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Influence of Land Use on the Water Quality of the Upper Mahaweli River: A Comparative Analysis in Dry and Wet Weather Conditions

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Abstract:

Understanding the relationship between land use and surface water quality is paramount for effective water management. A limited amount of research has been carried out focusing the effect of land use pattern and water quality of river basins in Sri Lanka, thus a study focused on the longest among all has not been traced in the literature up to data. As such this study has been carried out to investigate the variations in water quality of Mahaweli River in relation to the different land use pattern. Water quality of the selected river stretch was examined for duration of four months and those were correlated with the land use data of watershed area of the river and the rainfall data of pertinent catchment. Study area was divided into three catchments based on their land uses. 15 water quality parameters at 10 sampling locations of study stretch were recorded. Analysis of land use data in three catchments revealed that there was a significant increment of urbanization from upper end to the lower end of the study area whereas agricultural and forest areas were prominent in the upper most catchments. Moreover, analysis portrayed that there was a significant impact from land use patterns on water quality. Ammonia-N, Turbidity, COD and BOD_5 have observed to be dominant in urbanized catchments. Higher level of TSS has been observed with the increment of the agricultural/forest ratio. BOD_5, EC, COD, Faecal coliform and TOC have been escalated with the increment of urban/forest ratio. Interestingly, most of the water quality parameters are not affected by the rainfall fluctuations in selected three catchments. Although the water quality parameters show significant variations with the impact of land use patterns, overall water quality classified as Water Quality Index (WQI) was similar for all three catchments.

Keywords: Mahaweli river upper catchment, Land use, Water quality, Water quality index

1. Introduction

Sri Lanka is a tropical country bestowed on a heavy and continual rainfall throughout the year. This persistent rainfall has significantly influenced the sustainability of the prevailing fresh water sources such as lakes, rivers and streams spread throughout the country. People meet up with most of the water requirements such as drinking, household uses, agricultural use, and industrial uses, relying on freshwater resources [1]. Moreover, fresh water sources also play a pivotal role as habitats for many animal and plant species [2,3]. The demand for fresh water resources has continuously soared in recent decades due to the aftermath of rapid human population increases, intensive industrialization, and unplanned agricultural activities. Furthermore, those have positively been influenced on the deterioration of the water qualities of surface water bodies [4].

Fresh water sources can be polluted by anthropogenic activities in two folds: (1) by point sources, such as discharge of effluent from industries and treated treatment effluent discharge; and (2) by non-point sources such as overland runoff from urban and agricultural areas (buffer zones) [5,6]. Ngoye and Machiwa (2004) and Silva and Villiums (2001) reported that the river water quality can be deteriorated due to the changes in the land used patterns within the catchment area as a result of the increased anthropogenic activities [5,7]. In addition, changes of land used pattern of the catchment area of surface water sources were portrayed as the main contributing factors for the changes of the hydrological system, which eventually caused the water quality [8,9]. Moreover, some previous studies have concluded a positive relationship between water quality and the composition of land use types, such as cropland and urban land use types, were related with stream pollutant levels positively, while forest and grasslands that were less influenced by anthropogenic activities had negative correlations [10,11]

Mahaweli River is the longest of the 103 river basins found in Sri Lanka and it covers about 16% of the island's total area. The river itself has a winding course, rising about 50 km south of Kandy and flowing north then north-east to the sea near Trincomalee covering a distance of 320 km [12]. The Mahaweli River flows through Nuwara Eliya, Kandy, Badulla, Mathale, Polonnaruwa and Trincomalee districts. During the course of Mahaweli, until it falls into the Indian Ocean, it encounters numerous land use patterns such as agricultural, urban areas, forest and industrialization, etc. Within Nuwara Eliya district, river flows through a less urbanized terrain consisting of high density of forest, tea, small amount of home gardens. In the Kandy district, Kothmala oya confluences with Mahaweli River. Following the Gampola town, river encroaches into a semi urbanization area and then it flows across the Peradeniya. Then, the Meda Ela which is, one of adversely polluted streams; connects with the Mahaweli River. Within the Kandy region the river strolls surpassing a considerable number of hotels, paddy lands and industrial areas. Even though the Mahaweli River is a major water course in Sri Lanka, studies on variation of water quality of the River is very limited. A study conducted by Dissanayake and Weerasooriya (1986) elucidated the impact of the use of fertilizers, pesticides, herbicides on crops and pastures, pollution from farm animals, pollution from septic tanks used for disposal of domestic wastes, exposure of the land to erosion during the cultivation of fields and land clearing for building roads on water quality is paramount important, such comprehensive studies are not conducted up to date, to investigate it. Therefore, the purpose of this study is to assess the water quality along the Mahaweli River (in upper catchment) from Nawalapitiya to Polgolla and to investigate any correlations among land used patterns and water quality because the land use pattern from in this river stretch is significantly varied.

