WATER QUALITY ASSESSMENT IN BORONGAN CITY, EASTERN SAMAR

[a]ALJON VICTOR G. NIBALVOS, [b]LYLAH DAISY A. ACORIN, [c]MARICAR T. OBINA

College of Science, Eastern Samar State University, Borongan City, Eastern Samar, Philippines
email: [a]avgn.research@gmail.com, [b]dacorin@yahoo.com, [c]mtobina@gmail.com

Abstract: Brgy. Maypangdan and Brgy. Tabunan, 2 of the many barangays of Borongan City are one of the beneficiaries of the ABTIC extension program of the Biology department of Eastern Samar State University. The ABTIC extension program aims in developing the mangrove areas in the two barangays which has already started in Brgy. Maypangdan. Mangrove development has something to do with water quality, hence, this study was conducted. The physical and chemical properties of the water in Balacdas River, found in Brgy. Tabunan and Maypangdan River in Brgy. Maypangdan were determined in situ. Results revealed that the physic-chemical profile of the rivers are in good condition, and that, all are within limits set by various departments in the environmental sector. Moreover, no significant relationship was found in almost all parameters except for temperature. Hence, this study suggest annual monitoring of water parameters in the area to further map the increase or decrease in the numerical data of the parameters and include additional factors of the rivers.

Keywords: water quality assessment, Borongan City, ABTIC extension program, physico-chemical characterization, limnology

1 Background of the Study

Our ecosystem are primarily affected by anthropogenic activities, over the past years, the environment has worn out and become ragged. In an ecosystem, water is primarily affected by these activities. Water quality assessment is hereby essential to determine the level or volume of such human destruction. Causes of water damage include enlarging human population which enables human wastes to contaminate and pollute watersheds that is the center of the ecosystem in an area isolated to humans.

Freshwater is a finite resource, essential for agriculture, industry and even human existence[1]. Without freshwater of adequate quantity and quality sustainable development will not be possible. Water pollution and wasteful use of freshwater threaten development projects and make water treatment essential in order to produce safe drinking water. Discharge of toxic chemicals, over-pumping of aquifers, long-range atmospheric transport of pollutants and contamination of water bodies with substances that promote algal growth (possibly leading to eutrophication) are some of today's major causes of water quality degradation[1].

It has been unequivocally demonstrated that water of good quality is crucial to sustainable socio-economic development. Aquatic ecosystems are threatened on a world-wide scale by a variety of pollutants as well as destructive land-use or water-management practices. Some problems have been present for a long time but have only recently reached a critical level, while others are newly emerging[1].

Gross organic pollution leads to disturbance of the oxygen balance and is often accompanied by severe pathogenic contamination. Accelerated eutrophication results from enrichment with nutrients from various origins, particularly domestic sewage, agricultural run-off and agro-industrial effluents. Lakes and impounded rivers are especially affected[1]. In small watersheds, (<100 km2) the influence of a single factor can cause a variation of several orders of magnitude. Water quality is generally more constant in watersheds greater than 100,000 km2, and the variation is usually within one order of magnitude for most of the measured variables[2].

It is mostly important to determine the quality of water or a body of water to have a better understanding on the extent of damage of human activity for the past years and to have evidence on the prevailing climate change which do not only affect us humans, but also the total ecosystem of the earth.

Samar, an island of the Philippines situated in the Eastern Visayas region of the country is divided into three provinces and Eastern Samar is one of these provinces. In this province, numerous waterbeds can be found and these areas are somewhat affected by natural and anthropogenic activities that is currently happening. These bodies of water have the most number of biological and economical importances in the said province for it is known that Samar Island is one of the most diverse ecosystems in the Philippines. Over the time, civilization in Eastern Samar grew and with the development of each and every municipality in Eastern Samar comes the degradation of its freshwater resources and watercourses and its watersheds. Hence, water quality evaluation is important to describe and identify actual and emerging problems of water pollution in Eastern Samar, more specifically its surface waters which are the center of ecosystem in Eastern Samar.

