Online
25 Jun 2025

SLJGEM (2025), Vol. 02, Issue (01), Pp.118 - 134

KEYWORDS

Drinking water
Point source pollution
Urban land use
Water quality parameters
Weighted Arithmetic WQI Method

**Corresponding author*
E-mail address:
syapa@geo.ruh.ac.lk

https://orcid.org/0000-0003-3390-6610

ISSN 3051 5335X (Online)

Published by:

Department of Geography and Environmental Management, Faculty of Social Sciences and Languages, Sabaragamuwa University of Sri Lanka

ABSTRACT

River water quality can be identified as a factor that has greatly affected the healthy life of both aquatic life and humans. Increased population and industrial activities in urban areas significantly impact the river water quality, resulting in aquatic ecosystem degradation and increased human health risks. In Sri Lanka, urban-induced river water pollution has a significant impact on the drinking water supply, especially in the Mahaweli River which is the longest river in Sri Lanka. Measuring the water quality of the Mahaweli River, which flows through the city of Kandy, has become a pressing need at present. Therefore, this study mainly identifies and assesses the water quality near and of the point source pollution sites in the Kandy city area. Forty water samples were taken from the systematically selected locations in the river to assess the water quality. Seven water quality parameters, such as pH, temperature, acidity, electrical conductivity, total phosphate, total coliform, and dissolved oxygen, were measured. The values obtained were analysed using the Weighted Arithmetic Water Quality Index. The spatial interpolation technique was used for data visualization. The study identifies five major point source sites that adversely affected the water quality of the Mahaweli River. These sites are a site where the Kandy Meda Ela joins the Mahaweli River, where the Piga Oya joins the Mahaweli River, near the Katugastota Railway Bridge, near the Guhagoda Waste Management Site and the Peradeniya Bridge. According to the WQI, the overall water quality of the Mahaweli River is very poor and entirely unsuitable for drinking purposes or other daily activities.

How to Cite this Article: *Dissanayake NWW, Yapa LGDS and Hemakumara GPTS (2025). Geospatial Analysis of Effects of Urbanization on Surface Water Quality of Mahaweli River,Kandy City, Sri Lanka. SLJGEM,02 (01), Pp. 118 - 134.*

1. INTRODUCTION

Surface water bodies such as rivers, tanks, reservoirs and groundwater aquifers are critical in supporting biodiversity, providing drinking water and sustaining various human activities. River water is one of the primary water sources for irrigational, industrial, and domestic purposes. River water quality is substantially deteriorating worldwide because of numerous natural factors and the continual acceleration of anthropogenic activities (Uddin et al., 2021; Sarker et al., 2021). Natural factors affecting water quality include hydrological, atmospheric, climatic, topographical and lithological factors (Uddin et al., 2021). Human-related activities that adversely influence water quality are land cover land use changes, ad-hoc development, mining, waste disposal and industrial activities (Uddin et al.2021; Makubura et al., 2022).

River water pollution is a complex and multifaceted problem arising from mixing pollutants into water bodies from diverse sources, resulting in significant threats to aquatic ecosystems, human health and the overall ecological balance (Najim & Rajapakse, 2011; Jinadasa et al.,2012). It leads to species decline and loss of biodiversity. Contaminants accumulate in the food chain, affecting fish and other aquatic life and ultimately posing a risk for humans. As industrialization, urbanization, population growth and food demand continue to intensify, especially in developing countries, the problem of water quality degradation has gained significant attention (Uddin et al., 2021; Gunawardena et al., 2017).

Based on the pollution sources, anthropogenic sources are adversely impact on water quality. Accordingly, anthropogenic sources could be identified as point-source pollution and non-point-source pollution sources based on their origin (Nishanthi et al., 2021; Jayasiri et al., 2022). Point source pollution originates from a direct and identifiable source that includes industrial discharges, municipal wastewater treatment plants, power plant oil spills and mining and canals (Wu & Chen, 2013; Sarker et al., 2021). Nonpoint source pollution originates from diffuse sources that spread over a wide area. Unlike point sources, nonpoint sources are difficult to identify and control (Jayasiri et al., 2022; Wu et al., 2020). Nonpoint source pollution occurs when pollutants are transported to water bodies through stormwater runoff, agricultural runoff or groundwater seepage.

River pollutants can be classified into several categories, such as biological, chemical and physical pollutants (Prabagar et al., 2023; Jayasiri et al., 2022). Biological pollutants include bacteria, viruses, and other microorganisms that can cause waterborne diseases, while chemical pollutants include heavy metals, pesticides, fertilizers, pharmaceuticals, and industrial chemicals. Physical pollutants include a variety of non-degradable materials, such as plastic debris and sediments, which can severely impact aquatic habitats. Industrial discharges are mainly caused by discharging untreated or partially treated wastewater into nearby water bodies. Agricultural runoff is another vital source, where excess fertilizers and pesticides from agricultural fields are carried by rainwater into rivers and lakes. In addition, inappropriate waste disposal, including plastic waste and household chemicals, can pollute water sources through landfills or illegal dumping. Contaminated river water may rapidly spread waterborne diseases such as cholera and gastroenteritis. Long-term exposure to chemical pollutants in water can cause chronic health problems, including cancer, neurological disorders and developmental issues (Jayasiri et al., 2022; Koliyabandara et al., 2020).

Researchers in the world including Sri Lanka have found that river pollution is mainly caused by urban population-related factors rather than agricultural and industrial factors as a result of urban growth, failure of regulations, unplanned settlements, lacking proper sanitation and absence of proper waste management systems (Jinadasa et al.,2012; Chen et al.,2022; Abeygunawardane et al., 2011). Previous scholars in Sri Lanka have also found that river water quality and its aesthetic value have deteriorated significantly in rivers such as Kalani, Mahaweli, Gin Ganga, Walawe, Malwathu, Deduru oya and Kalu Ganga due to diverse anthropogenic factors (Narangoda et al.,2023; Gunawardena et al., 2017; Jayasiri et al., 2022; Siriwardhana et al., 2023). A significant portion of urban wastewater, along with sewage is discharged directly into the water sources without proper treatment, adversely impacting on drinking water supply (Abeygunawardane et al., 2011). Therefore, extensive water treatment is an integral part of the water supply, especially for urban areas. To determine the level of water treatment and to ensure water is acceptable for human consumption, the World Health Organization (WHO) has introduced drinking water quality standards, and many countries follow their guidelines (Uddin et al., 2021; Jinadasa et al.,2012). Sri Lanka follows guidelines for both potable water and groundwater from both WHO (WHO 2011) and Sri Lanka Standards (SLS 614:2013) (Senarathne et al., 2021). Those standards support safeguarding human health, ensuring the availability of safe water resources and guiding efforts to treat and manage water supplies for urban areas.

