

## Correlates of Pollution Load and Assessment of Water Quality Index of a Major Stream along Yemetu Community in Ibadan Nigeria



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### ABSTRACT

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#### Keywords:

*water quality, correlation, Yemetu stream, pollution, sampling points, water quality index, physico-chemical parameters*

This study aimed at assessing the correlates of pollution loads and water quality index of a major stream along Yemetu community in Ibadan, Nigeria. Water samples were collected during the raining season at eight sampling points (S1 to S8) for four weeks for physicochemical and bacteriological analyses using standard methods described by American Public Health Association (APHA) (2005). Pearson correlation coefficient was used to identify correlated parameters and Water Quality Index (WQI) was used to classify the quality of the water. The pH at all sampling points were slightly acidic, Total coliforms and *E. coli* counts were higher than the permissible limits, BOD<sub>5</sub> was significantly correlated with COD ( $r = 0.97, P < 0.01$ ), EC ( $r = 0.71, P < 0.05$ ), TDS ( $r = 0.75, P < 0.05$ ), TCC ( $r = 0.89, P < 0.05$ ), and *E. coli* ( $r = 0.86, P < 0.05$ ). The WQI ranged from 227 (very poor water) in S1 to 667 (water unsuitable for drinking) in S7. The study recommends effective monitoring of water quality of the stream (most especially the bacteriological characteristics) through the control of various anthropogenic activities around the stream by the appropriate authorities.

## 1. INTRODUCTION

Water according to Allan [1] is regarded as an essential resource to all forms of life. It constitutes 50-97% of the weight of all plants and animals, and about 70% of the human body. Sources of fresh water could be in the form of surface water (e.g. lakes, and rivers), glaciers, groundwater, rainwater, etc. Apart from drinking purpose, water resources play a vital role in different sectors including agriculture, forestry, livestock production, industrial activities, fisheries, hydropower generation, and other activities. The quality and availability of surface water have been impaired as a result of factors such as increasing population, industrialization and urbanization [2]. Several anthropogenic activities have resulted in a significant decrease in the quality of water in the aquatic systems [3]. Streams play a key role in receiving and dispersal of many municipal, industrial and agricultural wastewater [4]. The water pollution problem is being experienced by both developed and developing countries. Human activities bring about pollution of water by the introduction of various wastes into water bodies. Pathogenic organisms, plant nutrients that stimulate algal blooms, oxygen-demanding organic substances, inorganic, and organic toxic substances are the most common pollutants of water [5]. The quality of water in a stream can be determined through assessment of various constituents present. When water quality is poor, it affects not only the aquatic life but also the surrounding ecosystem [6]. To keep streams and aquatic systems healthy, certain water quality indicators or parameters must be examined and put to check. Water Quality Index (WQI) was used to classify the level of pollution of Yemetu stream in this study.

Water quality index is an approach that expresses the overall quality of water of a particular location at a particular time based on certain water quality parameters [7]. The development of WQI was coined by Horton in the early 1970s where a mathematical method was employed to calculate a single value from multiple test results [7]. The result of WQI gives information on the quality of water in a given water basin, such as river, lake, or stream. After Horton, several workers all over the world developed WQI based on rating of different water quality parameters [8-11]. A number of physicochemical and bacteriological parameters are required to calculate the quality index of a particular stream. Basically, WQI attempts to provide a mechanism through which a cumulatively derived numerical expression is used to define the water quality of water in a particular stream [12]. The index (WQI) summarizes large data on water quality into simple terms (such as: excellent, good, poor and unsuitable) to report to the public and appropriate stakeholders in a consistent manner [13]. It compares the quality of water of different sources and reveals the pollution level of that particular water source [14].

Streams and rivers in many urban and semi-urban areas in Nigeria are polluted due to the discharge of organic wastes and untreated wastewater directly into them [15]. Thus, making river pollution a central issue of water management in Nigeria [16]. Studies have revealed the various impact of human activities and their implications on our aquatic resources [17-19]. Yemetu stream is an urban stream that receives untreated wastewater and organic wastes from the surrounding households and is also subjected to various anthropogenic impacts. This study was aimed to assess the correlates of

pollution loads and the water quality index of a major stream along Yemetu community in Ibadan, Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Study area

This study assessed the pollution load of Yemetu stream, in Yemetu community, Ibadan North Local Government Area, Ibadan, Oyo State, South-west, Nigeria. The community was described in Oloruntoba et al. [20]. In the study area, some households along the stream discharged their excreta into the stream. Eight stations were purposively selected along the stream (Figure 1).

