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Biophysical Characteristics and the Anthropogenic Activities in San Roque River, Northern Samar

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ABSTRACT

River provides essential various ecosystem goods and services that are essential for living organisms' survival. As such, its quality must be maintained to ensure the healthy condition of the environment as well as the safety of the community. The study aimed to assess the biophysical characteristics and the anthropogenic activities in San Roque River, Northern Samar. It employed descriptive research combined with laboratory analysis and SPSS was employed to treat and analyze the data.

The study revealed that the physico-chemical characteristics of the water in San Roque River in terms of temperature, pH, TSS, TDS, and turbidity were within the DENR standards. However, the water of the river was highly contaminated with total coli forms and fecal coli forms. Likewise, the salinity was beyond from the standard that made the water of the river salty. T-test revealed that the characteristics of water during high and low tides showed no significant differences. On the contrary. It has shown significant difference on water parameters in terms of temperature, pH, TSS, TDS, BOD, and DO between high tide and the standards. Likewise, pH, TSS, BOD, and DO have shown significant difference on low tide with the standards. It also revealed that there were anthropogenic activities and practices of the community living along the river that directly affect the water quality and condition of the river. Moreover, this also concludes that there were no significant relationships on the characteristics of the water and the anthropogenic activities. Lastly, the San Roque River was classified as Class D river at the time of the conduct of the study. This concludes that the river needed rehabilitation so that the potential uses of the river would be maximized which would redound to better benefits of the community.

KEYWORDS: *river ecosystem, anthropogenic activities, water quality*

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INTRODUCTION

The Earth's surface is almost covered by 70 percent water that makes the ocean and seas as the marine water and surface water such as freshwater that is in the form of river, lakes and wetlands (Botkin& Keller, 2011). According to Tyokumber, Okorie, and Ugwumba (2002), the major sources of water for domestic, agricultural, transportation, electrical power generation, recreation and industrial uses is the freshwater bodies. Freshwater ecosystems support various species of flora and faunaon its diverse habitats. On the other hand, rivers as freshwater body are the most natural resources for human consumption and development. Essentially, freshwater ecosystem provide various ecosystem services such as primary sources of freshwater for domestic and agriculture consumption, transportation, industrial, and recreational purposes. Due to the presence of pollutants and pollution that make the organisms vulnerable in their natural habitat the quality of life those organisms are being affected.

However, as reported by Joshi, Kumar, and Agrawal (2009), pollution of a river instantaneously affects the water quality and exhaustively destroys the entire ecosystem as food web has been significantly disrupted. Apparently, both point sources and non-point sources of pollution had affected the quality of the water bodies that makes it polluted. There are various practices of river pollution monitoring and control systems that requires the collaboration of different expertise of discipline in order to address the river pollution as a global problem.

Apparently, anthropogenic activities had tremendously altered the inland aquatic ecosystems with the incessant land conversion, sand and gravel extraction, and indiscriminate disposal of any forms of wastes such as sewage, agricultural and industrial wastes into the bodies of water. Thus, it is necessary to periodically assess the water quality and evaluate its ecological, human, and economics impacts so that effective measures can be imposed to mitigate the problems (Mishra, Mukherjee, &Tripathi, 2009). Subsequently, toxic compounds that made by humans had causes the degradation of the water quality as to its physical, chemical, or biological characteristics which absolutely incurred with magnitude environmental risk to both surface and groundwater bodies. Furthermore, Idowo, Oluremi, and Odubabawo (2011) cited that water resources quantity and quality are being affected by the anthropogenic activities.

As stressed by Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015), the problem on water pollution is apparent worldwide and has been alarming for decades because of its effects on humans, animals and plants. Water pollution affects the entire ecological system that poses threats to organisms in the aquatic environment and health risks to the living organisms on the biosphere. When these water sources are polluted and intertwined with poor sanitation and unhygienic practices, waterborne as well as water-related diseases become prevalent. Consequently, water is known as a crucial natural resource in the Philippines. The demand for clean water is growing because of the rapid population explosion, demands of improving the living standards of life, and the requirement in attaining economic development. While abundant water resources are almost omnipresent in the country, the threat of contamination and pollution makes our waters limited and unusable.

The National Statistical Coordination Board (NSCB) presented in their report that 16%of the households in the Philippine were unable to access clean and potable water for their daily needs. This untoward circumstance is still expected to worsen in the future because of the incessant increase of population in the country. The occurrence of the declined water supply is caused by resource mismanagement and misuse over the years. As reported in the Senate Economic Planning Office (2011), the predicted decline is supported by the National Water Resources Board (NWRB) and Japan International Cooperation Agency (JICA) by positing that Philippines and its major cities will be incessantly facing shortage of water supply by 2025.

On the other hand, the municipality of San Roque in the province of Northern Samar has a pristine river in which community, family, and children are enjoying the natural beauty of the river. In the past, the water was clear and safe for swimming, and other domestic purposes. Some are fetching the water that is used for cooking. There are various aquatic freshwater fishes, crustaceans and other bivalves that can be harvested from the river as source for food for human consumption and livelihood means. The river was not so wide and deep unlike this time that the geophysical characteristics of the river were quite far from its previous condition. Lots of people considered the river as very much useful and safe for use. However, as time went by, the condition of the river is deteriorating and it is believed that it is due to human activities that lead to the destruction of the river condition today.

With this situation, it motivated the researcher to conduct a study on the characterization and anthropogenic activities of San Roque River, Northern Samar. Furthermore, this study aimed to awaken the local government of the municipality to cope up with policy on the restoration and management of the river. The quality of river and its water is an indication of a healthy watershed area in the locality. Thus, researcher was prompted to conduct this study on "biophysical characteristics and anthropogenic activities in San Roque River, Northern Samar". Specifically, it determines the following research objectives, (1) evaluate the physical and biochemical characteristics of San Roque River; (2) determine the significant difference on the characteristics of water in San Roque River; (3) determine the anthropogenic activities of the community living along the riparian zone; and (4) identify the classification of San Roque River based on the standards set by the Department of Environmental and Natural Resources (DENR).