Scholars worldwide have introduced Water Quality Indexes (WQIs) based on adopted standards to identify the areas with poorer water quality to treat (Uddin et al., 2021; Wu et al.,2021). Compared to various modelling techniques and statistical approaches, the Weighted Arithmetic WQI has been widely accepted as a convenient and robust method for assessing surface water and groundwater quality based on standardized parameters (Wu et al., 2021; Rahman et al., 2021). As there is no commonly accepted unified WQI, there are several calculations and models for WQI used in previous studies (Wu et al., 2021).

Scholars in Sri Lanka have studied water quality using water quality parameters and adopted standards in Kalu Ganga, Beira Lake, Mada Ela catchment in Kandy and Kalani River using WQI (Piyadasa & Meegaswatte, 2022; Makubura et al., 2022; Senarathne et al., 2021). However, no study was found that uses both WQI to assess the water quality and advanced mapping techniques to visualize spatial distribution patterns of river water quality near and around the point source pollution sites in urban areas, especially in Kandy City, Sri Lanka. Accordingly, this study aims to evaluate the water quality condition in the Mahaweli River using WQI at 40 sites covering the urbanized area in Kandy City and to illustrate its distribution pattern at a spatial scale using a Geographic Information System (GIS) and Global Positioning System (GPS). The findings of this study will benefit local water resource management and formulation of relevant policies in water quality control in urbanized areas.

2. MATERIALS AND METHODS

2.1 Study Area

The Mahaweli River is the longest in Sri Lanka. The Mahaweli River flows through the Kandy suburbs and the city centre. The Mahaweli River area from Peradeniya Bridge to Polgolla Reservoir Dam was selected for this study as this area belongs to the Kandy Municipal Council. The Mahaweli River has three canals, the Middle Canal, the Pigga Oya and the Mahaiyawa Canal, mainly collecting sewage from the Kandy area. All urban waste is directly released into the Mahaweli River. Because of this, identifying the point sources of water pollution in the river and analyzing its water quality has become an essential factor.

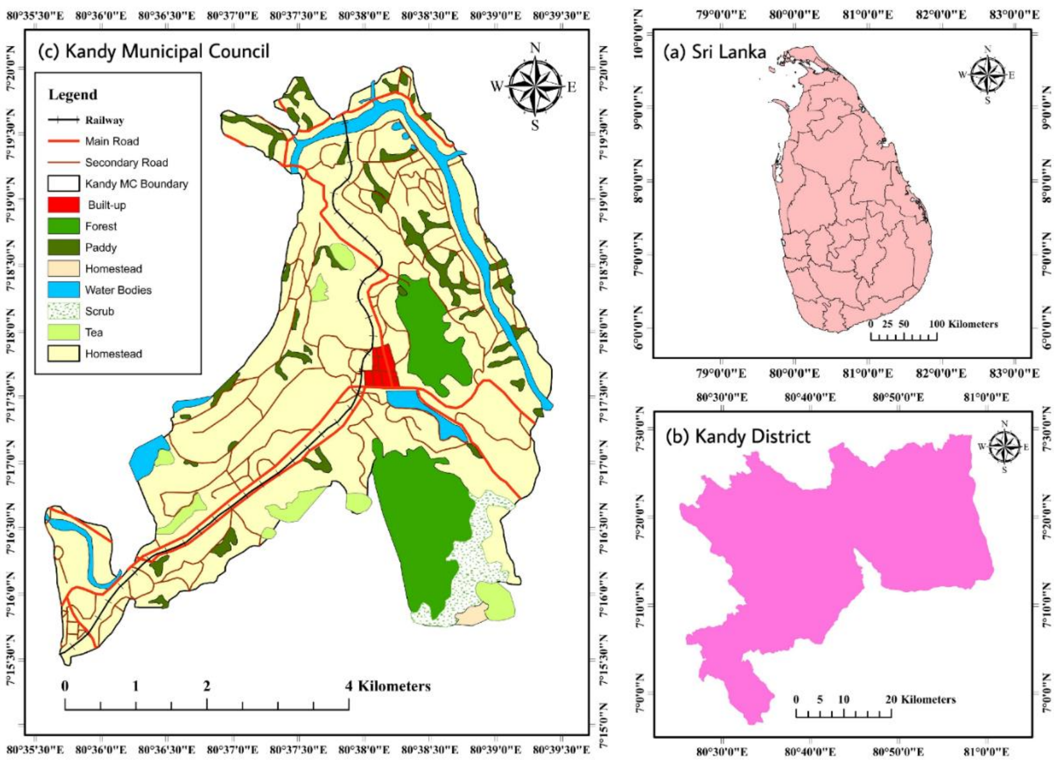

Figure 1: Study Location: (a) Sri Lanka; (b) Kandy District; (c) Kandy Municipal Council.
Source: Data for source: Survey Department of Sri Lanka

2.2 Sampling, Parameters Selection and Testing Water Quality

Water samples were systematically collected in October 2023 at 40 locations covering 15-point source pollution sites along the Mahaweli River, covering the Kandy MC area (Figure 1). All the water samples were collected following the standard procedure and analysed in the laboratory to determine selected physical (Temperature, Electrical Conductivity [EC] and turbidity [tur]), chemical (pH, Dissolved Oxygen [DO] and Total Phosphate) and biological properties (Total Coliform) of water samples. All these parameters were selected based on previous studies considering their relevance to the area. The Weighted Arithmetic Water Quality Index (WQI) was used to evaluate river water quality based on these parameters.

