WATER QUALITY ASSESSMENT OF RIVER WITH THE AID OF ABIOTIC FACTORS AND BACTERIAL ANALYSIS

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Abstract: This study intended to assess the water quality of a River in terms of the abiotic factors and bacterial analysis. Sampling stations were established through transect sampling. The abiotic factors or the physico-chemical parameters recorded from the river were found to be very supportive for the total well-being of the water and the aquatic organisms alike: water velocity (0.36 m/s) is smooth and temperature (23.18 °C) is on average that make both parameters "essential" to support the life cycle of organisms known to indicate a good water quality; pH level (7.14) is average/"satisfactory" for a fresh water; and turbidity (17.95 NTU) is rated as excellent. The bacterial analysis indicated that the water of Dahilayan River, Manolo Fortich, Bukidnon, Phils. contains bacteria that make the water not potable. It is then concluded that the Dahilayan River is still in good condition as it projects on-standard-levels of abiotic factors or the physico-chemical parameters, however the streams' bacterial content makes the water not potable.

Keywords: water quality, abiotic factors and bacterial analysis

1. INTRODUCTION

Great Ocean and seas surround the archipelagic nation of the Philippines. But aside from these salty bounties, it is the country's freshwater resources that mainly supply the water needed for domestic, industrial and agricultural use. According to the River Basin Coordinating Office (RBCO) of the Department of Environment and Natural Resources (DENR), the Philippines counts as its freshwater resources some 421 principal rivers, 79 natural lakes and groundwater aquifers of about 50,000 square kilometers (Caparas, 2014). According to Tibor et al. (2018) on his report in WWF Global organization: Philippine Freshwater, The streams and lakes of the Philippines freshwater ecoregion support high numbers of endemic species, particularly fish. These then give aid to the communities living near each of the ecosystem in terms of food and financial help.

Albeit advantages provided by the freshwater of the country, some of the citizens forget to put into considerations the ecological balance needed to maintain the well-being of the respective ecosystems. Industry's unfettered disposal of toxic materials and byproducts into our water supply plays a huge role in the growing water crisis. In the Philippines alone, chemical pollution is quickly taking its toll on our limited supply of fresh water. A lethal cocktail of hazardous chemicals are being dumped daily into such major water sources.

To mitigate the adverse anthropogenic impacts towards the freshwater ecosystem, the government had promulgated laws. An act providing for a comprehensive water quality management and for other purposes was made into a law way back the year 2004. This and the other laws made specifically for the protection of the freshwater ecosystem were activated but not all of the citizenry cannot or do not follow each of the requirements in the law. Furthermore, Republic Act 9275 known as The Philippine Clean Water Act of 2004 aims to protect the country's water bodies from pollution from land-based sources (industries and commercial establishments, agriculture and community/household activities).

With the points stipulated above, it is then empirical to conduct the study water quality assessment of Dahilayan River, Bukidnon, Philippines with the aid of abiotic factors and bacterial analysis.

2. MATERIALS AND METHOD

A letter permit was sent to the local government and to the immediate caretaker of the area where the river is located. Likewise, a letter was assured from the Department of Environment and Natural resources (DENR) of the Municipality of Manolo Fortich, Bukidnon, Phils. An ocular survey was done before the conduct of the study. Safety and accessibility was the basis in the selection of strategic sampling stations. Three (3) sampling stations were designated in the study location. Each of the sampling stations covered 50m dimension transect area creating a rectangular profile.

Figure 1. The Study site at Dahilayan River, Manolo Fortich, Bukidnon, Phils.

The materials for the study were the Nuelog[R]Multiparameter Sensor, laboratory thermometer, meter stick, ping pong ball, stop watch and protective gloves.