### 2.2 Sample collection

Water samples were collected from eight sampling stations along Yemetu stream for four weeks between September and October, 2017. It was raining season and the river flow was optimal. Separate sample containers were used to collect water

samples for analysis of the physico-chemical, bacteriological parameters, and Biochemical Oxygen Demand (BOD<sub>5</sub>). Plastic kegs of 1.5 litres capacity were used to collect samples for physico-chemical analysis while samples for BOD<sub>5</sub> analysis were collected using BOD bottles which were filled completely to expel air bubbles. Samples were collected from each of the selected sampling stations once a week for a period of 4 weeks according to the standard methods described by the American Public Health Association [21]. The sample bottles were tightly stoppered after each collection and transported to the laboratory for determination of physico-chemical parameters such as pH, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Nitrate, phosphate, Dissolved Oxygen and BOD<sub>5</sub> using standard methods [21]. Samples for bacteriological examination were collected using glass sample bottles which were pre-washed with distilled water and sterilized in an oven at 170°C for 1 hour. The samples were collected under aseptic conditions, stored in light-proof containers with ice packs at 4°C, and transported to the laboratory for immediate estimation of total coliform and *Escherichia coli* counts [21].

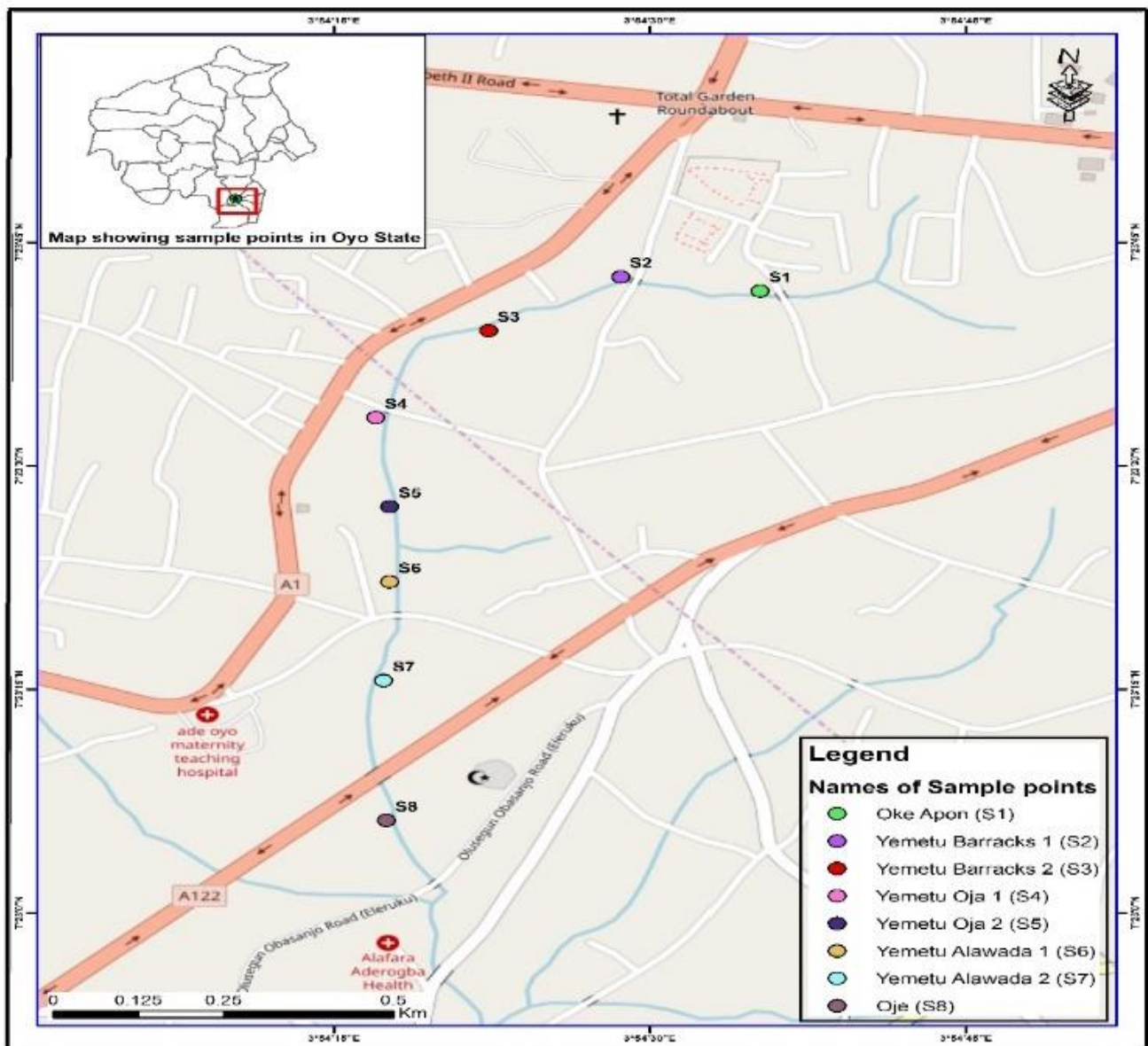


Figure 1. Map of Yemetu community showing the sampling points

**Table 1.** Unit weight, relative weight and WHO/NESREA standards for WQI computation

Parameters [Units]	Unit weight	Relative weight	WHO/NESREA Standards
pH	3	0.088	6.5-8
Conductivity $\mu\text{s/cm}$	2	0.059	400
Total Dissolved Solids (TDS) [mg/L]	3	0.088	500
Total Suspended Solids (TSS) [mg/L]	3	0.088	30
Dissolved Oxygen (DO) [mg/L]	4	0.118	7.5
Biochemical Oxygen Demand (BOD) [mg/L]	5	0.147	40
Chemical Oxygen Demand (COD) [mg/L]	5	0.147	80
Nitrate [mg/L]	4	0.118	50
Total Coliforms [MPN/100mL]	5	0.147	10