The rivers lying in Brgys. Maypangdan and Tabunan of Borongan City, are two of the major rivers used by its constituents for economic and transportation purposes. In terms of its economic viability, these rivers are utilized for food and aquaculture. Since most of the populations in the said barangays are fishermen, they rely on the sea and river areas for their everyday food consumption and production. In these areas, the folks catch different types of animals of economic importance such as mud crabs, prawns and fish. In terms of its transportation capability, far flung sitios and other barangays of Borongan City uses boats and motorized pump boats to reach the said areas via these rivers. Hence, the rivers' importance and sustainability should be preserved and never be deteriorated. To preserve these rivers, one way of safeguarding them is studying their underlying physical and chemical properties which can make up a line of story to tell to the people on whether these rivers are okay or not, or tell the people the prospect of the rivers in the scientific community, hence, water quality monitoring is an adept start up plan for conserving these bodies of water.

Water quality monitoring is the foundation on which water quality management is based. Monitoring provides the information that permits rational decisions to be made on the following: this study describes water resources and identify actual and emerging problems of water pollution in Eastern Samar. Formulate plans and setting priorities for water quality management and develop and implement water quality management programs.

2 Objectives

This study's objective was to evaluate the water quality of Tabunan and Maypangdan Rivers found in Borongan City, Eastern Samar. Specifically, this study;

1. Determined the physico-chemical properties of the river waters in Brgy Tabunan and Brgy. Maypangdan, Borongan City in terms of:
   a. Electrical Conductivity (EC)
   b. Oxidation – Reduction Potential (ORP)
   c. pH
   d. Refractive Index (RI)
   e. Salinity
   f. Specific Gravity (SG)
   g. Temperature
   h. Total Dissolved Solids (TDS)
   i. Turbidity
2. Determined if there is a significant difference in the physico-chemical properties between the two rivers.

3 Null Hypothesis

There is no significant difference in the physic-chemical properties of the water samples between the rivers located at Brgy. Tabunan and Brgy. Maypangdan, Borongan City, Eastern Samar.

4 Methodology

4.1 Research Design

Experimental research design was utilized by this study. All tests were done in situ, and replications were further utilized to determine the average physical and chemical properties if water samples. Sampling of water was based upon the Water Quality Monitoring Program Guide with the protocol of the UNEP and WHO[3].

4.2 Locale of the Study

The rivers of Brgy. Tabunan and Brgy. Maypangdan were the zone in which this study was conducted. Found in Borongan City, Eastern Samar is a province in the Philippines located in the Eastern Visayas region.

4.3 Data Gathering Procedures

4.3.1 Selecting Sampling Site and Sampling Station

Sampling sites were 100 to 150 meters away from the bridge and the water at high tide with 1 meter in depth, a width of 5 meters and a length of 0.08 – 0.7 km to utilize complete mixing. The two rivers in the area of the two barangays were subjected as macrolocations with 4 sampling stations or microlocations. Microlocations have an interval of 100 to 150 meters from each other going upstream.

Each microlocations are separated by 100 to 150 meter distance, the first microlocation is located 100 to 150 meters from the bridge going seaward. Then, the second microlocation is under the bridge, the third is 100 to 150 meters away from the bridge going upstream and the last microlocation is 100 to 150 meters in distance from the third microlocation. Each microlocations are tested for its water quality, independent from the each other. Water quality testing was done from the 4th microlocation going downstream during high tides.

4.3.2 Sample Collection and Analysis

Water sample collection were done during high tide with at least 1 meter in depth, a width of 5 meters and a length of 0.08 – 0.7 km to utilize complete mixing of substances. Water samples were collected using a 250 mL beaker. Analysis was done on site using a 7 in 1 water parameter tester.

