IMPACT OF THE WATER QUALITY OF NAPOLAN RIVER TO THE RESIDENTS OF BRGY. NAPOLAN, PAGADIAN CITY, ZAMBOANGA DEL SUR, PHILIPPINES

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ABSTRACT

The healthy aquatic ecosystem is dependent on physico-chemical and biological characteristics (Venkatesharaju, Ravikumar, Somashikar&Prakash, 2010). The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem. Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. Thus, monitoring these parameters is essential to identify the magnitude and the source of any pollution load (Thirupathaiah, Samatha&Sammaiah, 2012). This study was conducted in order to determine the chemical properties of the water of Napolan River located in Brgy. Napolan, Pagadian City, namely; the pH, dissolved oxygen, salinity, total dissolved solids and electrical conductivity); the microbial presence;and to evaluate the awareness of the residents regarding the quality of the water using a self-made questionnaire. The said chemical properties were determined during dry season and wet season. Water samples were brought to Pagadian City Water District (PCWD) for a test on microbial presence.

The results of this study showed that the chemical properties of the water samples from Napolanriversupport the growth or reproduction of Coliform bacteria which is an indication of fecal contamination. Water samples taken during dry season were noted to contain more coliform bacteria than those collected during wet season.

Keywords: dry season, residents, river, water, wet season.

INTRODUCTION

Accordingly, man depends upon inland waters, especially fresh water, for domestic and industrial use. Rivers have been very useful to men in all parts of the Earth since in the very early times (Martinez, Mijares&Galera, 2011). It is also seen as ecological systems supporting various life forms for some beneficial and other detrimental in human life, and can be an ecosystem and natural life habitats (Jordaan, 2012). It is indeed a complex life support systems and the sustainability of which depends on rather delicate balances being maintained. During ancient times, the rivers are the source of drinking water of all living creatures. But with the

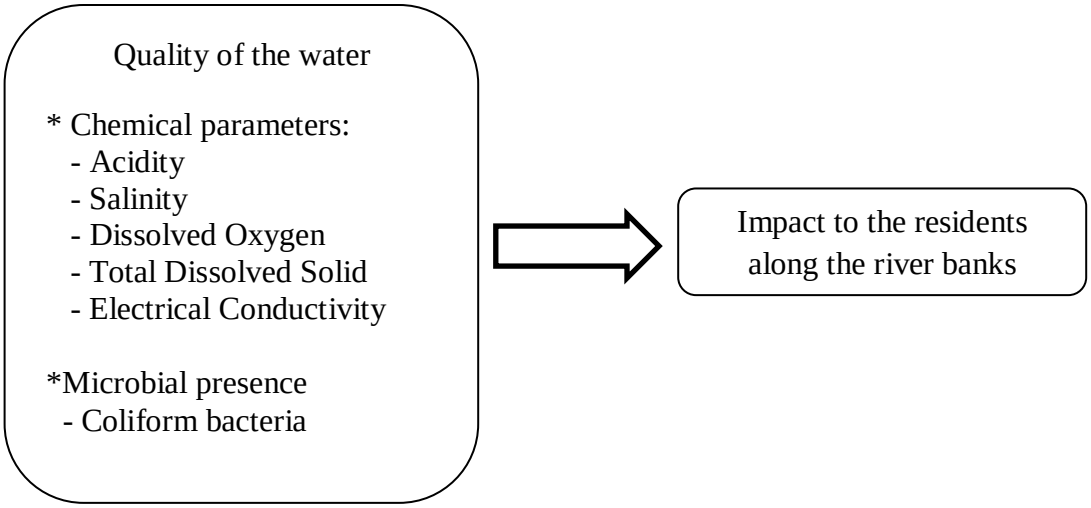
increasing number of population, water pollution is inevitable. Thus, the supply of drinking water is at risk.

The healthy aquatic ecosystem is dependent on physico-chemical and biological characteristics (Venkatesharaju, Ravikumar, Somashikar&Prakash, 2010). The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem. Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. Thus, monitoring these parameters is essential to identify the magnitude and the source of any pollution load (Thirupathaiah, Samatha&Sammaiah, 2012).