METHODOLOGY

Research Design

The study primarily aimed to assess the biophysical characteristics and the anthropogenic activities in San Roque River, Northern Samar. With this, descriptive research design was employed by the researcher. Descriptive research is a design that describes the prevailing conditions for the purpose of description and identification of trends and relationships among variables being studied (Aggarwal, 2008).

The study had assess the characteristics of San Roque River in terms of physical characteristics that include the average temperature, average pH, total suspended solids (TSS), total dissolved solids (TDS), turbidity, and electrical conductivity (EC). Likewise, biochemical characteristics were also analyzed such as total coliform, fecal coliform, biological oxygen demand (BOD), dissolved oxygen (DO), and salinity. Then, anthropogenic activities of the community living along the riparian zone of San Roque River in terms of domestic practices, fishing practices, farming practices, quarrying activities, and recreational activities were also determined in the study. Additionally, significant relationship and the differences on the characterization of water in San Roque River during high tide and low tide as well as with the DENR standards were measured. Lastly, with the use of the DENR standards on water quality the river was identifiedas to its classification.

Locale and Time of the Study

The study was conducted in San Roque, Northern Samar. The Municipality of San Roque is a coastal municipality that is strategically located in the Northern part of the province. The municipality of San Roque is situated between the latitude of 120 32' 43" and longitude of 1240 52' 34" East, bounded on the North by limits of the municipal water of San Roque, on the North East in straight line from the seashore of Barangay Dale, Pambujan, Northern Samar. It has a total land area of 18, 771.99 hectares.

The municipality comprises about 5.08% of the total land area of the Province of Northern Samar. The major natural resources of San Roque includes forest, springs, wildlife, mangrove forest, river system, and vast agricultural lands. It has sixteen (16) barangays that composed of 30, 580 total population as of 2015census. Moreover, the San Roque, Northern Samar is classified as fourth class municipality (CLUP, 2017).

Specifically, the study has three (3) sampling sites namely: Site 1 – San RoquePoblacion (downstream); Site 2 – Brgy. Bantayan (midstream); and Site 3 – Malobago (upstream). The map of San Roque, Northern Samar is shown in Figure 1 which also indicates the three (3) sampling sites of the study. The study was conducted from January to April 2019.

Sampling Procedures

The researchers utilized two (2) sampling procedures in this study. First, the sampling techniques that were used in collecting water samples that were used for water analysis. Then, the second sampling procedure was used in choosing the respondents.

The water quality of San Roque River was assessed through laboratory analysis. Preparation for the field work started by thoroughly washing, drying, and labelling all sampling containers which is the 1.5 L PET bottles. A three (3) liters of water samples were taken from its sampling site using the

grab sampling technique. There were three (3) water samples were grabbed in each sampling site. The researcher laid a six (6) meter transect lines perpendicular to the riverbank that is divided into three (3) parts (0, 3, 6) meters representing the three (3) sub-sites in each of the site. The parameters for the water quality was tested by adopting the procedure and s prescribed guidelines of EMB-DENR Monitoring Manual Volume 1 on the Ambient Water Quality Monitoring (EMB-DENR, 2008). Then, the water samples were used for physical, chemical and microbiological analysis that were analyzed in the Regional Laboratory of DOST, Palo, Leyte.

Moreover, the study employed a purposively sampling techniques as sampling procedure in determining the respondents of the study. Purposive sampling techniques was used because the researcher intentionally choose the barangay officials and household members that are living along the river as respondents of the study. The chosen and identified respondents had answered the checklists on the anthropogenic activities of community living along San Roque River in terms of domestic practices, fishing practices, farming practices, quarrying activities, and recreational activities.

Instrumentation and Validation of Instruments

A checklist questionnaire type was used in the study to determine the different activities of the community living within the riparian zone of San Roque River. The activities would include the domestic practices, fishing activities, farming activities, quarrying activities, and recreational activities. The purposively chosen and identified barangay officials and household members that are living along the river have answered the checklist tool of the study. Respondents have answered the indicators on the checklist by Yes or No. The checklist tool was adopted from the study of Perez, Hara, and Cabrestante (2017) and slight modification to localize the checklist's indicators appropriate to the research environment.

The checklist questionnaire as one of the tools used by researcher in the data gathering was adopted from Perez, Hara, and Cabrestante (2017). Subsequently, the checklist questionnaire was checked and validated for its validity and reliability as to its contents. Then, comments and suggestions given by the evaluators were addressed by the researchers for the refinement of the tool.

Data Gathering Procedure

The researchers observed proper protocol and communication process in the conduct of this study and its data gathering. Initially, a permission letter was sent to the Local Government Unit of San Roque Municipality and the barangay officials where the three (3) sampling areas are situated to ask permission that the researcher be allowed to conduct the study. Moreover, the researchers also asked assistance from the Community Environment and Natural Resource Office (CENRO) Pambujan to help him in doing the in-situ measurement and in collecting water samples from San Roque River.

The researchers collected water samples from the river through grab method using the DENR suggested sampling technique as prescribed in the EMB-DENR Monitoring Manual Volume 1 on the Ambient Water Quality Monitoring. Then, the water samples were sent to DOST Regional Laboratory in Palo, Leyte to analyze the water quality of San Roque River in terms of physical and biochemical characteristics. On the other hand, the researchers through a checklist questionnaire gathered data on determining the different activities of the community living within the riparian zone of San Roque River. This tool was answered by the barangay officials and selected residents along the river. Then, all data were gathered, tallied, recorded and treated and analyzed the gathered data with the use of SPSS.

Statistical Treatment

Descriptive statistics was employed to describe the physical and biochemical characteristics of water quality in San Roque River. Then, t-test for independent samples was utilized to measure the significant difference of the water characteristics of San Roque River in during high and low tides, high tide and the standards, and low tide and the standards. While, frequency and rank were to describe the anthropogenic activities of the community living along the riparian zone of San Roque River.

RESULTS AND DISCUSSIONS

High and Low Tides Characteristics of San Roque River, Northern Samar

Table 1 and Table 2 presents the characteristics of San Roque River, Northern Samar during high and low tides in terms of physical characteristics and biochemical characteristics. The physical characteristics of the water in San Roque Rive is presented in Table 1.