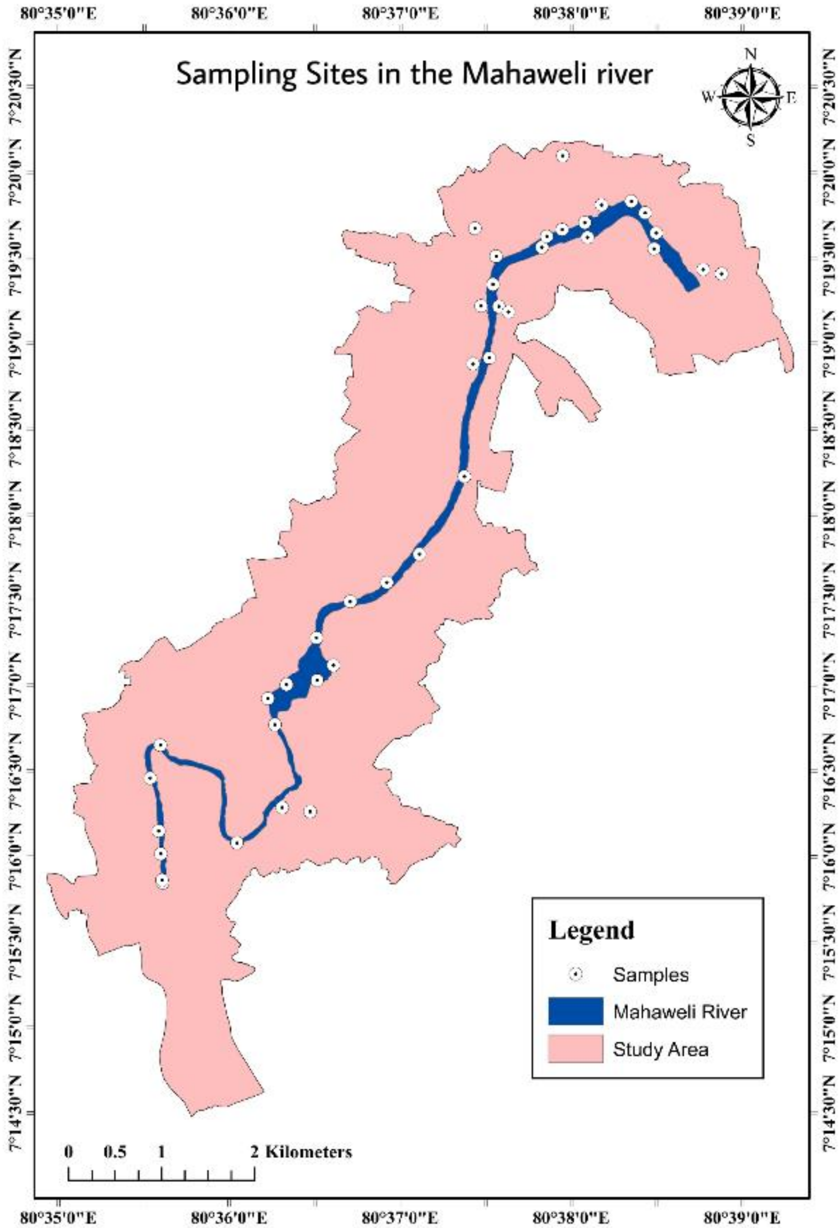

Figure 2: Location of the Sampling Sites in the Mahaweli River within and near the Kandy City

Source: Field Survey, 2023

2.3 Weighted Arithmetic WQI Method

The weighted arithmetic WQI method (Akter et al., 2016) was applied to evaluate surface water quality based on local water quality criteria. The following formula calculated the water quality rating scale, relative weight, and overall WQI (Equation 1,2 & 3).

Water quality rating scale

$$q_i = (c_i/s_i)\ 100$$

where q_i, C_i, and S_i indicated the quality rating scale, the concentration of the *i* parameter, and the standard value of the *i* parameter, respectively.

Relative weight

$$w_i = 1 / s_i$$

where the standard value of the i parameter is inversely proportional to the relative weight.

Overall WQI

$$WQI = \sum q_i w_i / \sum w_i$$

2.4 Data Analysis and Visualization

QGIS Desktop 3.40.1 software was used to create theme-based maps. The interpolation technique of Inverse Distance Weighted (IDW) was used to show the spatial distribution of water quality parameters in the study area.

3.Results and Discussion

3.1 Point source pollution sites

Point-source pollution is the release of pollutants through a pipe or drain into water bodies or streams. Usually, these controlled as the location of the source can be easily identified (Dayawansa, 2006). According to this the 15 – point source pollution sites were identified.

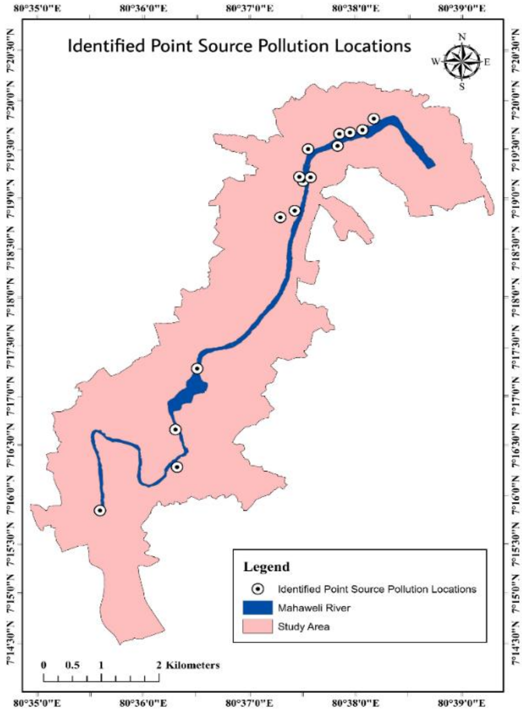

Figure 3 :Identified Point Source Pollution Locations
Source: Field Survey, 2023

3.2 Spatial distribution pattern of water quality parameters

The pH in the area ranged from 6.02-7.33 (from moderately acidic to neutral). The median is 6.60, and the standard deviation is 0.15. According to the water quality standards of Sri Lanka, water with a pH value between 6.5-8.5 is suitable for drinking (National Water Supply and Drainage Board, 2022). Of the 40 sampling points in the study area, 62.5% of the pH values are suitable for drinking water, but 37.5% of the samples have a range of values lower than the Sri Lanka Standards Institute value.