### 2.3 Laboratory analysis

The pH was determined using a pre-calibrated pH meter (Bosch PHS-25 CW) while EC and TDS were measured using a Jenway TDS/EC combined meter. TSS was determined using gravimetric method while dissolved oxygen was determined using the Jenway Model 9070 waterproof DO meter. The BOD<sub>5</sub> of the water sample was determined using the Jenway Model 9070 waterproof DO meter. The DO<sub>1</sub> was determined on the first day while the sample for DO<sub>5</sub> was incubated at 20°C and determined on the fifth day. The COD was determined by a titrimetric method using Standard Methods as described by APHA [21]. Nitrate was determined using the Phenol Disulphonic Acid method while phosphate was determined using the stannous chloride method. The Total coliforms and *E. coli* counts were determined by standard methods described by [21]. The media used for the Total coliforms and *E. coli* determination were MacConkey and Brilliant green bile broth respectively. The samples were thereafter incubated for 24 h at 37°C for total coliforms and at 44°C for the *E. coli*. The Most Probable Number (MPN) technique was adopted in estimating the microbial populations. All media were prepared according to the manufacturers' specifications. All reagents used for analysis were prepared from analar grade chemicals. Appropriate reagent blanks were prepared for each analysis to ensure Quality Control and Quality Assurance. All analyses were carried out in triplicates [21].

### 2.4 Calculation of water quality index

This study adapted the Water quality index method described by Mohamad [22]. A total of nine parameters (pH, conductivity, total dissolved solids, total suspended solids, dissolved oxygen, Nitrate, biochemical oxygen demand, chemical oxygen demand, and Total coliform count) were used to evaluate the water quality index of the stream. Values were compared with WHO guidelines /NESREA Standards. Four steps were used to compute the WQI of the water. The four steps are:

#### 2.4.1 Assignment of unit weight to each parameter

Each parameter being considered was assigned a weight ( $w_i$ ) based on their perceived effects and their importance to water quality (Table 1). Parameters with major effects on water quality were assigned with highest weight of 5 while those considered not harmful were assigned a minimum weight of 2. Each parameter's relative weight ( $W_i$ ) was computed by dividing its unit weight by the summation of all parameters using the following formula:

$$W_i = \frac{w_i}{\sum_{i=1}^n w_i}$$

where:  $W_i$  = the relative weight,

$w_i$  = unit weight of each parameter and

$n_i$  = number of selected parameters ( $n = 9$  in this study).