Table 1.Physical Characteristics of San Roque River During High and Low Tides

Parameters	Units	Downstream		Midstream		Upstream		Mean		Permissi-ble Limits (DAO 1990-34)	Remarks
		High Tide	Low Tide	High Tide	Low Tide	High Tide	Limits	High Tide	Low Tide		
Average Temperature	°C	28.00	28.50	28.00	28.00	27.00	26.30	27.67	27.60	27 - 30	Within
Average pH	pH	7.21	7.50	7.00	6.65	6.75	6.85	6.99	7.00	6.5 - 8.5	Within
Total Suspended Solids	mg/L	19.00	10.50	10.5	14.5	8.00	6.00	12.50	10.33	< 25	Within
Total Dissolved Solids	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	≤ 500	Within
Turbidity	FAU	4.00	4.00	4.00	5.00	5.67	6.00	4.56	5.00	≤ 5	Within
Electrical Conductivity	µS/cm	38,250	50,050	18,830	24,800	243	246	19,108	25,032	≤ 1, 500	Beyond

Average Temperature: As shown in the table above, water temperature of the water in the three (3) sampling stations ranges from 27 ^{0}C to 28 ^{0}C during the high tide of the river, while, during the low tide the water temperature ranges from 26.30 ^{0}C to

28.50 ^{0}C. Then, the mean water temperature of the river during the high tide is 27.67 ^{0}C, while, during the low tide its water temperature is 27.60 ^{0}C. Looking into the water temperature of the river in both high and low tides, the water temperatures are within the permissible limit set by the DAO 1990-34 which falls within the water temperature of 27 to 30 ^{0}C. The findingsof this study is similar to that of Kumar, Karthik, and Rajakumar (2017). According to them, the optimum water temperature for aquatic life forms in the river for their survival should be 20-30^{0}C in the sense that water temperature is an important biologically significant factor for metabolic activities of the organism in the water bodies.

Average pH: The pH level of the water during the high tide ranges from 6.75 to 7.21 while, during low tide water measured with 6.85 to 7.5 pH. Then, the mean pH of river water is 6.99 during high tide and 7.00 pH during low tide. The measurements of the pH levels in San Roque is within the standards of 6.5 to 8.5 levels as set by the DENR. This result justified the findings of the Fifield (1995) and Arbotanteet. al (201), stated that the acceptable and safe pH for water is at 6.5-8.5. Outside of this range, water productivity becomes limited.

Total Suspended Solids (TSS): As reflected in Table 1, the TSS across the three (3) sampling stations of San Roque River ranges from 6 mg/L to 19 mg/L. However, the TSS of the water during high tide is higher than the low tide TSS level. Nevertheless, the TSS of the river water is within the range of the permissible limit of ≤ 25 mg/L, it only concludes that the water quality of San Roque River is still good. This implies that San Roque River is free from suspended particulates that pollutes the river. This condition of the river is advantageous and favourable for the aquatic organisms to survive in the river because is its free from pollution. The same results is observed in the study of Angagao, Quiao, Roa and Prado (2017), divulged that the obtained TSS is within the DENR-EMBstandard, it means that aquatic life within the river is in good environment.

Total Dissolved Solids (TDS): Table 1 shows that across the three (3) sampling stations in SanRoque River that even in high and low tide, there is no trace of TDS analyzed in the water. This means that the water is still clean and free from minute particles that came from the decaying organic matters or from siltation in the river. This also concludes that San Roque River had absolutely passed in terms of TDS from the standard set by DENR of ≤ 500 mg/L. It implies that the river is still in good condition and it has good water quality in terms of TDS which is too favourable for the survival of the aquatic life forms living in the river and an indicator of good condition of the river ecosystem. This findings is similar to the study of Sinco, Senaydiego, Saab, Mojico, Tampus, and Rondez (2014), which the Cagayan de Oro River in terms of TDS is within the permissible limit of the DENR. They also added that the TDS concentration in the river and its tributaries may be caused by several factors. The presence of high concentration of dissolved ions in freshwater bodies is not merely an indication that the water is polluted or has an unhealthy condition.

Turbidity: As reflected Table 1, the turbidity of the downstream and midstream obtained a measurement of ranges from 4.00 to 5.00 FAU during high and low tides which is within the permissible limit of ≤ 5 FAU of the DENR. However, the upstream of the river has a turbidity of 5.67 FAU during high tide and 6.00 FAU during low tide. The data shows that the water is downstream and midstream is very clear as compared the less turbid water in upstream station. Then, the mean turbidity level of San Roque River is 4.56 FAU on high tide and during low tide is 5.00 FAU.

This means that generally the turbidity of the river is still passed or within the standard of ≤ 5 FAU. The present study has similar result to the study of Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015) stated that the turbidity in St. Joseph Waterways in Balilir River were within the standard as it is showed with overall turbidity level of 3.3 FAU. This means the water are transparent and clear.

Electrical Conductivity: Among the three (3) stations, downstream station obtains the highest electrical conductivity during high tide (38, 250 µS/cm) and low tide (50, 050 µS/cm), while, upstream has the lowest electrical conductivity of 243 µS/cm during high tide and 246 µS/cm during low tide. Then, the mean electrical conductivity level of San Roque River is 19, 108 µS/cm during high tide and 25, 032 µS/cm on its low tide. The data shows that the electrical conductivity of San Roque River exceeded the standard limit of ≤ 1, 500 µS/cm. The electrical conductivity in water is used evaluate the purity of water which is independent on the ionic concentration and water temperature. It is also regarded as an indication of its freshness of water body which is necessary for primarily productivity and fish production (Sandoval, Cada, Labana, &Dungca, 2017). They stressed that the desirable limit for electrical conductivity of water should fall between 200-1500 µS/cm, in which the present study had a finding which is the same with the Sandoval's study.

Table 2 presents the biochemical characteristics during high and low tides.