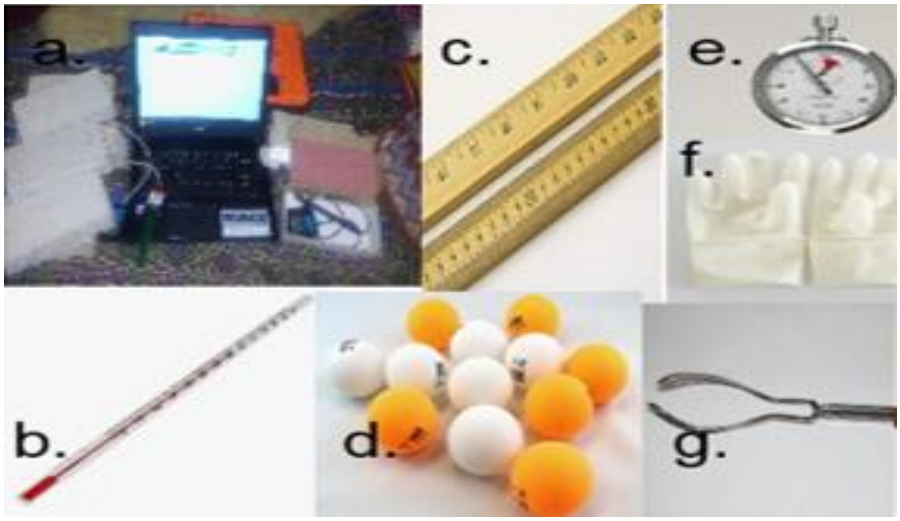

Figure 2: Materials and equipment use: a) NueLogMultiparameter Sensor; b) laboratory thermometer; c) meter stick; d) ping pong ball; e) stop watch; f) protective gloves; g) forceps.

The abiotic factors were assessed from the river in three (3) stations. The following procedures were completed to collect data on the abiotic factors:

1. Current Velocity

Using a small ball and a stopwatch, current velocity was measured within the river having a length of 15 meters. With the stopwatch, the small ball was timed as it reaches the finish line of 15 meters. It was repeated three times and was recorded in meter per second (m/s).

2. Water Depth

A meter stick was submerged into the river to measure the depth of the water. The measurements will be read and recorded in inches.

3. Temperature

The temperature logger sensor (NeuLog NUL-203) was connected to a laptop via a USB module (NeuLog USB-200), and was operated by the NeuLog application. The metallic rod of the sensor was partially submerged into the sampled water. In three minutes sampling duration, the temperature sensor was read in every station. The measurements was read and recorded in degrees Celsius or (C°).

4. ph level

The *pH* logger sensor (NeuLog NUL-203) was connected to a laptop using a USB module (NeuLog USB-200), and was identified by the NeuLog application. The probe tip of the sensor was carefully removed from the plastic storage sution bottle attached from it. The plastic storage solution bottle was filled with appropriate amount of river water. The probe tip was inserted back into the plastic storage solution bottle, and was closed tightly to avoid spillage of the liquid sample. Physical contact with the glass bulb was avoided to prevent reading discrepancies. The measurements read and recorded using the pH scale, which ranges from 0 to 14.

5. Turbidity

The turbidity logger sensor (NeuLog NUL-231) was connected to a laptop thru a USB module (NeuLog USB-200), and was detected by the NeuLog application. A cuvette was filled with liquid sample before placing into the sensor to prevent spilling and damage to sensor, and was inverted a few times. Shaking was avoided because it carries air bubbles which might be detected by the sensor and might give an incorrect reading. The cuvette was held as far towards the top, and the bottom portion was wiped with a tissue.

The researcher avoided contact with the bottom portion as this will leave a residue which will affect the results of the experiment. The cuvette was placed into the quadrangular space located on the sensor's faceplate and was gently pressed down to slide the cuvette into place. The measurements were read and recorded to Nephelometric Turbidity Unit or NTU.