2. Materials and Methods

2.1 Study area and sampling stations

The study area is part of Mahaweli River upper catchment (30° 51′ 21″–30° 51′ 34″ N, 110° 53′ 27″–110° 54′ 50″ E) encompasses an area located within Nuwara Eliya and Kandy Districts of Sri Lanka (Figure 1). The altitude of the study area ranges from 338 m to 619 m. It is bound by a watershed area of approximately 3210 km2.

The study area was divided into three catchment zones shown in Figure 1, namely Catchment 1 (Nawalapitya to Gampola), Catchment 2 (Gampola to Peradeniya), and Catchment 3 (Peradeniya to Polgolla). The boundaries of three catchment areas were determined based on the urbanization, other land uses and local administration divisions. Ten sampling locations were selected along the Mahaweli River starting from Ramukpitiya (7°00'26.2"N 80°29'18.9"E) to Polgolla (7° 19' 24" N, 80° 38' 42" E) as shown in Fig. 1.

2.2 Determinations of land use pattern

Quantitative land use data of the selected catchment areas were obtained from Land Use Planning Office at District secretariat office, Kandy. Area of five selected land use types namely forest, urban area, paddy, and other agricultural lands were calculated and spatial distribution map of land use pattern was prepared using Arc GIS software.

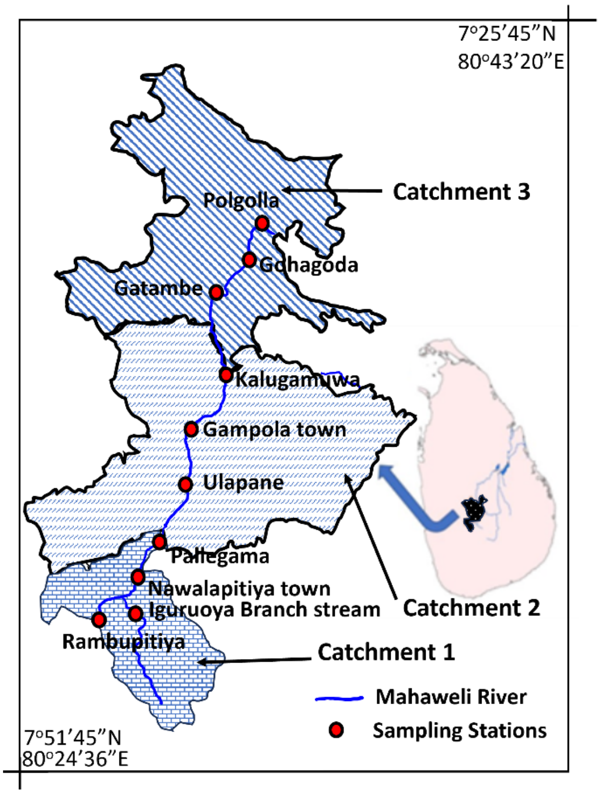

Fig. 1. The study area (three catchments) as divided according to the land use pattern.

2.3 Sampling Locations and Surface Water Sampling

Nine sampling locations along the major stem and one sampling location in a branch stream of the Mahaweli River were selected for sampling purposes. During a period of five months, surface water sampling at 9 locations were carried out in upstream, middle stream and downstream areas of the Mahaweli upper catchment basin (Fig. 1). Two duplicate water samples were collected at each sampling station from the middle of the stream at 50 cm to 100 cm depth. During sampling, in-situ measurements were conducted to assess water temperature, electrical conductivity (EC), pH, and dissolved oxygen (DO). A portable EC meter (Mettler Toledo, Columbus, OH, USA) was utilized to measure EC and water temperature (TEM, °C). Additionally, DO and pH were measured in situ using a portable DO probe (YSI Incorporated Company, Yellow Springs, OH, USA) and a pH meter (LAQUA F-72, Kyoto, Japan), respectively.