Table 2.Biochemical Characteristics of San Roque River During High and Low Tides Total Coliforms

Parame-Ters	Units	Downstream		Midstream		Upstream		Mean		Permissi-ble Limit (DAO 1990 -34)	Remarks
		High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide		
Total Coliform	MPN/ 100 ml	54,000	160,000	4,600	35,000	330	330	19,643	65,110	5,000	Beyond
Fecal Coliform	MPN/ 100 ml	7,900	160,000	1,700	4,900	330	9.3	3,310	54,970	200	Beyond
Biological Oxygen Demand (BOD)	mg/L	2.37	2.05	3.57	3.77	1.34	1.46	2.43	1.46	≤10.00	Within
Dissolved Oxygen (DO)	mg/L	8.49	7.86	8.01	8.37	8.33	8.21	8.28	8.15	≥ 5.00	Within
Salinity	‰	27.00	36.00	14.00	17.00	1.00	1.00	14.00	18.00	≤ 1.00	Beyond

Among the three (3) sampling stations in San Roque River, downstream station obtains the highest total coliforms during high tide (54, 000 MPN/ 100 mL) and low tide (160,000 MPN/100 mL), while, upstream has the lowest total coliforms of 330 MPN/100 mL in both high and low tides. Then, the mean total coliforms level of San Roque River is 19, 643 MPN/100 mL during high tide and 65,110 MPN/100 mL on its low tide. The data suggests that the total coliforms level of San Roque River exceeds beyond to the permissible limit of ≤ 5,000 MPN/100 mL. This suggests that the river is contaminated with bacteria are derived from the different decaying organic sources. The result of the similar to the findings of the Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015). According to their study, the St. Joseph Waterways exceeded the permissible limit of total coliforms in the water which is the same with the present study. They further explained that contamination of coli forms aredeemed determining factor of the cleanliness of the water bodies and it's associated to health issues. This explains that the presence of high coliform counts in the water would result to various forms of diseases.

Fecal Coliforms; The same observation has been noted on the fecal coliforms of the water in San Roque River to its total coliforms. As shown on the table above, the downstream station of the river measures with the highest fecal coliforms contamination in both high tide (7,900 MPN/100 mL) and low tide (160,000 MPN/100 mL). While, the upstream station obtains with the lowest fecal coliforms counts with 330 MPN/100 mL during high tide and 9.3 on its low tide. The data also suggests that it is most of the time during low tide the fecal coliforms peaks on high contamination. It concludes that the fecalcoliforms of the water in San Roque River is beyond the permissible limit of 200 MPN/100 mL. The result of the study is still the same with the findings of the the Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015). Accordingly, the high prevalence of animal and human manures in the water bodies would make the water bodies contaminated and hazardous to health of both human and animal.

Biological Oxygen Demand (BOD): As to the BOD of the river, all the sampling stations have obtained the BOD level of lower than the permissible limit of ≤10.00 mg/L in both high tide and low tide condition of the river. This means that BOD level of San Roque River is within the standards of DENR. Similarly, the Balili River had a BOD which was within the standard too as studies by Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015) and Ugwu and Wakana (2012). Similar to the observation of Ugwu and Wakawa (2012), the researchers had also advanced that the rationale for measuring BOD is based on the idea that the depletion of oxygen occurs faster when there is a greater demand, hence, posing a lesser availability of the oxygen for the maintenance of aquatic life. The data denotes that the higher the BOD in the water bodies there are less aquatic life forms survived on it.

Dissolved Oxygen (DO): Table 2 reflects that the three (3) sampling stations in San Roque River have recorded a dissolved oxygen ranges from 7.86 mg/L to 8.49 mg/L in both high and low tides. While, it's mean DO is 8.28 mg/L during high tide and 8.15 mg/L during low tide. The data showed that the DO level of San Roque River is within the 5.00 mg/L standards. The study of Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015) had the same observation with the DO level of San Roque River. As explained by Bengao, Cababat, Anacin, Azarcon, Janeo, and Lubrica (2015) that the dissolved oxygen (DO) is an essential characteristics in the water needed for the survival of aquatic life in the river. The presence of high DO level is favourable for the aquatic life forms in the water bodies in the sense that every organisms needs ample supply of oxygen for their survival.

Salinity: Among the three (3) sampling stations, the downstream station recorded with the highest salinity level of water in both high tide (27 ‰) and low tide (36 ‰). While, station in the upstream portion has the lowest salinity level for having a 1.00 ‰ in both high and low tides. The data describes that salinity of San Roque River is beyond the standard of a freshwater that should marked of 1.00 ‰ level. A higher than 1.00 ‰ indicates that the water in San Roque River is considered salty and mixed with seawater. As stressed in the study of Kumar, Karthik, and Rajakumar (2017) the major driving factor affecting the water density and growth of aquatic organisms is salinity.

Significance Difference on the Characteristics of Water in San Roque River

Table 3, 4 and 5 present the significant difference in the characterization of water in San Roque River in terms of high and low tides, high tide and the standards, and low tide and the standards.

Table 3.T-test Result on Significant Difference on the Characteristics of Water in San Roque River between High Tide and Low Tide

Parameters	Mean Difference	t-value	df	p-value
Average Temperature	0.068	0.128^{ns}	6	0.902
Average pH	-0.013	-0.061^{ns}	6	0.953
Total Suspended Solids	2.168	0.741^{ns}	6	0.487
Turbidity	-0.443	-0.780^{ns}	6	0.465
Electrical Conductivity	-5924.250	-0.463^{ns}	6	0.660
Total Coliform	-45466.750	-1.250^{ns}	6	0.258
Fecal Coliform	-51659.825	-1.389^{ns}	6	0.214
Biological Oxygen Demand (BOD)	0.243	0.341^{ns}	6	0.745
Dissolved Oxygen (DO)	0.130	0.891^{ns}	6	0.407
Salinity	-4.000	-0.449^{ns}	6	0.669

High Tide and Low Tide: As can be seen in Table 3.1 there is no significant difference on the characteristics of water in San Roque River between high tide and low tide in terms of the parameters of average temperature (p=0.902), average pH (p=0.953), TDS (p =0.487), turbidity (p=0.465), EC (p=0.660), total coliforms (p=0.250), fecal coliforms (p=0.214), BOD (p=0.745), DO (p=0.407), and salinity (p=0.669). This shows that there is no significant difference in the characteristic of water

in San Roque Rive between high tide and low tide. This happens because all the obtained p-values of the parameters were greater than the level of significance of 0.05.