#### 2.4.2 Quality rating scale calculation for each parameter

The Each parameter's rating scale ( $Q_i$ ) was calculated by dividing the concentration of each parameter by the value of its permissible limit as defined by WHO/NESREA and the result multiplied by 100 according to the equation below:

$$Q_i = \left( \frac{C_i}{S_i} \right) \times 100$$

where:

$Q_i$  = quality rating scale,

$C_i$  = concentration of each parameter in mg/L

$S_i$  = drinking water standard for each parameter in mg/L

#### 2.4.3 Calculation of sub-indices

The determination of water quality sub-index value ( $Sl_i$ ) was done for each parameter through the multiplication of its relative weight ( $W_i$ ) with its quality rating scale ( $Q_i$ ) as expressed in the equation below

$$Sl_i = W_i \times Q_i$$

#### 2.4.4 Summation of sub-indices

The addition of sub-indices of all the selected parameters was done to determine the WQI of the stream as indicated in the equation below:

$$WQI = \sum_{i=1}^n Sl_i$$

The water quality of the stream was determined according to the computed WQI values obtained. The WQI was categorized into five classifications [23], as shown in Table 2.

**Table 2.** Water quality indices range and classification

WQI Range	Type of water
< 50	Excellent water
50 – 100	Good water
100.1 – 200	Poor water
200.1 – 300	Very poor water
> 300	Water unsuitable

**Table 3.** The classification of lakes (trophic status) on the basis of total phosphate

S/No	Trophic status	Values of PO <sub>4</sub> <sup>2-</sup> mg/L
1.	Oligotrophic	<0.005
2.	Mesotrophic	0.005-0.01
3.	Mesoeutrophic	0.01-0.03
4.	Eutrophic	0.03-0.1
5.	Hypereutrophic	>0.1

### 2.5 Data management

All results were statistically analyzed using Statistical Package for Social Sciences (SPSS) version 20. Data were analysed using descriptive statistics (the mean and standard deviation) while Pearson's correlation coefficient (r) was used to determine highly interrelated and correlated parameters. The required number of the component was determined using a screen plot and the suitability of the data for Principal Component Analysis (PCA) was evaluated by Kaiser–Meyer–Olkin (KMO) and Bartlett test of sphericity. Nine parameters were used in the Cluster Analysis. The similarities between clusters and separating homogenous clusters were determined based on Euclidean distance and hierarchical Cluster Analysis using Ward's Method. The trophic state of Yemetu stream was computed with the mean phosphate concentration along the eight sampling stations which were plotted in box and whisker chart. The stream trophic status was compared with the

classification of lakes (trophic status) on the basis of total phosphate described by Wetzel [24] (Table 3).

### 3. RESULTS

Characteristics of the stream at the eight sampling stations are presented in Table 4. The pH of the stream was 5.43±0.43 (S1), 5.49±0.28 (S2), 5.87±0.22 (S3), 5.73± 0.56 (S4), 5.27± 0.55 (S5), 5.74± 0.16 (S6), 5.82± 0.29 (S7) and 5.45± 0.58 (S8) respectively. All the pH values were slightly acidic and below the recommended limits (6.5-8.5) by both WHO and NESREA. Values for TDS, EC, TSS, DO, COD, BOD<sub>5</sub>, and Nitrate at all the sampling stations were found to be within WHO and NESREA permissible limits. Phosphate level (mg/L) were 5.07± 1.42 (S1), 5.03± 1.92 (S2), 11.7± 3.87 (S3), 10.02± 5.14 (S4), 5.17± 1.17 (S5), 5.62± 1.13 (S6), 6.61± 2.5 (S7) and 14.45± 11.1 (S8) respectively. These values were higher than the limit (2-5mg/L) recommended by NESREA. Total coliform counts (MPN/100mL) ranged from 1.42×10<sup>4</sup> (S1) to 497×10<sup>4</sup> (S8) while that of *E. coli* ranged from 1.34×10<sup>4</sup> (S1) to 3.8×10<sup>4</sup> (S8). Correlation matrix (Table 5) shows that a significant positive correlation existed between BOD<sub>5</sub> and other parameters such as COD (r = 0.97, P<0.01), EC (r = 0.71, P<0.05), TDS (r = 0.75, P<0.05), TCC (r = 0.89, P<0.05), and *E. coli* (r = 0.86, P<0.05). Positive correlation also exists between EC and TDS (r = 0.98, P<0.01), Nitrate and Total coliforms (r = 0.82, P<0.05), *E. coli* (r = 0.91, P< 0.01).