To measure other water quality parameters, a set of duplicate samples were passed through Whatman GF/C filter paper and stored at 4 °C in darkness until transportation to the laboratory for further analysis. Sulfuric acid was added to the samples to adjust their pH to < 2 for preservation in pre-cleaned bottles. These bottles were kept in iceboxes until analysis. Another set of duplicate unfiltered samples were collected transported to laboratory for further analysis. The laboratory analysis included the determination of chemical oxygen demand (COD, mg/L) using the Titrimetric method. Total phosphorus (T-PO_4^{3-}, mg/L), ammonia nitrogen (NH_4^+-N, mg/L), nitrite (NO_2^--N mg/L), and nitrate (NO_3^--N, mg/L) were quantified using a spectrophotometer (UNICO2100, UNICO Company, South Brunswick, NJ, USA). COD, TP, and TN were measured using unfiltered samples, while NH_4^+-N and NO_3^--N levels were assessed using filtered samples. The values reported for the fourteen parameters in this paper represent the averages of triplicate analyses. Laboratory procedures followed the Standard Methods for Examination of Water and Wastewater. Additionally, suspended solid concentration (SSC) was determined using a filtration method (Guy, 1969). In-situ analysis was conducted for pH (Orion 260A), dissolved oxygen (Orion 830A), turbidity (Hatch 2100P), total dissolved salts (TDS), and water temperature (thermometer). Concentrations of heavy metals (Fe, Cu, Pb, and Cr) were measured using Atomic Absorption Spectrophotometer (SHIMUDZU, AA7000, Japan). BOD_5 in the samples was evaluated using the 5-day BOD method. Total and fecal coliform concentrations in these samples were obtained using the membrane filtration method.

2.5 Determination of dry and wet seasons

Variation of rainfall in the selected study area was recorded in parallel to the water quality assessments of the samples. Rainfall time series of Nawalapitiya and Peradeniya gauging stations were obtained from the Department of Irrigation, Sri Lanka. Köppen climate classification method, that defines a dry season month as a month having an average precipitation below 60 mm and a wet (rainy) season month as a month with an average precipitation is 60 mm or more, was deployed in categorizing the wet season in the study area.

2.6 Calculating Water Quality Index (WQI)

Water quality index method developed by the National Sanitation Foundation (NSF) considering selecting parameters was used to determine the overall water quality at each sampling station. This method constitutes a common scale and assign weights to each parameter considered in the index, to calculate WQI of various water bodies those are critically polluted. Nine water quality parameters, namely; DO, faecal coliform, pH, BOD_5, temperature, total T-PO_4^{3-}, NO_3^--N, turbidity, total solids were used to calculate the WQI of water at a sampling station.

3. Results and Discussions.

3.1 Spatial distribution of land use pattern

Land use data was obtained from Land Use and Planning Department, Kandy. Distribution of key land use patterns is shown in Figure 1 and Figure 2. The percentage coverage of each land use type within the catchment is shown in Table 1. The most fascinating factor regarding land use pattern of the study area was rapid increment of the urbanized area from Catchment 1 (25.2%) to Catchment 3 (73%), while forest coverage is rapidly decreasing from catchment 1 (25.8%) to Catchment 3 (9.2%). The ratio between urban and forest areas in Catchment 3 experiences an eightfold increase compared to that in Catchment 1, located in the upper reaches of the river. This substantial increase primarily due to the urbanization expansion in Gampola, Peradeniya, and Kandy cities within Catchment 3. The larger extent of tea cultivation was observed in the Catchment 2 and the land utilization for paddy cultivation was higher in Catchments 3 and 2 relatives to the upper reach of the study area. Similarly, land use coverage by other forms of agriculture was showing a decreasing trend toward the catchment 3.

