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Water Quality in Pampanga River Along Barangay Buas in Candaba, Pampanga

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Abstract: Pampanga River traverses the provinces of Nueva Ecija, Pampanga, and Bulacan and is the second largest river in the whole of Luzon with a total length of 260 kilometers. It divides into small branches that empty to several fishponds especially in the town of Candaba. This study aimed to initially identify the physico-chemical characteristics of the river using some parameters such as pH, temperature, dissolved oxygen, ammonia, nitrates, and phosphates. Dissolved oxygen, pH, and temperature were measured using DO meter, pH meter, and thermometer. Chemical tests were done on site using test kits from Aquarium Pharmaceuticals Incorporated (API). It was found that ammonia and phosphate concentrations exceeded the maximum value required by the DAO 34 -Water Quality Standard for Class C Water. The DO concentration was below the minimum requirements for river water.

Key Words: Candaba; Pampanga; River Water; Community

1. INTRODUCTION

Pampanga River with a total length of 260 kilometers, is the second largest river in the whole of Luzon (Figure 1). It traverses the provinces of Nueva Ecija, Pampanga and Bulacan. The headwaters of Pampanga River came from the mountains of the Sierra Madre and drains via the Lanbangan Channel into Manila Bay. Pampanga River provides irrigation to about 363,246 hectares of farmlands in the provinces of Nueva Ecija, Pampanga, and Bulacan. The river has small branches that empty to several fishponds especially in the town of Candaba.

Buas is one of the barangays in Candaba. It is a small town with a population of 3,000. Figure 2, shows the map of Barangay Buas. It can be seen that the barangay is directly connected to one side of the river and houses are built along the river bank. The town is more of a residential area with big factories not yet locally taking advantage of the river.

River studies had been conducted by several researchers. Khalik et.al, 2013 made an analysis on the physico-chemical characteristics of Bertam River in Malaysia and found that the water quality has degraded along seasonal changes. Khound et.al, 2012 made physico-chemical studies on water quality in Jia-Bharali River, India and found that the physico-chemical parameters in terms of pH, phosphates, nitrates, and other mineral salts are within the WHO prescribed limit for water quality. Sangeetha et al, 2013 studied on the water quality status of eastern rivers in India, they were able to

Figure 1. Map of Pampanga River with Candaba Swamp indicated from https://www.google.com.ph /search?q=Map+of+Pampanga+River

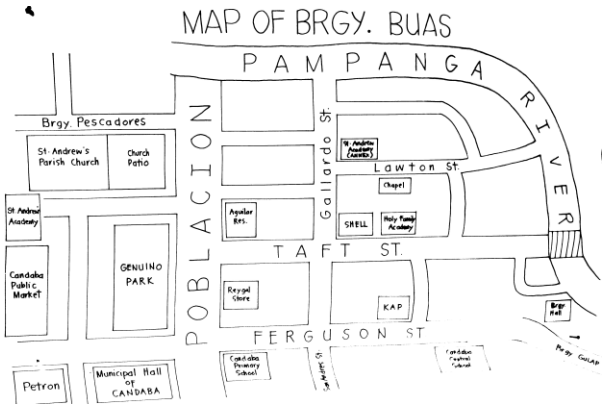

Figure 2. Map of Barangay Buas in Candaba Pampanga

conclude that the parameters analyzed were at a safe level except for problems on water hardness. Zain etal, 2011 studied on the high ammonia, phosphate, and nitrate concentrations along 11 stations in Perlis River Basin in Malaysia. They were able to identify sources of pollution which includes anthropogenic sources. The researchers recommended river quality management activities that need to be implemented. Aragoncillo et al, 2011 of the Environmental Laboratory Research Division in Rizal Philippines conducted a water quality study in Sapong Baho River, Rizal. An input of pollution from domestic solid and liquid waste was identified. The researchers recommended proper solid and liquid waste management of people living near the river.

In the light of the information and literature cited, this study aimed to initially identify the physico-chemical characteristics of Pampanga River along Barangay Buas, Candaba.

2. METHODOLOGY

Water samples were collected 4.00 meters away from the river bank at three selected sites. The three sites are situated at an area where the river enters the barangay (S1), at the mid point of the river's trajectory beside the barangay (S2), and at an area where water flows away from the river adjoining the barangay (S3). Samples were collected and tested three times in October and November. The time of collection was at 10:00 am and at 3:00 pm.

River water samples were scooped 10 cm below the water surface and were placed in 1L polyethylene (PET) bottles. The samples were analyzed for pH, dissolved oxygen DO, temperature, nitrates, ammonia, and phosphates on site. Three trials were done for every parameter tested.

Physical tests were done with a pH meter, DO meter, and a thermometer. Chemical tests were done using the freshwater master kit from Aquarium Pharmaceuticals Incorporated (API).

3. RESULTS AND DISCUSSION

The observable physical attributes of the river and the community nearby were noted at each sampling date. Typical of small communities, there were no great changes during the entire sampling

period. The flow of the blue-green water in the river was moderate in the morning and faster in the afternoon. The river banks were sandy with mud deposits along the water line. Although the sampling period coincided with the cooler season of the country with the northeasterly trade winds or amihan blowing, data collection days fell on cloudy mornings with light precipitation in the afternoon.