**Table 4.** Characteristics of Yemetu stream

Parameters	Unit	Sampling stations								NESREA Limit	WHO Limit
		S1	S2	S3	S4	S5	S6	S7	S8		
pH		5.4±0.40	5.49±0.28	5.87±0.22	5.73±0.56	5.27±0.55	5.74±0.16	5.82±0.29	5.45±0.58	6-9	6.5-8.5
EC	µS/cm	12.22±0.55	11.50±1.17	12.61±2.39	12.50±2.53	11.49±1.46	11.94±1.30	12.87±0.94	12.62±0.93	-	400
DO	mg/l	1.76±0.97	1.93±1.13	2.07±0.73	1.67±0.46	2.45±1.23	1.75±0.49	1.79±1.17	1.26±0.35	-	7.5
BOD	mg/l	7.99±1.32	7.72±2.42	8.78±1.52	8.63±1.22	8.32±1.71	8.48±1.54	8.68±1.81	10.59±2.13	30	40
COD	mg/l	20.33±3.27	19.71±5.57	22.10±3.81	22.0±2.95	21.46±4.13	22.65±4.34	22.15±4.79	26.59±4.82	60	80
TDS	mg/l	7.70±0.37	7.41±0.75	8.81±1.37	8.92±1.52	7.89±0.98	8.20±0.81	8.56±0.52	8.42±0.58	500	500
TSS	mg/l	5.71±0.97	11.36±5.17	7.34±1.05	11.31±4.99	10.54±3.67	8.54±3.41	9.96±2.85	9.20±4.27	30	-
Nitrate	mg/l	1.5±0.23	1.52±0.15	1.51±0.51	1.55±0.32	1.56±0.73	1.53±0.62	1.58±0.88	1.59±0.73	45	50
Phosphate	mg/l	5.07±1.42	5.03±1.92	11.65±3.87	10.02±5.14	5.17±1.17	5.62±1.13	6.61±2.5	14.45±11.17	2-5	0.1
Total Coliforms	MPN/100ml	142	149	193	290	285	248	441	328		10
<i>E. coli</i>	MPN/100ml	134	142	173	197	238	233	360	273	0	0

Note: All parameters are expressed in arithmetic mean except Total coliform and *E. coli* that are expressed in geometric mean

**Table 5.** Correlates of pollution load of Yemetu Stream

Parameter	pH	EC	DO	BOD <sub>5</sub>	COD	TDS	TSS	NO <sub>3</sub>	PO <sub>4</sub> <sup>2-</sup>	TCC	<i>E.Coli</i>
pH	1.00										
EC	0.63	1.00									
DO	-1.80	-0.56	1.00								
BOD <sub>5</sub>	-0.57	0.71*	-1.34	1.00							
COD	0.43	0.59	-0.16	0.97*	1.00						
TDS	0.63	0.98**	-0.55	0.75*	0.65	1.00					
TSS	-0.71*	-0.26	0.11	0.09	0.17	-0.11	1.00				
NO <sub>3</sub>	0.21	0.40	-0.30	0.73*	0.76*	0.41	0.46	1.00			
PO <sub>4</sub> <sup>2-</sup>	0.25	0.63	-0.54	0.16	0.11	0.60	-0.40	0.15	1.00		
TCC	0.28	0.55	-0.22	0.89*	0.93**	0.64	0.35	0.82*	0.23	1.00	
<i>E.coli</i>	0.24	0.47	-0.19	0.86*	0.91**	0.53	0.28	0.91**	0.15	0.97**	1.00