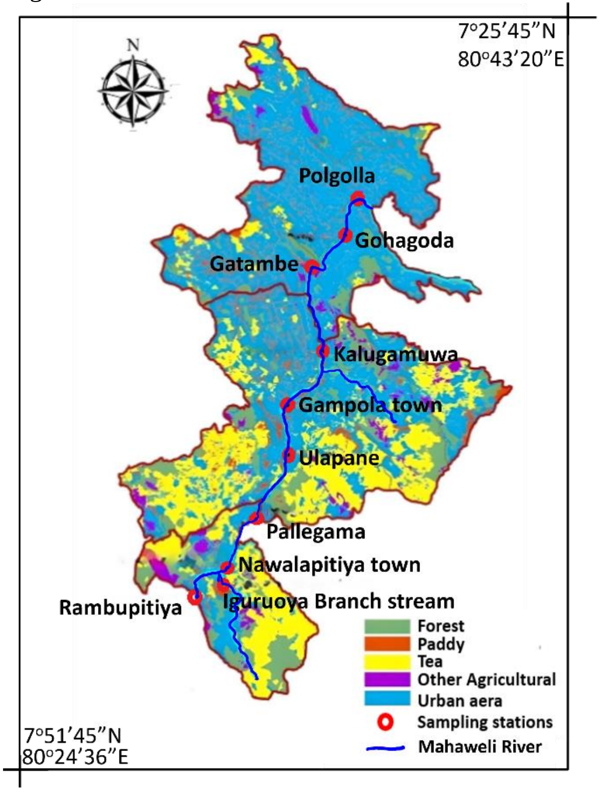

Fig.2. Spatial variation of land use pattern

Table 1
Distribution of land use patterns as percentages of each catchment extent

Land use Pattern	**Area (%)**		
	Catchment 1	**Catchment 2**	**Catchment 3**
Forest	25.82	17.02	9.22
Urban	25.12	41.87	72.97
Tea	37.89	30.50	5.33
Paddy	3.09	6.62	10.15
Other agricultures	8.07	4.00	2.32

3.2 Spatial characteristics of water quality

The concentrations of water quality parameters of three Catchments during sampling period were measured and p-values were calculated by Kruskal Wallis ANOVA analysis to identify the significance of water quality parameters among Catchments. Calculated p-values are shown Table 2. The Kruskal-Wallis test showed that the values obtained by each parameter, including EC ($p < 0.01$), turbidity, NH_4^+-N ($p < 0.01$), T-PO_4^{3-} ($p < 0.01$), and fecal coliform ($p < 0.01$) were significantly differ among selected catchments of Mahaweli River (Table 3). EC increases from Catchment 1 (67.0 ± 32.7 μScm^{-1}) to Catchment 3 (132.7 ± 78.5 μS/cm (Table 3). Turbidity values were showing a considerable variation among these Catchments with the highest values observed in Catchment 3 (14.22 ± 7.62 NTU) while lowest NTU value of 6.92 ± 4.21 was reported in Catchment 2. Concentrations of NH_4^+-N of catchment 1, catchment 2, and catchment 3 were 0.095 ± 0.07 mg/L, 0.056 ± 0.04 mg/L, and 0.294 ± 0.60, respectively showing significant variation among selected three Catchments. T-PO_4^{3-}in Catchment 1 (0.61 ± 0.70 mg/L) was about three-fold higher than those of Catchment 2 (0.20± 0.19 mg/L) Catchment 3 (0.19 ± 0.16 mg/L). Interestingly, faecal coliform (Colonies/100ml) were drastically increased from Catchment 1 (152.3 ± 128.6) toward Catchment 3 (244.4 ± 200.3) with the increases of urbanization from Catchment 1 to Catchment 3. Similar to faecal coliform variation, COD increases toward the direction of river flow showing highest value of COD in Catchment 3(18.88 ± 16.90 mg/L) while lowest value COD of 9.00 ± 6.61mg/L was observed in upper Catchment 1. Values of water quality parameters of TSS (p= 0.305), BOD (p= 0.189), pH (p= 0.178), DO (p= 0.135), NO_3^-—N (p= 0.494), COD ($p < 0.05$), NO_2^--N (p= 0.295), and TOC (p= 0.155) were not significantly different over these three Catchments. pH and DO along the river showed almost unchanged and minimal variation in the standard deviations of pH and DO indicate that they were relatively stable over the study period.