Table 4 presents the significant difference in the characteristics of water in San Roque River in terms of high tide with low tide, high tide with the standards, and low tide with the standards

Table 4.T-test Result on Significant Difference on the Characteristics of Water in San Roque River between High Tide and Standards

Parameters	Mean Difference	t-value	df	p-value
Average Temperature	-0.833	-3.532*	6	0.039
Average pH	-0.513	-5.451**	6	0.002
Total Suspended Solids	-37.500	-15.930**	6	0.000
Turbidity	-0.443	-1.124^{ns}	6	0.304
Electrical Conductivity	18607.75	2.398^{ns}	6	0.053
Total Coliform	18643.25	1.531^{ns}	6	0.177
Fecal Coliform	3210.00	1.949^{ns}	6	0.099
Biological Oxygen Demand (BOD)	-2.573	-5.646**	6	0.001
Dissolved Oxygen (DO)	3.278	32.847**	6	0.000
Salinity	13.000	2.449^{ns}	6	0.050

High Tide and Standards: Among the parameters being computed on the significant differences between the high tide and standards, five (5) of these parameters have shown highly significant differences namely: average temperature (p=0.039), average pH (p=0.002), total suspended solids (p=0.000), BOD (p=0.0010), and DO (p=0.000). While, turbidity, EC, total coliforms, fecal coliforms, and salinity have shown no significant differences between the high tide and standards. It means that the water parameters in terms of average temperature, average pH, TSS, BOD, and DO have shown significant difference between the high tide and standards because those parameters have passed with the standards unlike the other parameters that they failed from the standards set by the DENR.

Table 5 shows the significant difference on the characteristics of water in San Roque River between low tide and standards.

Table 5.T-test Result on Significant Difference on the Characteristics of Water in San Roque River between Low Tide and Standards

Parameters	Mean Difference	t-value	df	p-value
Average Temperature	-0.900	-1.912^{ns}	6	0.104
Average pH	-0.500*	-2.756*	6	0.033
Total Suspended Solids	-39.668	22.849**	6	0.000
Turbidity	0.000	0.000^{ns}	6	1.000
Electrical Conductivity	24532.000	2.413^{ns}	6	0.052
Total Coliform	64110.000	1.870^{ns}	6	0.111
Fecal Coliform	54869.825	1.477^{ns}	6	0.190
Biological Oxygen Demand (BOD)	-2.815	-5.153**	6	0.002
Dissolved Oxygen (DO)	3.148	29.557**	6	0.000
Salinity	17.000	2.377^{ns}	6	0.055

Low Tide and Standards: Table 5 discloses that among the parameters tested for significant differences on the characteristics of water in San Roque River between low tide and standards, its only total suspended solids (p=0.000), BOD (p=0.002) and DO (p=0.000) have shown highly significant difference, and average pH (p=0.033) has shown significant difference; hence their computed p-values were less than 0.01 and 0.05, respectively. While, average temperature, turbidity, EC, total coliform, fecal coliform, and salinity levels have shown no significant differences between low tide and standards. The data concludes that during low tide average pH, TSS, BOD, and DO measurements are within the standards measurement, unlike with the other parameters wherein they failed from the DENR standards. This implies that these even during low tide, those water parameters of San Roque River in terms of average pH, TSS, BOD, and DO measurements have passed with the standards set by DENR.

Anthropogenic Activities of the Community Living Along the Riparian Zone of San Roque River

Table 6 presents the anthropogenic activities of the community living along the riparian zone of San Roque River in terms of domestic practices, fishing practices, farming practices, quarrying activities, and recreational activities.

Domestic Practices: As can be glimpsed from Table 6 as to domestic practices of the community living along the riparian zone of San Roque River, the topmost practices that are practiced by the community are "disposes laundry water into the water body of the river" and "builds pig pens along the river banks". While, the activities that was not practiced by the people are "disposes sewage wastes from septic tank directly into the river" and "throws kitchen wastes directly into river from their sink". This means that most of the people living along the riparian zone of San Roque River are aware that can affect or destroy the river caused by the human activities. That is why, most of their domestic activities are not detrimental to the river and on its water quality.

Fishing Practices: Most of the respondents have identified their topmost fishing practices that they practiced along San Roque River are "uses fine fish net in fishing" and "involves in unregulated fishing and harvesting of "bebe". While, the topmost fishing practices that the community that they are not practicing are "uses toxic chemicals in catching fish" and "leaves unused fishing

gears and disorder fishing materials in the river and along the river banks". The data suggests that fishermen have fishing practices that are not so much destructive to the river and to its water quality.

Table 6.Frequency and Rank Distribution on the Anthropogenic Activities of the Community Living Along Riparian Zone of San Roque River