6. Dissolved Oxygen

The oxygen logger sensor (NeuLog NUL-205) was connected to a laptop using a USB module (NeuLog USB-200), and was identified by the NeuLog application. The blue rubber cap on the end of the oxygen probe was gently removed. The membrane cap was unscrewed and filled with partial liquid sample from the river. Another half of the dissolved oxygen filling solution was added to the membrane cap. It was closed tightly to ensure accuracy of the readings, and to avoid spillage. Using 50 ml syringe, the water sample was saturated. The measurements were read and recorded to the percentage saturation of dissolved oxygen.

Dissolved oxygen levels and water quality

Dissolved oxygen (ppm)	Water quality
0.0 to 4.0	poor quality some organisms cannot survive
4.1 to 7.9	Average
8.0 to 12.0	Good
greater than 12	high, retest and look for artificial aerators

In the conduct of the bacterial analysis of water, the researchers make sure to contact the Microbiology Laboratory of the College of Veterinary Medicine from Central Mindanao University, Bukidnon, Phils. The Microbiology laboratory provided three (3) 500 mL sterilized bottles that served as the container for the water samples. Water samples were then taken from the established three (3) stations of Dahilayan river. The collected water samples were then placed inside an ice bucket to preserve its integrity and were sent to the Microbiology Laboratory for the bacterial identification and analysis.

3. RESULTS AND DISCUSSION

3.1 Abiotic Factors

As presented by the table 1, station 3 showed the highest current velocity average reading of 0.57 m/s compared to station 2 with the reading of 0.31 m/s and the station 1 with the reading of 0.24 m/s. in terms of water depth, Station 3 had the highest average reading of 0.36 m., followed with station 2 and station 1 with the reading of 0.31 m. and 0.26 m. respectively. The velocity of moving water near submerged wood surfaces is an important factor for shaping benthic communities in varying bottomed streams.

Table 1. Average readings of the Physico-Chemical measurements of the water stream in the three stations.

	Current velocity (m/s)	Water depth (m)	pH (0 to14)	Temperature (°C)	Turbidity (NTU)	Dissolved oxygen
Station 1						
T1	0.25	0.23	6.97	23.5	16.10	62.5
T2	0.24	0.27	7.02	23.72	24.42	61.4
T3	0.24	0.28	7.28	24.08	24.22	63.0
Mean	0.24	0.26	7.09	23.77	21.58	62.2
Station 2						
T1	0.31	0.25	7.00	22.77	21.67	64.1
T2	0.29	0.39	7.09	23.70	20.27	65.6
T3	0.32	0.30	6.90	22.85	18.69	61.7
Mean	0.31	0.31	7.00	23.10	20.21	63.8
Station 3						
T1	0.57	0.23	7.26	22.35	12.78	64.8
T2	0.59	0.43	7.37	22.76	10.62	65.7
T3	0.55	0.41	7.40	22.87	12.76	63.8
Mean	0.57	0.36	7.34	22.66	12.05	64.8
Grand mean	0.37	0.31	7.14	23.18	17.95	63.6

Station 3 with an average reading of 7.34 pH value is considered "satisfactory". Same as Station 1 with an average reading of 7.09 pH value and Station 2 having 7.00 pH value. The 3 Stations showed "satisfactory" rating in terms of pH value and were able to attain the desirable quality criteria with >6.5-8.5 pH level. As stated by Barbour (2002), the pH of most inland fresh waters containing fish ranges from about 6 to 9 with most water, particularly those with healthy, diverse and productive communities having a pH between approximately 6.5 and 8.5 units.

In terms of water in three (3) stations, Station 3 showed the lowest temperature which is 22.6 °C, followed by Station 2 with the average temperature of 23.10 °C and lastly Station 1 with 23.77°C average temperature reading. Over all temperature recorded which is 23.18°C is enough to support aquatic life.

Station 1 obtained the highest average turbidity reading with an average of 21.58 NTU, followed with Station 2 and Station 3 having an average of 20.21 NTU and 12.05 NTU respectively. Referring on the scale, turbidity with the reading 17.95 NTU is considered as "excellent" because it ≥ 20. According to USEPA (2012), a lower turbidity could decrease water temperature because suspended particles could no longer absorb more heat. As this continues,

suspended materials cannot clog fish gills, resistance to disease in fish is preventable, increase in growth, and could develop affecting egg and larva development.