The river was also observed to carry yard waste and plastic bags filled with garbage, and on one occasion, a distended carcass of a goat was seen floating downstream. Its relatively advanced stage of decay indicate that it might have been thrown into the river much further upstream. There seems to be no coordinated community effort towards the preservation or protection of the river, specially as houses of predominantly light to medium materials were built along the stretch of the river. The smallest of these would usually have no septic tanks and their sewage joins the river directly. People were fishing in the river, but drainage canals from the barangay conveniently empty into the river. At the end of one sampling day, the barangay official assisting the group volunteered to take care of our trash, which to our dismay, he only threw into the river.

Table 1. Summary of parameters measured from Pampanga river at barangay Bauan

Parameter	Site 1		Site 2		Site 3	
	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)
pH	6.90.30-9.20	8.30(0.072)	6.60-9.20	8.20(0.608)	7.40-9.10	8.38(0.497)
DO (mg/L)	3.9- 4.7	4.2(0.200)	3.4-5.0	4.2(0.416)	4.2-5.9	4.6(0.265)
Temperature(^{0} C)	28.8-35.1	31.4(1.95)	29.3-30.5	30.1(0.492)	29.1-32.0	30.5(0.687)
Nitrate(mg/L)	2.5-7.5	4.84(1.40)			3.42-10.0	6.01(1.37)
			4.50-7.50	5.29(1.09)		
Ammonia(mg/L)	0.080-0.45	0.386(0.00471)	0.13-0.70	0.32(0.218)	0.08-1.58	0.38(0.554)
Phosphate(mg/L)	0.15-1.17	0.82(0.679)	0.15-1.67	0.74(0.563)	0.20-1.67	0.66(0.310)

Statistical analysis of the results from the three separate sampling days and the time differentiated samples of the same day show no significant variation in the measured parameters. Thus values are averaged and treated as representative of the October-November period in the past year.

The average pH is weakly basic at 8.29 and typical for hard water. Without speciation and assuming natural alkalinity, the pH may indicate bicarbonate, carbonate and hydroxide ions. However, looking at the range, there are some portions of the river that exceeded the DAO-Water Quality Criteria for class C water (fishery water, recreational water, and industrial water supply) and the EPA/WHO standards. The acceptable and safe pH is at 6.5-8.5. Outside this range, water productivity becomes increasingly limited. (Fifield, 1995)

Table 2. Average physico-chemical parameters

Parameter	Average values
pH	8.29
Dissolved Oxygen	4.37 ppm
Temperature	30.7º C
Nitrate	5.38 ppm
Ammonium	0.321 ppm
Phosphate	0.737 ppm

The mean concentration for DO is low, 4.37 mg/L, suggesting less than ideal water quality. The minimum amount of DO for class C water is 5 mg/L as per DAO 34 - Water Quality Standard. Solubility of oxygen in water at 30ºC is 7.57 ppm. Dissolved oxygen can be depleted by the biochemical breakdown of organic materials (Fifield, 1995). The presence of organic matter causes more bacteria to thrive and in extreme cases result in algal bloom or red tide. The bacteria consume much of the oxygen in water thus lowering the oxygen concentration. Fish and other aquatic animals need oxygen, thus a low DO value in river water compromise aquatic fauna, although Pampanga River has had no recorded incidence of fish kill and extreme DO levels may not be a concern.

Nitrates did not exceed the maximum value of 10.00 mg/L for Class C water of DAO Water Quality Standard. However, it can be seen that the mean concentration of ammonia (0.321 mg/L) exceeded both the O.2 mg/L set by the Canadian Environmental Studies Board (1972) and the 0.1 mg/L US Environmental Protection Agency (EPA) levels that indicate polluted water in rivers.

Phosphates (0.737 mg/L) in the river samples exceeded the DAO 34 - Water Quality Standard for class C water. The maximum tolerable amount of phosphate for river water is 0.4 mg/L.

The high amount of ammonia and phosphate in the river sample might be due to anthropogenic activities of the barangay alongside the river. This justification is similar to the study made by Zain et al in 2011 where the high ammonia, phosphate, and nitrate concentrations along Perlis River Basin in Malaysia were due to anthropogenic sources.

It was observed on site that canals and drainages were directed into the river. It is possible that human and animal wastes, domestic waste water with detergents, soaps, and other cleaning reagents are contributory factors to the presence of ammonia and phosphates in the river samples. Since the river banks are sandy, phosphates might have also leached from the rocks.

4. CONCLUSIONS

The low DO concentration suggests the presence of more organic pollutants. High ammonia and phosphate concentrations in the samples tested suggest poor water quality along the river adjoining Barangay Buas, Candaba. However, the absence of significant differences in the data through the three sampling sites suggest that although the river may be classified as being polluted, the barangay, as of the moment do not greatly impact the river. The sites were chosen at the boundaries and the middle of the barangay.

To verify this conclusion, testing sites may be spread farther down and upstream of the barangay. At the least, the statistically constant results provide current baseline information reflecting water quality of the river in the vicinity of barangay Buas. We intend to continue sampling to monitor the environmental status of the river and at the same time raise environmental awareness that can benefit Pampanga River.

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