The EC values reported in this study were within the normal range of EC found in freshwater streams ranges from 0-800 μS/cm which reported by various studies [14,16-19]. However, the results of the analysis suggested that land use pattern had a significant impact on EC in the upper catchment of the Mahaweli River. Spatial distribution of EC indicated that, it increases towards the downstream of the river. It can be presumed that the increase in EC toward the downstream is mainly caused due to the dissolving numerous ions in river water by point and nonpoint pollution sources.

Presence of N and P in surface waters is triggered due to the ecological impacts on freshwater systems [20]. Application of fertilizer in agriculture is one of the cynosure sources for N and P. If these elements do not meet any form of degradation, they accumulate in ground and surface waters and eventually in the sea [21]. It was observed concentration of NH_4^+-N in the river water significantly increases toward the flow direction. In addition to the application of fertilizer, point source pollution with sewerage waste is another main source of NH_4^+-N which could also be a reason for higher NH_4^+-N in the Catchments 2 and 3. Because, measurements of faecal coliforms revealed that it also significantly increases from Catchments 1 to 3 (Table 2). The large amounts of toilet waste are discharged into streams

Table 2
Kruskal Wallis ANOVA results for three catchments of the Mahaweli River basin.

Water quality parameter	Catchment 1	Catchment 2	Catchment 3	p-value
Total suspended solids (mg/L)	42.4 ± 51.9 (3-181)	33.9 ± 35.6 (0.5-126)	58.9 ± 52.9 (2-196)	0.305
Biochemical oxygen demand (mg/L)	2.25 ± 1.00 (1.06-5.11)	2.21 ± 2.58 (0.104-10.66)	2.67 ± 0.86 (1.83-4.6)	0.189
pH	7.36 ± 0.98 (6.51-9.51)	7.44 ± 0.65 (6.67-8.95)	7.43 ± 0.48 (6.97-8.82)	0.178
Dissolved oxygen (mg/L)	7.25 ± 0.96 (4.74-8.56)	7.47 ± 0.57 (5.78-8.37)	7.19 ± 0.76 (6.17-9.26)	0.135
Electrical conductivity (μS/cm)	67.0 ± 32.7 (25.65 -1 36.50)	86.9 ± 43.5 (40.08 - 200.10)	132.7 ± 78.5 (56.61-396.50)	0.0053
Turbidity (NTU)	7.67 ± 5.55 (3-25)	6.92 ± 4.21 (4-18)	14.22 ± 7.62 (5-33)	0.0001
Ammonia nitrogen (mg/L)	0.095 ± 0.07 (0.01-0.27)	0.056 ± 0.04 (0.01-0.17)	0.294 ± 0.60 (0.001-2.43)	0.0065
Total phosphate (mg/L)	0.61 ± 0.70 (0.02-2.56)	0.20± 0.19 (0.02-0.81)	0.19 ± 0.16 (0.02-0.55)	0.0062
Nitrite nitrogen (mg/L)	0.005 ± 0.003 (0.001-0.014)	0.006± 0.005 (0.002-0.023)	0.008 ± 0.009 (0.001-0.041)	0.494
Chemical oxygen demand (mg/L)	9.00 ± 6.61 (1.00-27.00)	9.95 ± 5.84 (1.00-24.00)	18.88 ± 16.90 (6.00-76.00)	0.295
Fecal Coliform (Colonies/100ml)	152.3 ± 128.6 (18-432)	244.4 ± 200.3 (18-785)	671.1 ± 588.0 (10-2340)	0.013
Total Coliform (Colonies/100ml)	158.3 ± 112.5	80.5 ± 68.7 (12-210)	442.2 ± 320.0 (120-935)	
Nitrate nitrogen (mg/L)	3.02 ± 1.16 (1.00-5.60)	3.19 ± 1.69 (0.7-6.5)	3.85 ± 2.16 (0.6-10.1)	0.155

Total organic carbon (mg/L)	1.39 ± 1.16 (0.21-3.44)	2.24 ± 1.83 (0.33-6.07)	3.01± 2.07 (1.03-7.61)	0.305

without proper treatment into Asian river basins with high population densities [22]. NO_3^--N is highly soluble in water and its concentration increases as water flow increases[21], which could be the reason for increase in NO_3^--N concentration toward the catmint 1 to 3, even though the spatial variation of NO_3^--N concentrations are not significant. Increase in NO_3^-–N concentration studies reported low concentration of NO_3^--N in upper catchments in rivers [23]. However, microbial processes such as nitrification and denitrification are significantly influence on the fluctuations of the input of fertilizer to agricultural lands, in contrast to very less to agricultural lands were found in Catchment 3 (Table 2). Decrease in T-PO_4^{3-} concentrations toward the flow direction is due to the decrease in agricultural lands, assimilation of PO_4^{3-} in plants and increase in discharge concentrations of N species. of the river [17,24, 25]. Catchments 1 and 2 showed high T-PO_4^{3-}probably due to the agricultural runoffs.