The pH level of the water in those 37.5% samples ranges from slightly acidic to medium acidity. The pH value's acidity and alkalinity also affect fish; when it is less than 6.5 and more than 9.0. The study revealed that the GN Divisions of Palle Peradeniya, Pahala Eriyagama, Uda Eriyagama East, Gatambe, Warathenna, Kumburugedara, Haloluwa, Dodamwala, Pallemulla, Bahirawakanda, Banwelgolla, Aniwatta East, Guhagoda, Balangala, Polgolla, Nawayalathenna, Mavilmada are in the pH range unsuitable for using water for drinking.

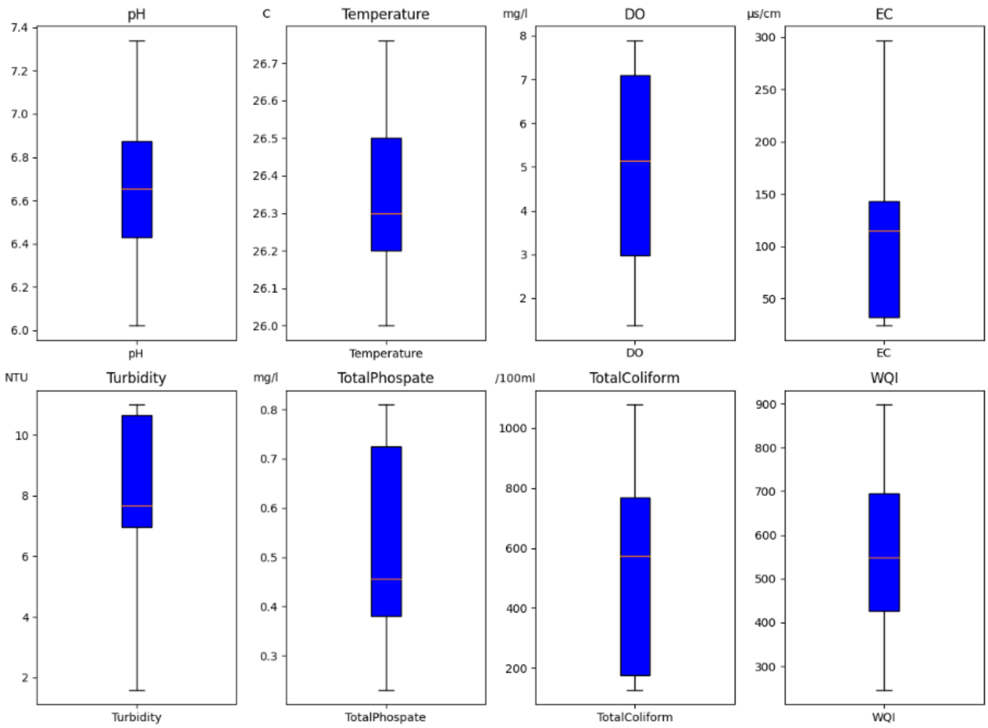

Figure 4: The Spatial Distribution of the Parameters included in the WQI
Source: Field Survey, 2023

Considering the temperature distribution of the Mahaweli River in the study area, it is observed that the temperature range is from 24.07 ^{0}C to 27.44 ^{0}C. The median is 26.36 ^{0}C, and the standard deviation is 0.14. In the Mahaweli River area belonging to the Mavilmada GN Division the optimum temperature range of 5-25 ^{0}C present. At the same time, in the other 37 Grama Niladhari Divisions, it can be observed that the optimum temperature range has been exceeded. During the field study, it was observed that problematic conditions that can arise in a watershed area due to exceeding the optimum temperature range, such as eutrophication, have occurred in those areas. Of the 40 water samples used to test the quality of the Mahaweli River in the study area, 5% were within the optimal temperature range, which can be considered a significant quality impairment.

The DO level in water by GN Divisions can be seen in a range of 1.37 - 7.88 ppm. The maximum value obtained for the dissolved oxygen level in water is 7.89 mg/L, and the minimum is 1.38 mg/L. The median is 5.17 mg/L, and the standard deviation is 1.21. Concerning the DO, the Sri Lanka Standards Institute (SLSI) guideline has specified the amount of dissolved oxygen in water as 6 ppm, usually more than 5 ppm. DO level in the water drops to about 1-2 ppm, resulting in the death of aquatic organisms. When the level approaches 0 ppm, anaerobic conditions are created in the water. The areas where the DO level was lower than the standard value of Sri Lanka are Gatambe, Gannoruwa, Bowala, Katugastota, and Polgolla. The values are below the appropriate level mainly because of the increased biochemical oxygen demand in those water areas. In contrast, other GN Divisions can observe a DO level higher than the standard value. Generally, the appropriate DO level in water areas is 6.5-8 ppm, and the GN Divisions where that appropriate level is present are Balangala, Pitakanda, Wegiriya, Wattaranthenna, Madapathagama, Guhagoda, Banwelgolla, Pallemulla, Bahirawakanda, Aniwatta, Haloluwa, Kumburugedara, Warathenna, Vel -Ata, Dodamwala, and other divisions.

The decrease in pH value and increase in temperature directly affect the increase in the EC of the water. Since the speed of ions increases as the water temperature increases and the pH value decreases, the acidic activity of the EC increases. Although the increase in EC of water does not directly affect human health, the changes in pH value, temperature changes, and changes in ions in the water directly affect human health, agricultural activities, aquatic organisms, and other living organisms. According to the Sri Lanka Standards Institution's water quality standards, the recommended value is 750 µs/cm (Perera et al., 2021). When observing the EC of the Mahaweli River in the study area, it is clear that there were no exceed the electrical conductivity standard value of 750 of the Sri Lanka Standards Institution. The maximum value of the values obtained for the EC is 296.44 µs/cm, and the minimum value is 24.01 µs/cm. The median is 90.86 µs/cm, and the standard deviation is 43.33. When observing the distribution of electrical conductivity by GN Divisions, the electrical conductivity ranges from 24-296, and the lowest electrical conductivity is in the Dodamwala GN Division, and the highest electrical conductivity is in the Wattaranthenna GN Division.