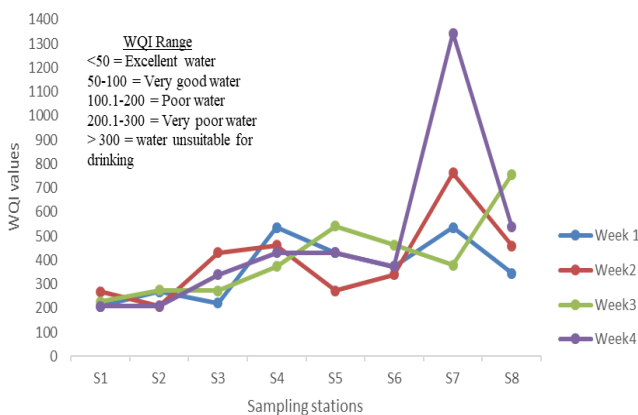
Note: \* = correlation is significant at p<0.05, \*\* = Correlation is Significant at p<0.01

**3.1 Water quality index**

Table 6 shows the Water Quality Index (WQI) of Yemetu stream based on sampling stations where water samples were collected. From the table, it was revealed that the first sampling station S1 was found to have the least value of WQI of 227 compared to other sampling stations while sampling station seven (S7) recorded the highest value of 668. Figure 2 shows the WQI of the stream based on the four weeks of sample collection. The figure shows that the WQI for the first two sampling stations fell within the range of very poor water throughout the four weeks of sampling collection while the rest of the sampling stations (S3-S8) for the four weeks fell within the range of water not suitable for drinking.

**Table 6.** Water Quality Indices of Yemetu stream based on sampling station

Sampling Location	WQI	Water quality classification
S1	227	Very poor water
S2	239	Very poor water
S3	304	Water unsuitable for drinking
S4	446	Water unsuitable for drinking
S5	439	Water unsuitable for drinking
S6	384	Water unsuitable for drinking
S7	668	Water unsuitable for drinking
S8	502	Water unsuitable for drinking



**Figure 2.** Water quality index of Yemetu stream across the four weeks of sample collection

**3.2 Essential parameters in the assessment of pollution load and tropic status of Yemetu stream**

The mean values of surface water quality parameters in the eight stations over 4 weeks were used to determine the essential parameters using principal component analysis (PCA) as seen in Table 7. The PCA factors are the main factors and express 83.549% of variance or changes as presented in Table 7. The table revealed that the most important factors justifying water quality changes were *E. coli*, Total Coliforms, phosphate, and BOD<sub>5</sub>. These are the first factor that shows 59.394% of the variance. The second factor shows 24.154% of change and includes COD, DO, and pH.

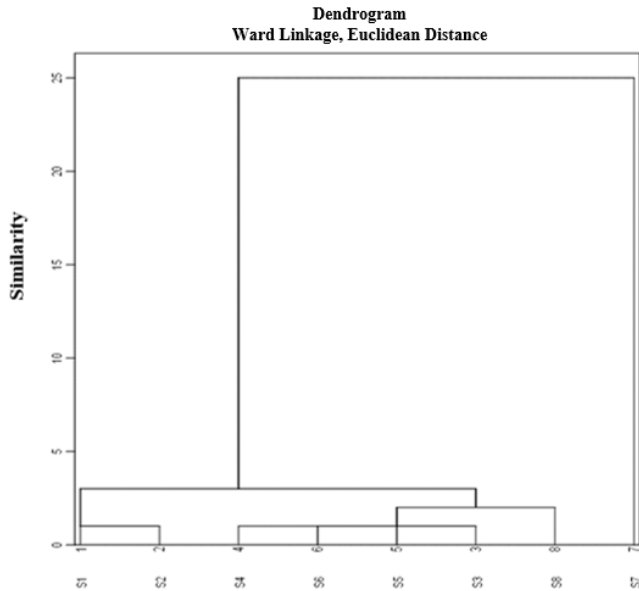
**Table 7.** Rotation component matrix for physicochemical and bacteriological parameters in the Yemetu stream