Activities	Responses			
	Yes	Rank	No	Rank
Domestic Practices				
Disposes sewage wastes from septic tank directly into the river.	4	4.5	36	1
Throws kitchen wastes directly into river from their sink.	3	6	37	2
Dumps garbage and solid wastes directly into river.	0	7	40	3.5
Build poultry houses along the river banks.	8	1.5	32	3.5
Encroaches of houses into the river banks.	7	3	33	5
Builds pig pens along the river banks.	8	1.5	32	6.5
Disposes laundry water into the water body of the river.	4	4.5	36	6.5
Fishing Practices				
Uses toxic chemicals in catching fish.	8	1	32	1
Leaves unused fishing gears and disorder fishing materials in the river and along the river banks.	0	5	40	2
Involves in unregulated fishing ad harvesting of fish in the river.	5	3	35	3
Involves in unregulated fishing ad harvesting of "bebe" and other aquatic resources in the river.	7	2	33	4
Uses fine fish net in fishing	1	4	39	5
Farming Practices				
Dumps agricultural wastes into the river.	4	6	36	1
Makes agricultural production within the riparian zone of the river.	5	5	35	2
Makes animal production within the riparian zone of the river.	7	3	33	4
Uses synthetic fertilizers and pesticides in the agricultural production.	6	4	34	3
Exhibits land tilling that indirectly destroys the natural condition of river and riverbank.	10	2	30	5
Makes the mouth and river banks as the outlet of the farm irrigation.	13	1	27	6
Quarrying Activities				
Involves in indiscriminate quarrying of both sand and gravel along the river.	13	4	27	1
Involves in indiscriminate quarrying of gravel along the river.	11	5	29	2
Involves in indiscriminate quarrying of sand along the river	9	6	31	3
Absence of municipal policy on the regulation of quarrying in the river.	17	2.5	23	4.5
Presence of soil erosion along the river bank that resulted from quarrying in the river.	17	2.5	23	4.5
Presence of poor water quality in the river due to quarrying.	18	1	22	6
Recreational Activities				
Uses river for scuba diving and snorkelling.	25	1	15	1.5
Build up resort/s along the river for recreational activities.	13	2	27	1.5
Uses river for sight-seeing along the river bank.	6	3	34	3
Uses river for boating and sight-seeing.	1	4.5	39	4
Uses river for swimming and bathing.	1	4.5	39	5

Farming Practices: Most of the respondents have identified their topmost farming practices along the San Roque River that are practiced and not practiced. The farming practices that are practiced by the community along the river are ") makes the mouth and the river banks as the outlet of the farm irrigation" and "exhibits land tilling that directly destroys the natural condition of river and riverbank". On the other hand, the farming practices that the community that are not practiced are "dumps agricultural wastes into the river" and "makes agricultural production within the riparian zone of the river". The data suggests that most of the community have farming practices that are not destructing to the river.

Quarrying Activities: The topmost quarrying activities that are practiced by the community living along the San Roque are "presence of poor water quality in the river due to quarrying" and "presence of soil erosion along the river bank that resulted from quarrying in the river". While the quarrying activities that are not practiced by them are "involves in indiscriminate quarrying of both sand and gravel along the river" and "involves in indiscriminate quarrying of gravel along the river". The data concludes that there are quarrying activities that are happening along San Roque River that resulted to soil erosion along the river banks of the San Roque River.

Recreational Activities: Among the recreational activities that re practiced by the community living along the river are "uses river for swimming and bathing" and "uses river for boating and sight-seeing". While, the recreational activities that are not practiced by the respondents along the river are "uses river for scuba diving and snorkeling" and "build up resorts along the river for recreational activities". The data suggests that the recreational activities of the community living along the riparian zone of San Roque are mostly swimming, bathing, boating and sight-seeing. This also implies that community are not doing other recreational activities that can adversely disturb and destroy the condition of San Roque River.

Classification of San Roque River Based on the Standards Set by DENR

The physical and biochemical characteristics such as average temperature, average pH, TSS, TDS, turbidity, BOD, and DO were within the standards level of the DENR. With this, the San Roque River can be classified as Class A. As stipulated in

DAO 1990-34, Class A River is considered as Public Water Supply Class II. This water sample requires extensive treatment process to pass the set standard for drinking.

However, in terms of total coliforms and fecal coliforms contamination of the water in San Roque River these parameters are beyond the DENR standards of 5,000 MPN/100 mL and 200 MPN/100 mL, respectively. This means that in terms of coliform indicators the San Roque River failed from the standards. Consequently, the San Roque River falls under the classification of Class D. According to DENR AO No. 94 of 1990, Class D river is a water resource which is not recommended for any domestic uses for it poses health risk to humans. This classification of surface water is only intended for agricultural uses and industrial uses.

Lastly, after assessing the water quality of San Roque River as to its overall characterization it is considered classified as Class D river. This is due to the high contamination of fecal and total coliforms present in the water. This concludes that people are not advised to swim, bath and use the river as their drinking source. Thus, reduction of fecal and total coliform should be addressed so that the potential uses of the river will be maximized.

CONCLUSIONS

The San Roque River is a potential water source of the municipality of the San Roque as based on the laboratory analysis of the physical characteristics, however, it is highly contaminated with the coliforms that delimits the usability of the water in the river for domestic uses. But then, the river is still favorable to the survival of aquatic life forms, agricultural and industrial uses of the river. On the other hand, the characteristics of the water in San Roque River are the equally the same in both high and low tides. Moreover, during high tide only temperature, pH, TSS, BOD and DO conformed to the DENR standards, while on low tides, only pH, TSS, BOD, and DO conformed to the standards of the DENR. While, other water parameters have changed during high tide and low tide as compared it with the DENR standards.

Then, the community living along the riparian zone of San Roque River were practicing an anthropogenic activities that were favorable for the condition of the river, but then, there were other practices and activities exercised by some people that are not favorable to the condition of the river that lead to the destruction of the river which primarily on soil erosion along the river banks and the high contamination of coliforms in the water of San Roque River.The anthropogenic activities of community did not directly affect the water quality of the river. Generally, San Roque River is classified as Class D as examined to the DENR standards and it is unfit for any domestic uses due to the high contamination of coliforms in the water.

RECOMMENDATIONS

The researchers suggest the recommendations as follows:

1. The local government unit of San Roque should have an activity that will intensify the awareness of the community on the value and importance of the river water quality and the effect of the anthropogenic activities to the water condition of San Roque River specifically on the high contamination of the bacteria due to coliforms present in the water. Similarly, they should also make policies through municipal ordinances that would ensure the preservation and conservation of the river in San Roque, Northern Samar.
2. The LGU through their municipal health office together with the barangay council should survey on the different household that have no comfort rooms and septic tanks and they should distribute toilet bowls to those households that have no comfort rooms. Then, they can also established communal comfort rooms in each barangay to avoid direct disposal of effluents into the river. However, the municipal and barangay officials should imposed strict evaluation and monitoring on the sanitation aspect on the use of the communal comfort rooms.
3. The barangay living along the river through their barangay officials should monitor the water quality of the river and they institute a monitoring team to do the regular monitoring activities. Likewise, the barangay council should craft and impose barangay ordinances that would enforce the community to protect, preserve, protect and maintain the good condition of the river
4. The Community Environment and Natural Resources Office (CENRO) of the DENR in the municipality of San Roque should conduct a symposium and seminar to the constituents of the different barangays along the river on various environmental laws and policies like the proper management of solid and liquid wastes disposal.
5. The municipal and barangay officials should initiate in organizing people's organization that would become their arms in implementing programs, projects, and activities relevant to the preservation, conservation, and management of San Roque River.
6. The future researchers will conduct further similar study on this kind of research focusing on the characterization of the river and its water quality using the longitudinal study.