This study was conducted in Napolan River, Pagadian City which is situated at $7^0$49'6.84"N, $123^0$25'22.33"E. The people living along the riverbank used to utilize the water for their household, garden as well as livestock. But when the dumping site of garbage was relocated near the river, the people are already hesitant to use the water for the said purposes. So, to determine if the water in the river is safe for household or livestock use, the researcherconducted a study to test the quality of the water in the river.

Thus, this study was conducted to determine the microbial presence and physico-chemical properties of the water in NapolanRiver, Pagadian City and to evaluate the impact of its quality to the residents along the riverbank

Figure1: Schematic Diagram of the Study



MATERIALS AND METHODS

This study utilizeda descriptive-quantitative research design in determining the quality of the water in NapolanRiver usingthe following parameters:pH level, salinity, dissolved oxygen, total dissolved solids, and electrical conductivity and also the presence of the coliform bacteria.

Collection of water samples (50ml) wasdone one (1) day after a heavy rain at three different sampling periods namely early morning at 6:00 am, noon time at 12:00 pm, and afternoon at 6:00 pm in three different sampling sites as shown in Figure 2 andthree (3) replicates each.

The pH meter, salt meter, hand held dissolved oxygen meter, TDS meter, and conductivity meter were used in determining pH level, salinity, dissolved oxygen, total dissolved solid and electrical conductivity, respectively while presence of coliform bacteria was done by bringing the water samples immediately toPagadian City Water istrict (PCWD) laboratory for analysis. PHC method was used in determining the presence of coliform bacteria.

The t-test was utilized in determining the significant difference between the two seasons (dry and wet season) on the microbial analysis of freshwater.

A survey on the impact of water quality of Brgy.Napolanriverto the residents along the riverbanks using a self-made questionnaire.

RESULTS AND DISCUSSIONS

A. Chemical Properties

pH (Acidity)

Figure 2 shows that during dry season, the average pH of water samples taken on day 1 is 8.14, while during wet season, the average pH of water samples was 8.67. On day 2, the average pH of water during dry season was 8.15, while the average pH of water during wet season was 8.80. On day 3, the average pH of water during dry season was 8.12, while the average pH of water during wet season was 8.39. On day 4, the average pH of water during dry season was 8.14, while the average pH of water during wet season was 8.45. On day 5, the average pH of water during dry season was 8.13, while the average pH of water during wet season was 8.56.

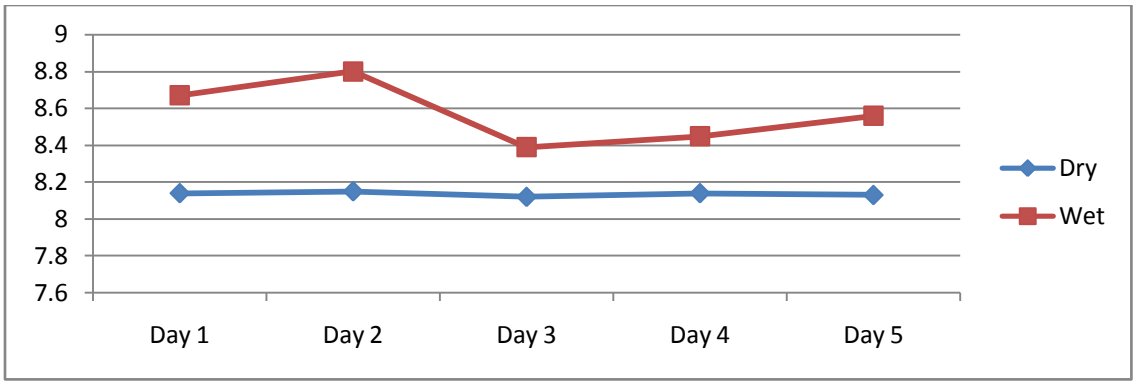


Figure 2.Average pH level of the water of Brgy. Napolanriverobtained from three periods (morning, noon & afternoon) per day during the two seasons (dry & wet)

As reflected in the figure, the pH level of water in Napolan river ranges from 8.12 to 8.80 which is near neutral (pH 7). This result supports the idea from the article "Bacterial *E.coli* Growth Media", 2003, which disclosed thatoptimal growth of *E.coli*is near neutral and that *E.coli* cells can grow well over a range of pH 5.5 to 8.5). Its minimum and maximum growth is pH 4.4 and 9.0 respectively.