In situ water analysis was conducted from August to October 2023, 1 to 2 parameters per day was determined regardless of weather. Time of conduct was between 9:00 AM to 1:00 PM. Water samples were analyzed on the same day based on the availability of apparatus and instruments, or when weather and times approve. In times where the rain is favored by weather, an umbrella is utilized by the researchers to minimize water contamination from surrounding rainwater.

All physical and chemical assessment was done four (4) times to ensure firm data per microlocations. Before any tests are done, all procedures were tested in a laboratory for reference. All Instruments used were calibrated as per standard calibration procedures.

4.3.3 Physical Assessment of Water Samples

Assessment of water samples were done *in situ* using an portable digital water quality multimeter and a secchi disk, based on its electrical conductivity, pH, temperature, total dissolved solids (TDS), turbidity, salinity, refractive index, specific gravity and oxidation – reduction potential (ORP). All parameters were tested four times.

4.3.4 Statistical Analysis of Data

Mean and percentage computations were used to determine average and percent of the water parameters of the water coming from the Balacdas and Maypangdan rivers. T-test for Independent samples was used to determine the significant differences between the Tabunan and Maypangdan rivers in terms of their physical and chemical characteristics.

5 Results and Discussion

The following data were collected and analyzed after the *in situ* analysis of water in the rivers of Balacdas at Brgy. Tabunan, and Maypandan in Brgy. Maypangdan, both rural barangays of Borongan City Eastern Samar. Results were also compared to certain National and International Standards for Water Quality.

5.1 Water Quality Data

The following data were collected and analyzed after the *in situ* analysis of water in the two samples rived in Borongan City, Eastern Samar:

Table 1. Water Quality Data and Comparison

Water Parameters	Water Samples	Water Quality Data	Accepted Range and Standards	Interpretation
Electrical Conductivity	Balacdas	34.175 uS/cm	0 – 1500 uS.cm**	Within acceptable range
	Maypangdan	34.125 uS/cm		
Oxidation – Reduction Potential	Balacdas	33.325 mV	300 – 500 mV****	Within acceptable range
	Maypangdan	54 mV		
pH	Balacdas	7.9525	6.0 – 9.0*	Within acceptable range
	Maypangdan	7.9325		
Refractive Index	Balacdas	2.8	1.333	Outside acceptable range
	Maypangdan	2.9		
Salinity	Balacdas	20.125 ppt	18.0 ppt – 30.0 ppt (euhaline) ***	Within acceptable range
	Maypangdan	20.125 ppt		
Specific Gravity	Balacdas	1.012	1	Within acceptable range
	Maypangdan	1.01125		
Temperature	Balacdas	31.4°C	25°C – 32°C*	Within acceptable range
	Maypangdan	29.075° C		
Total Dissolved Solids	Balacdas	275.5 mg/L	150 mg/L*	Outside acceptable range
	Maypangdan	219.75 mg/L		
Turbidity	Balacdas	11.6 NTU	<10 NTU***	Within acceptable range

*DENR Class D – Water Quality Guidelines and General Effluent Standards4
**Mary River Catchment Coordinating Committee
*** Volunteer Estuary Monitoring Manual, A Methods Manual, Second Edition, EPA-842-B-06-003.6
****https://datastream.org/en-ca/guidebook/oxidation-reduction-potential-orp7

The above table shows that almost all water parameters are within the acceptable range for the different standards set by various organizations and government agencies. Of all the parameters, only RI and TDS are outside their standards which bear correlation since it is observed that the refractive index (RI) of water changes with a change in total dissolved solids (TDS). Hence, the high number of total dissolved solids resulted in a high refractive index and a relatively high turbidity which was seen in Balacdas river.

5.2 Significant Differences

T-test for independent samples was used to determine significant difference between the parameters per river. The working null hypothesis was that, there is no significant difference in terms of the recorded parameter between the two (2) rivers. And if the T-computed value is higher than or beyond the T-tabular value at

.05 level of significance, the null hypothesis can be rejected in favor to the saying that there are significant difference between the two rivers in terms of any given parameters.