According to the Sri Lanka Standards Institution, the turbidity level of water of good quality should be below 2 Nephelometric Turbidity units (NTU) (Ranasinghe & Ariyaratne, 2012). Turbidity can increase due to the adverse effects of bacteria, viruses or parasites such as Cryptosporidium in the water. In the study area, turbidity levels ranged from 5.20 to 8.97 in most GN Divisions. The maximum value of the water sample data for the turbidity value is 20.3, and the minimum is 1.4. The median is 10.26, and the standard deviation is 3.30. Accordingly, the turbidity can be observed in a distribution range from 1.4 to 20.3. The highest turbidity range of 16.51-20.28 is observed in 8 out of 40 samples taken in the study area. Thus, the lowest turbidity range of 1.4-5.20 can be observed in only 8 out of 40 water samples. However, although it can be identified that the distribution ranges of turbidity are spread across the GN Divisions, it can be observed that the turbidity values in 38 of the water samples have exceeded the turbidity standard value of 2 NTU of the Sri Lanka Standards Institution. The highest turbidity value of 20.3 can be observed in the Gatambe GN Division, and the lowest turbidity value of 1.43 can be observed in the Wattaranthenna GN Division. Many factors directly affecting water turbidity, such as soil erosion, waste disposal, urban pollution, erosion of canal banks, and excessive algae growth, can be observed in the Mahaweli River section of the study area.

Poor agricultural practices, urban areas, and sewage treatment plants contribute to high phosphorus concentration in the river. High phosphorus concentrations cause the growth of algae and large aquatic plants (Carey & Migliaccio, 2009). As a result, the dissolved oxygen level in the water can decrease. High phosphorus levels in water can lead to the growth of toxic algae that can harm human and animal health. Phosphorus is generally considered to be the limiting nutrient in aquatic ecosystems. The presence of phosphorus in excess directly affects the deterioration of water quality. According to the SLSI guideline, the maximum phosphate value that should be present in drinking water is 2 mg/L. According to the total phosphate, a significant increase in phosphate cannot be observed in the Mahaweli River in the study area. The maximum value of the water sample data for the total phosphate value is 1.91, and the minimum value is 0.23. The median is 0.65, and the standard deviation is 0.18. The maximum phosphate concentration could be identified in the Grama Niladhari Divisions of Bowala, Uda Bowala, Siyambalagasthenna, Nawayalathenna, Mavilmada, Katugastota, Kahalla, Balangala and Galewatta. Also, the lowest phosphate value of 0.23 NTU can be identified in the village of Pitakanda.

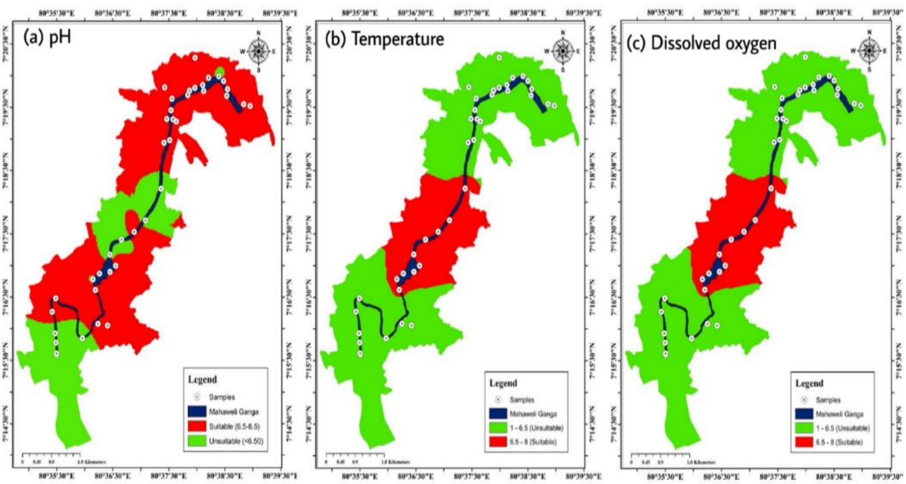

Figure 5 :Water quality status based on the Standards of Sri Lanka: (a) pH;(b) Temperature;(c) Dissolved oxygen

Source: Field Survey,2023

Several sources, including food animal waste from landfills, and the runoff of animal waste from landfills can contaminate coliform bacteria. Coliform bacteria are widespread in water bodies where the dead bodies of chickens, cows, pigs, and sheep are deposited. According to the Sri Lanka Standards Institute standards, coliforms cannot be present in drinking water. The total coliform index value of the Sri Lanka Standards Institute is 0 cfu/100ml (Perera et al., 2023).

By observing the Coliform distribution in the study area, it can be identified that the coliform bacteria index value ranges from 127 to 3080. The highest coliform value of 3080 can be seen where the Guhagoda Waste Collection Center joins the Mahaweli River and its surrounding area. The highest

coliform value has been reported in Polwatta 2 GN Division and Wattantenna GN Division. The lowest coliform index value of 127 in the tested water samples can be identified near Polgolla GN Division.

3.3 Water quality conditions based on the WQI

According to Akter et al. (2016), if WQI is below 50, water is most suitable for drinking.

If WQI ranges between 50-100, water is suitable for drinking. When WQI ranges between 101 and 200, water is not suitable for drinking, while WQI ranges between 201 and 300, and water is not very suitable for drinking. If WQI exceeds 300, water is unsuitable for drinking or other daily activities. The WQI values obtained for the 40 water samples are as follows.