Salinity

Both summer and rainy seasons have 0 ppt as shown in Figure 3. This indicates that the river water has no amount of salt in it which further reflects that water of Napolanriver is conducive for bacterial growth. This was supported by the findings of Doepner (2011) on the water of Santa Anariver which shows that as salinity increases, bacterial growth decreases.

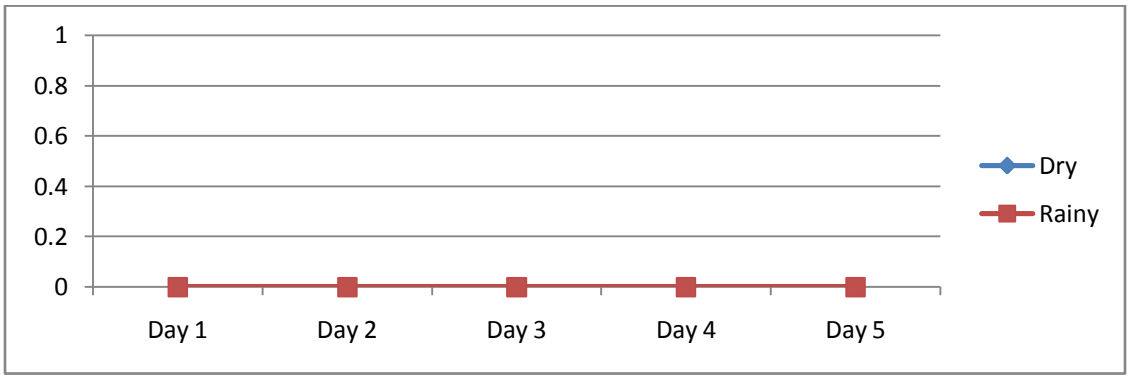


Figure 3.Average Salinity of the water of Brgy.Napolan river obtainedfrom three periods (morning, noon, afternoon) per day during the two seasons (dry & wet) in parts per thousand (ppt)

Dissolved Oxygen (DO)

Figure 4 shows that during dry season, the average DO of water on day 1 was 7.78mg/l, while the average DO of water during wet season was 7.90mg/l. On day 2, the average DO on dry season was 8.51mg/l, while the average DO of wet season was 7.85mg/l. On day 3, the average DO on dry season was 7.57mg/l, while the average DO of wet season was 8.04mg/l. On day 4, the average DO on dry season was 7.61mg/l, while the average DO of wet season was 7.86mg/l. On day 5, the average DO on dry season was 7.63mg/l, while the average DO of wet season was 7.88mg/l.

The findings of this study conforms with the study of LeChevallier (2013) which indicates that the maximum amount of dissolved oxygen present in a receiving water (streams, and rivers, etc.) is a function of temperature, atmospheric pressure, elevation, the solids content of the water, and salinity. In this study, value of dissolved oxygen that is present is relatively small. This might be because gas solubility increases withdecreasing salinity (freshwater holds more oxygen than does saltwater), ("Dissolved Oxygen", 2014).