In many studies, increase in urbanization showed positive correlation among increase in COD, BOD and SS [26,27]. Interestingly, results of present study didn't support it. Of the measured water quality parameters from the measured samples, only total and faecal coliform content exceeded the approved WHO drinking water values [28].

The seasonal variation of water quality parameters along the selected stretch of Mahaweli River was analysed. The Köppen climate classification method was attuned to delineate dry season and wet season months. The seasonal variation of the water quality parameters is shown in Table 3. The Kruskal-Wallis test results depicted that the corresponding values of all the measured parameters other than TSS are not significantly varying between dry and wet seasons. The average TSS concentration in all three catchments was 17.7 ± 16.92 mg/L in dry season while that was 43.13 ± 41.15 mg/L in wet season indicating that the TSS (p=0.002) variation is significant during dry and wet seasons.

Several previous studies have reported that water quality parameters showed seasonal variations (Ding et al., 2015; 5,25,29-30]. However, in present study only SS concentrations were significant varied seasonally (Table 3). High inflow discharges during the wet season carries more SS into the Mahaweli River causing higher SS during wet season. However, as most of other water quality parameters which were monitored during this study are not significantly altered seasonally, significant differences of water quality parameters described in above section 3.2 are caused mainly due to the differences in land use pattern in the selected catchments.

3.3 Seasonal variation of water quality

Table 3

Kruskal Wallis ANOVA results for seasonal variations of water qualities in Mahaweli River basin

Parameter	**Dry Season**	**Wet Season**	**p-value**
Total suspended solids (mg/L)	17.7 ± 16.92 (2 - 55)	43.13 ± 41.15 (1 - 196)	0.002
Biochemical oxygen demand (mg/L)	2.01 ± 0.74 (0.21 – 3.64)	2.44 ± 2.02 (0.42 – 7.61)	0.174
pH	7.42 ± 0.48 (6.89– 8.82)	7.41 ± 0.81 (6.51 – 9.51)	0.880
Dissolved oxygen(mg/L)	7.69 ± 0.71 (5.97 – 9.26)	7.13 ± 0.72 (4.74 – 8.37)	0.133
Electrical conductivity (µS/cm)	116.4 ± 88.9 (28.33 – 396.5)	85.1 ± 36.1 (25.63 – 174.60)	0.199
Turbidity (NTU)	8.15 ± 3.65 (4 - 15)	9.92 ± 7.59 (3 - 33)	0.226
Ammonia nitrogen(mg/L)	0.28 ± 0.68 (0.01 – 2.43)	0.09 ± 0.09 (0.001 – 0.048)	0.427
Total phosphate(mg/L)	0.33 ± 0.56 (0.02 – 2.56)	0.32 ± 0.39 (0.02 – 2.28)	0.257
Nitrite nitrogen(mg/L)	0.008 ± 0.009 (0.001 – 0.041)	0.006 ± 0.003 (0.002 – 0.019)	0.084
Chemical oxygen demand(mg/L)	15.83 ± 8.73 (2– 41)	10.83 ± 12.31 (1– 76)	0.621

Fecal Coliform (Colonies/100ml)	493.1 ± 598.6 (70 - 2340)	274.4 ± 252.9 (10 - 1180)	0.130
Total Coliform (Colonies/100ml)	169.0 ± 202.9 (12 – 700)	255.7 ± 272.7 (14 – 935)	
Nitrate nitrogen(mg/L)	169.0 ± 202.9 (12 - 700)	255.7 ± 272.7 (14 - 935)	0.257
Total organic carbon(mg/L)	3.8 ± 2.3 (1.5 – 10.1)	2.6 ± 1.7 (0.6 – 10.1)	0.502