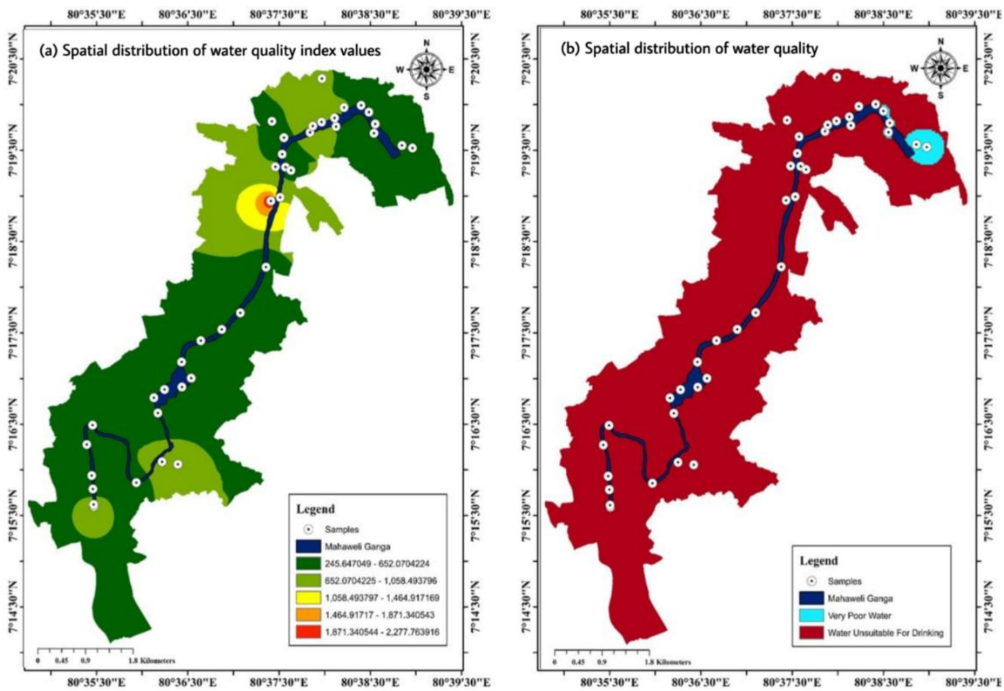

Figure 6: (a) Spatial distribution of water quality index values; (b) Spatial distribution of water quality
Source: Field Survey, 2023

The maximum value of the water sample data for the WQI values obtained in the water samples is 2277.76, and the minimum value is 24.65. The median is 595.27, and the standard deviation is 138.83. It can be identified that the river water in the entire study area is not suitable for drinking and other daily needs due to the lack of proper water quality standards. Moreover, it can be identified that the very poor category exists in the Polgolla, Balangala, and Palle Gunnepana South GN Divisions, and the completely unsuitable category exists in the other 35 GN Divisions. The highest value of the WQI distribution in the area, 2240, can be observed in Warathenna GN Division, and the lowest value, 245, can be observed in Polgolla GN Division.

The data obtained through the WQI index value used to analyze the water quality of the entire Mahaweli River in the study area revealed that the water quality is satisfactory in the entire water body of the study area. Only two categories of degraded water could be identified here. The category contains very poor water quality and is entirely unsuitable for drinking and other needs. The analysis identified that the area containing water that is unsuitable for any purpose is significantly spread across the entire area.

3.4 The impact of point source pollution sites

This study identified five major sites out of 15-point source sites that adversely affected the Mahaweli River water quality. These location sites are sites where the Kandy Meda Ela joins the Mahaweli River, where the Piga Oya joins the Mahaweli River, near the Katugastota Railway Bridge, near the manage ment Site and the Peradeniya Bridge (Figure 7).

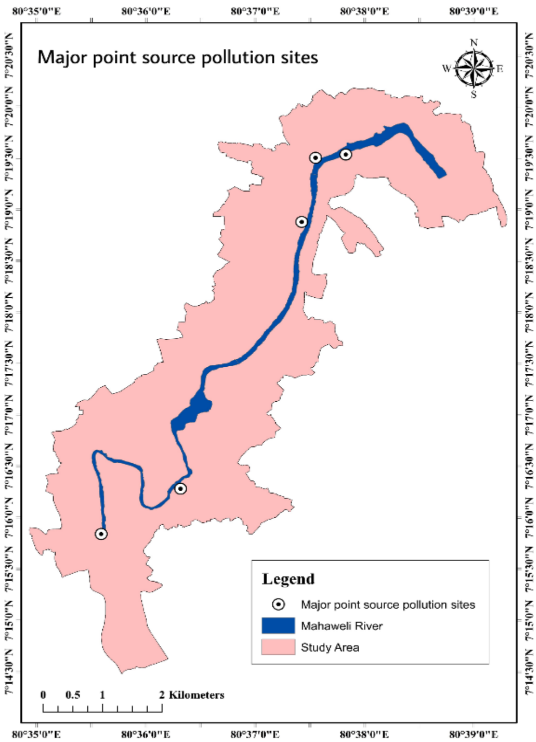

Figure 7: Location of five major point source pollution sites that adversely affected the Mahaweli River water quality

Source: Field Survey,2023

Human activities affecting the water quality of the Mahaweli River include large hotels and shopping malls on both sides of the river. It can be observed that the wastewater pipes of those buildings are directly connected to the Mahaweli River. The direct discharge of improperly managed wastewater through these pipes has led to many parameters, such as the Mahaweli River's coliform, phosphate, and pH values exceeding the standard conditions. It can be identified that the impact of these sites has directly affected the change in the temperature of the Mahaweli River water. The water samples taken from the area near the Peradeniya Bridge, the area where the Meda Ela joins the Mahaweli River, the area where the Piga Oya joins the Mahaweli

River, the Guhagoda garbage dump and the Katugastota Rail Bridge revealed that eutrophication conditions have also been created in those areas due to the increase in temperature.

When observing the turbidity values of water samples from identified point source pollution sites, it is possible to observe a value of approximately 7.4 near the Peradeniya bridge, a value of approximately 19.3 in Getambe, Warathenna near the point where the middle channel joins the Mahaweli River, and a value of approximately 18 in the vicinity of Dodamwala, Aniwatta, and Narangaskubura. The hotels and other buildings on both sides of the road have the main impact on the water quality of the Mahaweli River. The shopping street, which extends for about 250 m from the Peradeniya bridge towards Gampola, and the shopping street, which extends for about 190 m from the bridge towards Colombo, strongly impact water pollution. It can be observed that hotel waste and wastewater are mainly being illegally discharged into the Mahaweli River. In addition, several houses built without standards can be observed in that area, and all the waste and wastewater in those residential areas are being discharged into the Mahaweli River. It was also observed that soil erosion occurs directly through those non-standard constructions. This has directly affected the water quality of the Mahaweli River.