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REFERENCES

[1] Achwarin, N. (2009). *The Study of Teacher Competence of Teachers at Schools in the Three Southern Provinces of Thailand.* Unpublished Dissertation, Assumption University of Thailand. Retrieved from: http://repository.au.edu/handle/6623004553/12698, September 2016.

[2] Andem, A. (2012). *A study on some physical and chemical characteristics of Onariver, Apata, Ibadan southwest, Oyo state, Nigeria.* European Journal of Zoological Research, 1(2), pp. 37-46.

[3] Aggarwal, Y. P. (2008). *Meaning of the term-descriptive. International journal of transformations in business management*. Survey Research Method.*Vol.1, Issue No. 6.*

[4] Angagao, N., Quiao, M., Roa, E. & Prado, G. (2017).*Water quality assessment of the South-eastern part of Lake Lanao, Philippines.*International Letters of Natural Sciences, 63, pp. 34-41.

[5] Aragoncillo, L., Dela Cruz, C., Baltazar, V., & Hernandez, M. (2011).*SapangBaho River water quality assessment Report.* Environmental Laboratory Research Division, Rizal, Philippines.

[6] Arbotante, C., Bandao, J., De Leon, A., De Leon, C., Jangiro, Z., Lapus, J., Manaloto, B., Nacpil, B., &Salonga, F. (2015).*Water quality in Pampanga River along barangay Buas, Candaba, Pampanga.*Research Presentation.DLSU Research Congress, Manila, Philippines.

[7] Asian Development Bank. (2007). Asian Development Outlook: Report on River Basins in the Philippines. ISSN 978-971-561-619-5.

[8] Bengao, A., Cababat, R., Anacin, C., Azarcon, D., Janeo, M., &Lubrica, N. (2015). *Physico-chemical and biological analysis of St. Joseph waterway.* Retrieved on October 10, 2018 at www. Researchgate.com

[9] Bernardo, N. (2000). *An assessment of the rivers of Calbayog City: A basis for proposing maintenance and rehabilitation measures.* Unpublished Master's Thesis, TiburcioTancinco Memorial Institute of Science and Technology, Calbayog City.

[10] Blanco, A., Alarilla, A., Dimalibot, R., Bonga, M. &Paringit, E. (2014). *Assessment of water quality variations in San Juan River using GIS and multivariate statistical techniques*. ASEAN Engineering Journal, 2(2), 24-40.

[11] Botkin, D. & Keller, E. (2011).*Environmental Science as a Living Planet, 8th Edition.*USA: John Wiley & Son, Inc., p. 368.

[12] Boyd, C. & Tucker, C. (1998).*Pond aquaculture and water quality management.* Kluwer Academic Publication, London, pp. 44-48.

[13] Brebante, B. (2017). *Analyzing the effects of land cover/land use changes on flashflood: A case study of Marikina River Basin, Philippines.* Unpublished Master's Thesis. University of Twente, The Netherlands.

[14] Chhatawal, G. (1998). *Encyclopedia of Environmental Biology.* Anmol Publishing Pvt. Ltd., New Delhi, India.287-301.

[15] Chuang, P., Millspaugh, J., Patrick, J., &Trottier, S. (2010).*Water quality testing and water use assessment in Capiz Province, Philippines.* Unpublished Master's Thesis. Massachusetts Institute of Technology, United States of America.

[16] Columbia Electronic Encyclopedia. Retrieved from: www.columbiaelectronicencyclopedia, November 2018.

[17] Comprehensive Land Use Plan of the Municipality of San Roque, Northern Samar for 2017-2026. Office of the Municipal Mayor, San Roque, Northern Samar.

[18] Cruz, R. (1997). *Case study of Pasig River, Philippines.*World Health Organization and United Nations Environment Programme, the Water Supply and Sanitation Collaborative Council.

[19] Danquah, L. (2010). *The causes and health effects of river pollution: A case study of the Aboabo River, Kumasi.* Unpublished Master's Thesis, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

[20] Dayrit, H. (2001). *The Philippines: Formulation of a national water vision. From vision to mission: A synthesis of experiences in Southeast Asia.* Retrieved on October 10, 2018 at http://ftp.fao.org/dcorep/fao/004/AB776E.

[21] DENR Administrative Order (DAO) 2016-06. (2016). *Water quality guidelines and general effluent standards*. Retrieved on October 10, 2018 at http://www.emb.gov.ph/.

[22] Environmental Protection Agency (EPA) (1997).Water monitoring assessment. Dissolved oxygen. Retrieved on November 7, 2018 at http://water.epa.gov/type/rsl/monitoring/vms510.cfm.

[23] Fifield, F.W. &Haimes,, P.J. (1995). *Environmental Analytical Chemistry*.The Analysis of Water.

[24] Flores, M. &Zafaralla, M. (2012).*Macro invertebrate composition, diversity and richness in relation to the water quality status of Mananga River, Cebu Philippines.*5(2), 103-113.

[25] Jalilov, S. (2017).*Value of clean water resources: Estimating the water quality improvement in Metro Manila, Philippines.* Unpublished Master's Thesis. United Nation's University, Tokyo, Japan.

[26] Goel, P. (2006). *The river system.*New Age International Publishers.

[27] Gorme, J., Maniquiz, M., Song, P., & Kim, L. (2010).*The water quality of the Pasig river in the city of Manila, Philippines: Current status, management and future recovery.* Environmental Engineering Research, 15(3), pp. 173-179.