64.8% of dissolved oxygen was the highest among the obtain dissolved oxygen concentration which is from Station 3, followed with Station 2 having 63.8 % of dissolved oxygen and Station 1 having 62.2 % of dissolved oxygen.

3.2 Bacterial Analysis

As can be gleaned from the tables above, the water of Dahilayan River Failed from the test of potability which was through Multiple Tube Fermentation Technique (SMEW19th Ed, 1995). The water from the three (3) stations gave out a total fecal count of 78 MPN / 100 mL (table 2) which is very much far from the allowable coliform which is 0 (David et al., 2017). It then followed that water from this source is not advisable to be of source for drinking water or for any Hygienic purposes such as bathing. *Escherichia coli* and *Enterobacter hafnia* (table 3) were two of the prevalent bacteria found in the water sample of Dahilayan River. These bacteria are noxious for human health which can cause stomachache; vomiting and may often lead to Diarrhea (Mould et al., 2018; Singh and Saxena, 2018). Crytal clear water does not always guarantee free of harmful microbes such as *E.coli* that is why it is very necessary for everyone to be vigilant in checking the quality of the water source they are getting their drinking water from.

Table 2. Bacteriological Examination Results of the water from Dahilayan River, Manolo Fortich, Bukidnon, Philippines

Sample code	Results of Analysis Total Coliform (MPN/100 mL)	Fecal Coliform (MPN/100 mL)	HPC (CFU/mL)	Remarks
River 4811	78.0	78.0	40	FAILED

Table 3. Bacterial isolates of the water from from Dahilayan River, Manolo Fortich, Bukidnon, Philippines

Sample ID	Bacterial Isolates
River 4811	*Escherichia coli* *Enterobacter hafnia*

The possible cause for the presence of harmful bacteria in the water of Dahilayan River might be the activities that are happening in the upper part of the area which is already known to be a tourist destination, farming area, and other anthropogenic activities brought by both native and non-native dwellers of the immediate area.

4. CONCLUSIONS AND RECOMMENDATIONS

The study is focused on assessing the water quality of Dahilayan River of Manolo Fortich, Bukidnon, Phils. Through the abiotic factors and bacterial analysis.

To arrive at the result needed in the study, three sampling stations were employed where the water quality was tested. The River were assessed with the Physico-chemical Parameters and sample water was taken and tested with the bacterial content.

Based on the data gathered by the researchers, the following are the findings of the study:

The abiotic factor of the three stations falls under the excellent category. The third station has the highest current velocity, it also has the highest depth. The pH of the three stations was recorded and at the satisfactory. The water temperature of the river is enough to support aquatic life. The turbidity and dissolved oxygen of the river both fall on excellent category which are suitable to house aquatic organisms.

Bacterial analysis of water sample was conducted at the Microbiology laboratory of the College of Veterinary Medicine of Central Mindanao University and was found that the water contains bacteria such as: *Escherichia coli* and *Enterobacter hafnia* that are harmful for the human since it can cause stomachache, vomiting and even diarrhea; hence, the water is not potable.

It is recommended that the Local Government of Bukidnon shall impose strict measures highlighting the significance not only of Dahilayan River but to all river systems within the province. A river's freshwater is vital for people and wildlife. Thus it needs careful management because there's not enough to go around. Further studies are highly recommended for the protection of bodies of water within the municipality.

To the people inhabiting areas near these bodies of water, critical measures to avoid polluting the area shall be observed. People are affected too. Over the last 50 years, the frequency of and impacts caused by-severe flooding and drought has increased, partly because of damage to freshwater ecosystems. Mankind should be aware not beware.

It is further recommended that the same study be conducted to regulate and monitor the River of Dahilayan, Manolo Fortich, Bukidnon, Phils. Other Physico-chemical parameters which are not being mentioned be included in the next study.

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