Also, the direct impact of the 5 identified point source pollution sites has led to a decrease in the dissolved oxygen level in the river water. The dissolved oxygen level in the water is between 5.2-6.5 ppm near the Peradeniya Bridge, 1.37-2.67 ppm near the point where the Meda Ela joins the Mahaweli River, 2.67-3.98 ppm near the Piga Oya, and 3.98-5.2 ppm near the Guhagoda Waste Collection Center. According to the analysis of the water samples obtained, no identifiable impact of the point source pollution sites on changing the electrical conductivity of the Mahaweli River water in the area has been identified.

The impact of the Kandy Middle Canal and the Guhagoda Waste Collection Center has contributed to the increase in phosphate values. It can be observed that the phosphate index value is lower than the standard value, but its future risk should be considered. That is, since the phosphate value in those areas is close to 2NTU if the impact of those point source pollution sites occurs in the long term, the phosphate value will increase in the future, increasing the algae population in the Mahaweli River, increasing the biological oxygen demand and decreasing the amount of dissolved oxygen in the water. The central canal flowing through the centre of Kandy city has now become mainly a sewage channel. At present, due to the laying of sewage pipes, many areas in the Grama Niladhari Divisions, such as Nagasthenna, Deiyannewela, Sudhuhumpola, Mulgampola, Getambe, Heerassagala, Katukele, Bogodawatta, and Vel Ata are flooded even with a slight rainfall. Human activities in those areas have also directly affected the pollution of the central canal. Toilet wastewater flows through tunnels designed to drain rainwater and excess water in the Kandy area. The sewage coming from these toilet pipes is connected to the central canal through Deiyannewela. It can be observed that the water in this central canal is black during the rainy season. The wastewater discharged from houses and other buildings in the urban areas of Kandy. The wastewater is transported through pipelines and treated at the wastewater treatment plant built in Gannoruwa, which is then released back into the Mahaweli River. However, it can be confirmed from testing water samples taken from that area that the project is not being appropriately implemented.

The direct and high impact of the five identified point source pollution sites has contributed to the increase in the coliform bacteria index value in the study area. In particular, very high coliform bacteria index values have been reported in the vicinity of the Guhagoda Waste Collection Center and the place where the Meda Ela joins the Mahaweli River, near the Katugastota Rail Bridge, where the coliform bacteria accumulate heavily. The Guhagoda Waste Management Site, built near the Mahaweli River, currently dumps waste daily instead of properly managing it. The distance from the waste collection site to the Mahaweli River is less than 50m. The height of these garbage mountains has now reached about 200m. Evidence has also been found that waste and sewage from pits are being dumped at this site. The existing bylaws regarding the Mahaweli River clearly state that it is entirely illegal to dump waste into the river. However, the Kandy Municipal Council is violating these laws and is continuing to engage in this practice. The water of the Mahaweli River is being diverted from the Polgolla area to the Rajarata area. The illegally collected sewage is being diverted in this way, which is polluted by the waste.

4.CONCLUSION

This study concludes that the surface water quality of the Mahaweli River within the Kandy MC area is severely degraded. According to the WQI, it was revealed that river water is entirely unsuitable for drinking and other domestic purposes. This conclusion is substantiated by the analysis of selected water quality parameters. The study also found five major pollution hotspots that have a profound impact on the river. Rapid urbanization and inadequate waste management were the primary causes of this widespread water quality deterioration in the area.

Based on the findings, several suggestions are proposed to mitigate the adverse impacts of the water quality changes. The existing waste management system in Kandy City, particularly the Guhagoda Waste Management Center, requires urgent and comprehensive reform to control the dumping of waste near the river. It is also required to introduce effective waste management processes and safety precautions to avoid groundwater and surface water contamination, controlling leachate and surface water flow. Moreover, immediate action should be taken to monitor and eliminate the discharge of toilet wastewater to stormwater drainage systems in Kandy Meda Ela and Piga Oya. While a continuous river water quality monitoring program should be established along the point source pollution sites, public awareness campaigns should be initiated to educate residents and business owners about the severe impact of their activities on the river's health.

5.References

Abeygunawardane, A. W. G. N., Dayawansa, N. D. K., & Pathmarajha, S. (2011). Socioeconomic implications of water pollution in an urban environment: A case study in Meda Ela catchment, Kandy, Sri Lanka. *Tropical Agricultural*

Research, 22(4), 374–383. https://doi.org/10.4038/tar.v22i4.3788

Akter, T., Jhohura, F. T., Akter, F., Chowdhury, T. R., Mistry, S. K., Dey, D., Barua, M. K., Islam, M. A., & Rahman, M. (2016). Water Quality Index for measuring drinking water quality in rural Bangladesh: A cross-sectional study. *Journal of Health, Population, and Nutrition, 35*(1), 4.

Carey, R. O., & Migliaccio, K. W. (2009). Contribution of wastewater treatment plant effluents to nutrient dynamics in aquatic systems: A review. Environmental Management, 44(2), 205–217. https://doi.org/10.1007/s00267-009-9309-5

Chen, S. S., Kimirei, I. A., Yu, C., Shen, Q., & Gao, Q. (2022). Assessment of urban river water pollution with urbanization in East Africa. *Environmental Science and Pollution Research*, 29, 40812–40825. https://doi.org/10.1007/s11356-021-18082-1

Dayawansa, N.D.K. (2006). *Water Pollution in Sri Lanka*. Geo-informatics Society of Sri Lanka.

Gunawardena, A., Wijeratne, E. M. S., White, B., Hailu, A., & Pandit, R. (2017). Industrial pollution and the management of river water quality: a model of Kelani River, Sri Lanka. *Environmental monitoring and assessment*, 189, 1-15.