Table 2. T-test table

Water Parameters	t-computed value	t-tabular value	Interpretation
Electrical Conductivity	0.877	1.943	Not Significant
Oxidation – Reduction Potential	1.430	1.943	Not Significant
pH	0	1.943	Not Significant
Refractive Index	0.379	1.943	Not Significant
Salinity	0	1.943	Not Significant
Specific Gravity	0	1.943	Not Significant
Temperature	-26.72	-1.943	Significant
Total Dissolved Solids	-1.794	-1.943	Not Significant
Turbidity	-1.07	-1.943	Not Significant

Now, since all T-computed values for almost all the water parameters, except for temperature are all lower than the T-tabular value of ±1.943. This indicates that the null hypothesis of this study is accepted in almost all the parameters except for temperature; therefore it indicates that there is no significant difference between the rivers situated at Brgy. Tabunan and at Brgy. Maypangdan in terms of all the parameters mentioned. However, there is a recorded significant difference in terms of temperature between the two river systems, indicating that the waters in Balacdas River has a higher surface temperature than in Maypangdan.

6 Conclusions

Based on the results of this study, the researchers claim the following conclusions:

1. The average computed data on the parameters for Balacdas River are as follow:
   a. EC – 34.124 uS/cm
   b. ORP – 53.325 mV
   c. pH – 7.95
   d. RI – 2.85
   e. Salinity – 20.125 ppt
   f. SG – 1.012
   g. TDS – 275.5 mg/L
   h. Temperature – 31.4oC
   i. Turbidity – 11.6 NTU
2. The average computed data on the parameters for Maypangdan River are as follow:
   a. EC – 34.175 uS/cm
   b. ORP – 54 mV
   c. pH – 7.93
   d. RI – 2.9
   e. Salinity – 20.125 ppt
   f. SG – 1.011
   g. TDS – 219.75 mg/L
   h. Temperature – 29.075oC
   i. Turbidity – 9.75 NTU
3. There is no significant difference on the conductivity, ORP, pH, RI, salinity, SG, TDS and turbidity of the waters from the two river systems. However, there was a significant difference on the temperature between the two rivers, indicating that the water of Balacdas River has a higher temperature than that of Maypangdan River.

7 Recommendations

In reference to the collected and analyzed data, as well as the conclusion drawn, the researchers recommend the following:

1. Conduct annual water quality assessment of the two river systems so as to monitor the parameters necessary to indicate healthy aquatic environment.
2. Additional parameters such as DO, BOD and other chemical properties may be further tested so as to increase decision-making in indicating the health of the two rivers.
3. Conduct similar studies to further affirm or oppose the results of the current study.
4. Data can be used for the ABTIC extension program with emphasis on the measured parameters and its relationship to mangrove existence in the area.

Literature:

1. Bartram, J. & Helmer, R. *Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes.* 1st Ed, United Nations Environment Programme and the World Health Organization. 1996
2. Bartram, J & Ballance, R. *Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes.* 2nd Ed, United Nations Environment Programme and the World Health Organization. 1996.
3. United Nations Environment Programme and the World Health Organization. *Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes*. 1996.
4. DENR Class D – *Water Quality Guidelines and General Effluent Standards*. n.d.
5. Mary River Catchment Committee. *Water Quality Standards.* https://mrccc.org.au/wp-content/uploads/2013/10/Water-Quality-Salinity-Standards.pdf
6. *Chapter 14 of the Volunteer Estuary Monitoring Manual, A Methods Manual*, Second Edition, EPA-842-B-06-003. www.epa.gov/sites/production/files/2015-09/documents/2009_03_13_estuaries_monitor_chap14.pdf
7. *Oxidation-Reduction Potential. Physical and Chemical Characteristics*.https://datastream.org/en-ca/guidebook/oxidation-reduction-potential-orp

Primary Paper Section: D

Secondary Paper Section: DA, DJ