Parameters	Component	
	1	2
<i>E. coli</i>	<b>0.943</b>	-0.029
Total coliforms	<b>0.907</b>	0.081
Nitrate	0.269	-0.057
Phosphate	<b>0.802</b>	-0.050
COD	0.169	<b>0.888</b>
BOD <sub>5</sub>	<b>0.713</b>	0.149
DO	-0.287	<b>0.728</b>
Temperature	-0.136	0.568
pH	0.034	<b>0.896</b>
TSS	0.271	0.324
% of variance explained	59.394	24.154
% of cumulative	59.394	83.549

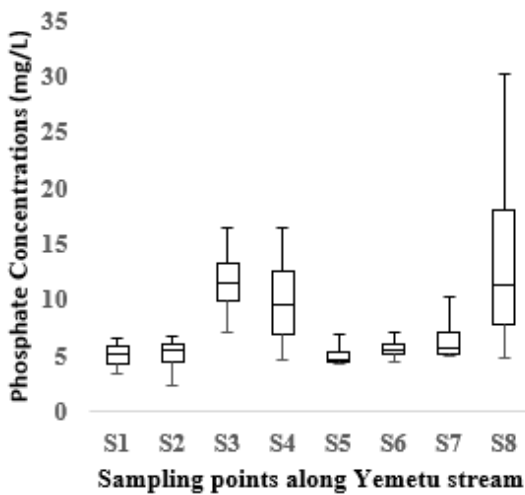
Furthermore, all the eight sampling stations were placed in three clusters during the cluster analysis as depicted in Figure 3. In the Figure, three clusters were extracted: The first cluster comprised stations 1 and 2, the second cluster contained stations 3, 4, 5 and 6 while the third cluster incorporated stations 8. In cluster 1 (i.e. stations 1 and 2) pH, phosphate, total coliforms and *E. coli* of the two sampling stations were similar. The pH was extremely lower, phosphate, Total coliform, and *E. coli* showed that the water was grossly polluted. Other parameters were within the recommended standards. In cluster 2, (Station 3, 4, 5 and 6) phosphate, total coliforms and *E. coli* of the two sampling stations were extremely higher than the values obtained in cluster 1.

Furthermore, Cluster 3 revealed that the sampling station 8 had phosphate, total coliforms and *E. coli* values that were higher. Other parameters were within the recommended limits by WHO and NESREA.

Trophic status evaluation of the stream was carried out according to Wetzel [24]. Phosphate concentrations (mg/L) of all the eight sampling points were higher than 0.1, clearly indicating hypereutrophic status as depicted in Figure 4. Furthermore, phosphate concentrations were extremely high in sampling points 3, 4 and 8 respectively.



**Figure 3.** Clustering of stations in the study area using clustering analysis



**Figure 4.** Trophic status of the sampling points along Yemetu stream

#### 4. DISCUSSION

This study revealed that the pH values of samples observed in all sampling locations were below the permissible limit of 6-9 set by NESREA [25] which indicates that all the water samples were acidic. The reason for the acidic nature of the water samples observed in all sampling locations might be a result of refuse around the stream which may contain acidic

substances. The study does not concur with a pH range of 6.01-7.27 reported by Eze [26]. This may be as a result of the difference in location and practice of refuse disposal in the area. Stephanie [27] indicated in her study that acidic soils and rocks such as basalt, granite, and sandstone could also be a contributory factor to lower pH values in water. The study reported that parameters such as TDS, TSS, EC, BOD, COD, DO and Nitrate in all sampling stations fell within the permissible limits by WHO and NESREA. Several studies have reported similar findings [28-33].

Data from this study revealed that BOD<sub>5</sub> had the most correlation with other parameters such as COD, EC, TDS, TCC, and *E. coli* and a positive correlation also exists between Electrical Conductivity and TDS, Nitrate and Total coliforms, and *E. coli*. Biochemical Oxygen Demand and COD have been reported as important parameters that indicate contamination with organic wastes [33]. The BOD is one of the parameters required to assess the pollution of surface and groundwater where contamination occurred due to disposal of domestic and industrial effluents [34].