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3.4 Heavy metal concentrations

Heavy metals concentrations of Cu, Pb, Zn and Cd in each sampling stations were determined by Atomic Absorption Spectrophotometer. Measured average concentrations of heavy metals at each sampling stations are shown in Table 4. It is important to note that the Pb concentrations at Gohagoda (0.3 mg/L) and Polgolla (0.2 mg/L) sampling stations are one-fold higher than that of the other sampling stations and they exceed the WHO guidelines for drinking water [28]. Heavy metal concentrations in Mahaweli river water have not been widely investigated in recent years. Bandara et al. (2011) reported same levels of Cd concentrations in Mahaweli River [32]. Cd concentrations at Gampola, Pollgolla, and Gatambe of river were 13.8 ± 2.65 µg/L, 10.8 ± 1.9 µg/L, and 21.5 ± 1.7 µg/L, respectively. In this study, the concentrations of Pb and Cd monitored in the Mahaweli upper catchment water were found to be one order of magnitude higher than those reported by Dissanayake and Weerasooriya (1986)[13].These increases in Pd and Cd concentration are presumed to be due to the extensive application of chemicals in agriculture and increase in anthropogenic activities in the study area. Further, measured heavy metal concentrations of Pb and Cd occasionally exceeded the approved WHO drinking water standards [28]

Table 4
Heavy metal concentration in different sampling stations.

Sampling station	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)	Cd (mg/L)
WHO Standard	1.5	0.05	5.0	0.005
Rambukpitiya	0.017	0.01	0.05	0.004
Inguru oya Branch Stream	0.010	0.01	0.02	0.004
Nawalapitiya Town	0.010	0.03	0.03	0.006
Pallegama	0.010	N/D	0.03	N/D
Ulapane	0.010	0.05	0.06	0.005
Gampola Town	0.010	N/D	0.02	0.003
Kalugamuwa	0.020	0.01	0.02	0.004
Gatambe	0.020	N/D	0.01	0.006
Gohagoda	0.015	0.30	0.02	0.008
Polgolla	0.010	0.20	0.02	0.005

3.5 Water Quality Index

Water quality index (WQI) values of sampled water at each stamping station were calculated using the method developed by the National Sanitation Foundation (NSF). WQI is a good indicator of overall water quality of a water sample. Calculated WQI values are shown in Table 5. According to obtained WQI values, all sampling stations except Gohagoda (sampling station 9) showed a "Good" (WQI 71-90) water quality. However, these results indicate that even some individual water quality parameters are influenced by land uses in the study area, the overall water quality of the upper catchment is not varied significantly with the changes of land use pattern. Gohagoda sampling station, which is located downstream of Gohagoda dump site has alarmed a "Medium" water quality resulting in a WQI value of 69.6. In addition, second lowest WQI value (72) was reported at Gatambe sampling station which is contaminated by the Medha ela [33].

Table 5
Water Quality Index values of sampling stations.

Sample Station No	Sample Station Name	WQI value
1	Rambukpitiya	73.2
2	Inguru oya Branch Stream	76.2
3	Nawalapitiya Town	73.6
4	Pallegama	77.4
5	Ulapane	75.2
6	Gampola Town	75.6
7	Kalugamuwa	76.2
8	Gatambe	72
9	Gohagoda	69.6
10	Polgolla	74.8

4.0 Conclusions

This research highlights the significant influence of land use, particularly urbanization, on water quality in three Mahaweli River catchments in Sri Lanka. The transition from agricultural to urban zones correlates with shifts in water quality indicators such as NH_4^+-N, Turbidity, COD, and BOD_5. The escalation of parameters like TSS, BOD_5, EC, COD, Faecal Coliform, and TOC with urbanization underscores human activity's impact on water quality. Despite variations, the WQI remained consistent along the Mahaweli River stretch, but excessive Cd and Pb near the Gohagoda landfill site indicate localized contamination.

As the recommendations, the addressing the impact of urbanization on water quality in the Mahaweli River catchments requires sustainable urban development practices, such as green infrastructure and stormwater management, to reduce pollutant runoff. Strengthening monitoring and regulatory measures, especially near contamination hotspots like landfill sites, is crucial for safeguarding water quality and preserving the ecological health of river ecosystems.

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