[28] Guzman, R. Z. & Guzman, R. S. (2000).*Tragedy of the commons.* Environmental Education for Sustainable Development. Wisdom Advocates Publishing: Philippines.

[29] Holm, J. (2004).*The water quality of the Wood River and the effects of land use.* Unpublished Master's Thesis. University of Saskatchewan, Canada.

[30] Idowu, A., Oluremi, B., &Odubawo, K. (2011).*Bacteriological analysis of well water samples in Sagamu, Africa.* Journal of Clinical Experimental Microbiology, 12(2), pp. 86-91.

[31] Joshi, D., Kumar, A., &Agrawal, N. (2009).*Studies on physic-chemical parameters to assess the water quality of river Ganga for drinking purpose in Haridwar district.* Rasayan Journal of Chemistry, 2(1), pp. 195-203.

[32] Kumar, D., Karthnik, M., &Rajakumar, R. (2017).*Study on seasonal water quality assessment and fishpond conservation in Thanjavur, Tamil Nadu, India.* Journal of Entomology and Zoology Studies, 5(4), pp. 1232-1238.

[33] Lontoc, D. (2013). *Civic engagement in urban water governance: the case of Pasig River rehabilitation in metropolitan Manila, Philippines.* Unpublished Master's Thesis. Milan Polytechnic University, Italy.

[34] Maglangit, F. (2014). *Physico-chemical assessment of the water quality of Buhisan River, Cebu, Philippines.*

International Journal of Research in Environmental Science and Technology, 5(2), pp. 35-49.

[35] Mahesh, R. &Arjun, B. (2011).*Evaluation of Vashisti river water water quality at Chiplun.* Advances in Applied Science Research, 2(5), pp. 104-109.

[36] Martinez, F. &Galera, I. (2011).*Monitoring and evaluation of the water quality of Taallake, Talisay, Batangas, Philippines*. Academic Research International, 1(1), 229-236. .

[37] Martinez, F., Mijares, M., &Galera, I. (2011). *Assessment of the water quality of Mamba river of Mts. Palaypalay/MataasnaGulod, Southern Luzon, Philippines.* International Conference on Chemistry and Chemical Process, Singapore.

[38] Mishra, A., Mukherjee, A., &Tripathi, B. (2009).*Seasonal and temporal variations in physico-chemical and bacteriological characteristics of river Ganga in Varanasai.* International Journal of Environmental Resources, 3(3), pp. 395-402.

[39] Morris, M. (2010).*The precautionary principle: Good for environmental activities, bad for business.* Journal of Business Administration Online, 9(2), 1-2. Nkrumah, A. (2011). *Physico-chemical analysis of well water from well sited close to on-site sanitation system: A case study in the Mfantsevan west district of the central region.* Unpublished Master's Thesis. Kwaneh University of Science and Technology, Ghana.

[40] Paclibar, G. (1985). *A chemical and microbiological analysis of water from three sources in Calbayog City.* Unpublished Master's Thesis. Marikina Institute of Science and Technology, Marikina, Metro Manila.

[41] Perez, M., Hara, J., Cabrestante, M. (2014).*Evaluation of water quality of major rivers in Palawan, Philippines using physico-chemical parameters and water quality index.* Journal of Multidisciplinary of Educational Science, 1.

[42] Ragas, S., & Villanueva, E. (2014). *Anthropogenic and environmental factors influencing water quality of Cagayan de Oro river: Implications to tourism development.* International Conference on Agriculture, Biology and Environmental Sciences (ICABES'14) Dec. 8-9, 2014 Bali (Indonesia).

[43] Ramsey, V. (2009), *Fundamentals of Earth Science*, Revised Edition, New York: John Wiley and Sons, Inc.

[44] Republic Act No. 9275.Philippine Clean Water Act of 2004. Retrieved on Oct 10, 2018 at http://www.chanrobles.com.

[45] Roxas, P., Boniao, R., Burton, E., Villarino, A., &Nacua, S. (2005). *Community-based inventory and assessment of riverine and riparian ecosystems in the Northeast part of Mt. Malindang, Misamis Occidental.* Technical Research Report. Biodiversity Research Programme (BRP) for Development in Mindanao: Focus on Mt. Malindang and Environs. SEAMEO SEARCA, Laguna, Philippines.

[46] Sandoval, K., Cada, K., Labana, R., Dungca, J. (2017). *Physico-chemical analysis of fish pond water in Candaba, Pampanga, Philippines.* Philippine Journal of Systematic Biology, 11(1).

[47] Sharma, R., Baruah, A., Bora, G. &Choudhary, P. (1996).*Water quality of the Rivers.* Pollution Research, 15 (19).

[48] Senate Economic Planning Office (2011). Turning the Tide: Improving Water Resource Management in the Philippines. Retrieved from: http://www.senate.gov.ph/publications/PB%202011-08%20-%20Turning%20the%20Tide.pdf, October 2018.

[49] Sinco, A., et. al. (2014).*Riverine biota as indicators of water quality in tropical Cagayan de Oro river, Philippines*. Advances in Environmental Sciences – International Journal of the Bioflux Society, 6(2), 157-167.

[50] The Habitable Planet.(2008). *Water resources.* Retrieved from: www.learner.org., October 2018.

[51] Tonog, M. &Poblete, M. (2013).*Drinking water quality assessment in selected*

[52] *barangays of Laoang, Northern Samar*.Faculty Research. University of Eastern Philippines, Catarman, Northern Samar.

[53] Tyokumbor, J., Okorie, T., &Ugwumba, O. (2002).*The freshwater ecosystem.* The Zoologist, 1, pp. 59-69.

[54] United Nations Environment Programme and the World Health Organization. (1996). Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. Retrieved from: http://www.who.int/water_sanitation_health/resources qualitywaterqualmonitor.pdf, October 2018.

[55] Webster Universal Dictionary. (2010), Students Edition. Scotland: Grosset and Geddes, Inc.

[56] Ybanez, B. (2014). *A study of the bacteriological quality of bottled and tap water in Cebu City, Philippines.* Unpublished Master's Thesis. Massey University, New Zealand.