Our study also revealed that values obtained from the Water Quality Index ranged from 227 in S1 to 668 in S7. The range shows that the stream was in a very poor state and water unsuitable for domestic purposes. This finding concurs with the report of a study by Ravikumar and Mehmood [34] where WQI classified Mallathahalli lake water as poor water. This assessment has revealed that the stream at all sampling stations was heavily polluted and is unfit for human consumption and other domestic purposes. Sampling station 7 had the highest level of pollution. The extreme level of pollution may be due to various anthropogenic activities such as direct discharge of wastewater from surrounding households into the stream and deposition of various solid waste into the stream. Similar study by Fathi et al [35] reported that the WQI of the stream in the study increased from upstream to downstream.

This study revealed that the phosphate concentration of water samples from the eight sampling stations were higher compared to the limit (2-5mg/L) recommended by NESREA [25]. This does not support the finding of the study by Ishola et al [36] where the highest value of phosphate reported was 0.13mg/L. A high concentration of phosphate could be attributed to the discharge of detergents into the stream by the surrounding houses at various points. Furthermore, the trophic status of the Yemetu stream was classified as hypereutrophic during the sampling period. Phosphates are chemicals containing the element phosphorus, and in excess quantities, phosphorus can lead to water quality problems such as eutrophication and harmful algal growth [37]. Sources of phosphorous in surface water have been identified as human excreta, and some industrial and trade effluents [34]. Other sources may be as a result of domestic waste, detergent and agricultural runoff containing fertilizer [38].

It was found that the sampling station 1 (S1), a station at an upstream community had the least number of coliform organisms compared to other stations. This sampling station is located in a low residential area where practices such as dumping of refuse and discharge of untreated sewage were minimal compared to other stations. However, sampling station 7 (S7) recorded the highest number of coliforms which could be as a result of increased practice of stream defecation and massive dumping of refuse into the stream. The number of *E. coli* organisms in all sampling stations was extremely above the permissible limit. Studies have reported a high count of coliforms in surface water [39-41]. The presence of *E. coli* in

all the water samples is evidence of faecal contamination from human and warm-blooded animals which may indicate the presence of pathogenic organisms.

Data from this study revealed that the PCA factors such as *E. coli*, Total Coliform Count, phosphate, and BOD were the main factors responsible for the pollution load of Yemetu stream. Other parameters identified were COD, DO, and pH. This finding is similar to a previous study which reported that principal component analysis (PCA) analysis of more important parameters were in factor 1 while the less important ones in the second factor [35]

Furthermore, all the cluster identified through cluster analysis (CA) shows that the stream was grossly polluted. This might have resulted from the high occurrence of phosphate, total coliform and *E. coli*, BOD and pH values of these sampling stations than the recommended limits by WHO and NESREA. Previous studies have reported similar findings using multivariate statistical methods such as PCA and cluster analysis (CA) to identify potential pollutants in surface water [35, 42-45].

## 5. CONCLUSION

The findings of this study have revealed that almost all the physico-chemical parameters were within the permissible limits with the exception of pH and phosphate that were above the limits. The bacteriological parameters (Total coliform and *E. coli*) were found to exceed the permissible limits in all sampling stations which indicate that the stream water was rich in microbes that could be detrimental to human health when consumed. The BOD, though within the permissible limit had the most significant correlation with other parameters (COD, EC, TDS, Total Coliform, and *E. coli*) which indicate that the BOD of the stream water must be strictly monitored in order to prevent subsequent pollution. The WQI computation classified the stream water quality as being very poor and unsuitable for drinking. the Principal Component Analysis factors such as *E. coli*, Total Coliform Count, phosphate, and BOD were the main factors responsible for the pollution load of the Yemetu stream. Other parameters identified were COD, DO, and pH. Furthermore, all the clusters identified through cluster analysis (CA) shows that the stream was grossly polluted. The study recommends prompt monitoring of water quality of Yemetu stream (most especially the bacteriological characteristics and BOD) through the control of various anthropogenic activities around the stream by the appropriate authorities.

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