Gunawardena, A., Wijeratne, E. M. S., White, B., Hailu, A., & Pandit, R. (2017). Industrial pollution and the management of river water quality: A model of Kelani River, Sri Lanka. *Environmental Monitoring and Assessment*, 189(457). https://doi.org/10.1007/s10661-017-6172-3

Jayasiri, M. M. J. G. C. N., Yadav, S., Dayawansa, N. D. K., Propper, C. R., Kumar, V., & Singleton, G. R. (2022). Spatio-temporal analysis of water quality for pesticides and other agricultural pollutants in Deduru Oya river basin of Sri Lanka. *Journal of Cleaner Production*, 330, 129897.

Jinadasa, K. B. S. N., Wijewardena, S. K. I., Zhang, D. Q., Gersberg, R. M., Kalpage, C. S., Tan, S. K., Wang, J. Y., & Ng, W. J. (2012). Socio-environmental impact of water pollution on the Mid-Canal (Meda Ela), Sri Lanka. *Journal of Water Resource and Protection*, 4(7), 451–459. https://doi.org/10.4236/jwarp.2012.47052

Koliyabandara, S. M. P. A., Cooray, A. T., Liyanage, S., & Siriwardana, C. (2020). Assessment of the impact of an open dumpsite on the surface water quality deterioration in Karadiyana, Sri Lanka. *Environmental Nanotechnology, Monitoring & Management*, 14, 100371. https://doi.org/10.1016/j.enmm.2020.100371

Makubura, R., Meddage, D. P. P., Azamathulla, H. M., Pandey, M., & Rathnayake, U. (2022). A simplified mathematical formulation for water quality index (WQI): A case study in the Kelani River Basin, Sri Lanka. *Fluids*, 7(5), 147. https://doi.org/10.3390/fluids7050147

Najim, M. M. M., & Rajapakse, I. H. (2011). Wastewater in Sri Lanka: Implications on human health. In A. Prakash, V. S. Saravanan, & J. Chourey (Eds.), *Water in South Asia Volume 3: Interlacing water and human health: Case studies from South Asia* (pp. 335-359). SaciWATERS.

Narangoda, C., Amarathunga, D., & Dangalle, C. D. (2023). Evaluation of water quality in the upper and lower catchments of the Kelani River Basin, Sri Lanka. *Water Practice & Technology*, 18(3), 716-737.

National Water Supply and Drainage Board. (2022). *Design manual D3: Water quality & treatment*. National Water Supply and Drainage Board. https://shorturl.at/EFAvl

Nishanthi, K., Dushanan, R., Mathanraj, S., & Priyadharshini, C. (2021). An assessment of water quality temporal variation in Sri Jayawardenapura Kotte canal, Sri Lanka. *World News of Natural Sciences*, 38, 139–157

Perera, D. D. N., Herath, A. T., Randika, J. L. P. C., Ruwandeepika, H. A. D., & Jayalal, R. G. U. (2023). Evaluation of microbiological quality of commercially available bottled drinking water in Colombo district, Sri Lanka. *Ceylon Journal of Science*, 52(2), 161–167. https://doi.org/10.4038/cjs.v52i2.8159

Perera, T. A. N. T., Herath, H. M. M. S. D., Piyadasa, R. U. K., Jianhui, L., & Bing, L. (2021). Spatial and physicochemical assessment of groundwater quality in the urban coastal region of Sri Lanka. *Environmental Science and Pollution Research*, 28(40), 56408–56424. https://doi.org/10.1007/s11356-021-16911-x

Piyadasa, R. U. K., & Meegaswatte, M. D. M. D. S. (2022). Assessment of pollution status of Meda Ela (Middle Canal) and its influence on Mahaweli River, Sri Lanka. *International Journal of Geography, Geology and Environment*, 4(1), 8–12.

Prabagar, S., Thuraisingam, S., & Prabagar, J. (2023). Sediment analysis and assessment of water quality in spatial variation using water quality index (NSFWQI) in Moragoda canal in Galle, Sri Lanka. *Waste Management Bulletin*, 1(2), 15–20.

Ranasinghe, D. M. A., & Ariyaratne, T. R. (2012). Design and construction of a cost-effective turbidimeter to be used in water purification plants in Sri Lanka. *Proceedings of the Technical Sessions*, 28, 65–70. Institute of Physics – Sri Lanka.

Sarker, B., Keya, K. N., Mahir, F. I., Nahiun, K. M., Shahida, S., & Khan, R. A. (2021). Surface and groundwater pollution: Causes and effects of urbanization and industrialization in South Asia. *Scientific Review*, 7(3), 32–41. https://doi.org/10.32861/sr.73.32.41

Senarathne, S., Jayawardana, J. M. C. K., Edirisinghe, E. A. N. V., & Chandrajith, R. (2021). Influence of regional climate on the hydrogeochemistry of a tropical river basin—a study from the Walawe river basin of Sri Lanka. *Environmental Science and Pollution Research*, 28, 15701–15715. https://doi.org/10.1007/s11356-020-11712-0

Siriwardhana, K. D., Jayaneththi, D. I., Herath, R. D., Makumbura, R. K., Jayasinghe, H., Gunathilake, M. B., ... & Rathnayake, U. (2023). A simplified equation for calculating the water quality index (WQI), Kalu River, Sri Lanka. *Sustainability*, 15(15), 12012.

Uddin, M. G., Nash, S., & Olbert, A. I. (2021). A review of water quality index models and their use for assessing surfacwater quality. *Ecological Indicators*, 122, 107218. https://doi.org/10.1016/j.ecolind.2020.107218

Wu, H., Yang, W., Yao, R., Zhao, Y., Zhao, Y., Zhang, Y., Yuan, Q., & Lin, A. (2020). Evaluating surface water quality using water quality index in Beiyun River, China. *Environmental Science and Pollution Research*, 27, 35449–35458.https://doi.org/10.1007/s11356-020-09682-4

Wu, Y., & Chen, J. (2013). Investigating the effects of point source and nonpoint source pollution on the water quality of the East River (Dongjiang) South China. *Ecological Indicators*, 32, 294–304.