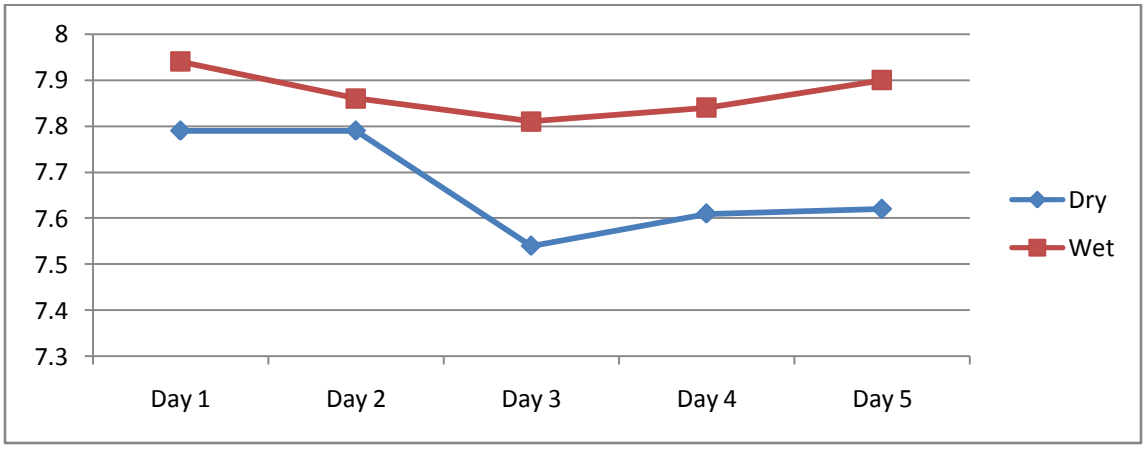


Figure 4.Average amount of Dissolved Oxygen of the water of Brgy.Napolan River obtained fromthree periods (morning, noon & afternoon) per day during the two seasons (dry & wet)

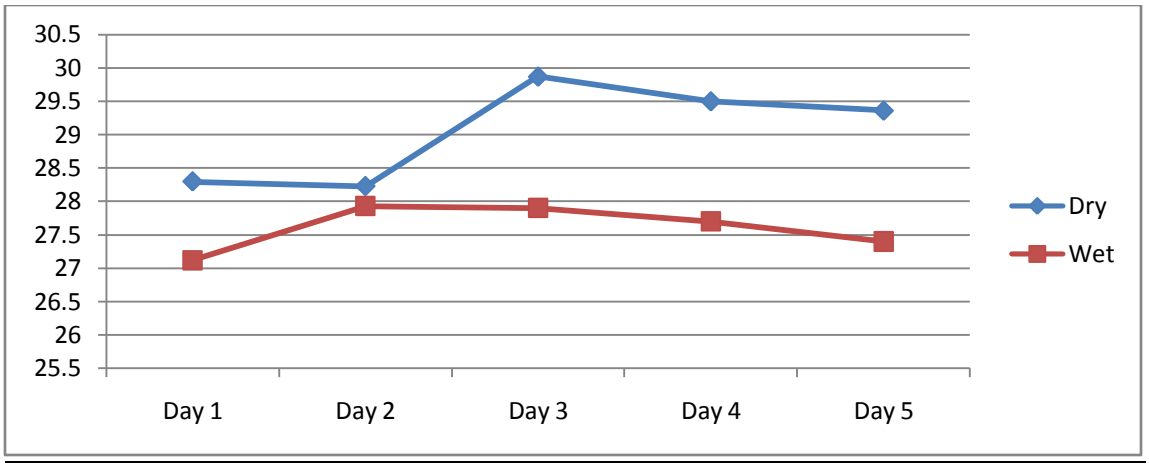


Figure 5.Average Temperature of the water of Brgy.Napolan River obtained from three periods (morning, noon, afternoon) per day during the two seasons (dry & wet)

As reflected in Figure 5, during dry season, the average temperature of water on day 1 was 28.3°C, while the average temperature of water during wet season was 27.12°C. On day 2, the average temperature on dry season was 28.23°C, while the average temperature of wet season was 27.73°C. On day 3, the average temperature on dry season was 29.87°C, while the average temperature of wet season was 27.9°C. On day 4, the average temperature on dry season was 29.5°C, while the average temperature of wet season was 27.7°C. On day 5, the average temperature on dry season was 29.36°C, while the average temperature of wet season was 26.0°C.

The data shows that the temperature of water samples ranges from 26.0 C to 29.87 C. These findings indicate that water samples are conducive to bacterial growth. This agrees with the findings of LeChevallier (2013) which emphasized that the occurrence of coliform bacteria was significantly higher when water temperatures were above 15 °C.

Total Dissolved Solids (TDS)

As shown in Figure 6, during dry season, the average TDS of the water on day 1 was 106.67ppm, while the average TDS of the water during wet season was 53.33ppm. On day 2, the average TDS on dry season was 113.33ppm, while the average TDS of wet season was 60ppm. On day 3, the average TDS on dry season was 120ppm, while the average TDS of wet season was 60ppm. On day 4, the average TDS on dry season was 123.33ppm, while the average TDS of wet season was 60ppml. On day 5, the average TDS on dry season was 130ppm, while the average TDS of wet season was 60ppm.

Pure water has nothing dissolved in it, so it has zero total dissolved solids. However, when minerals, salts, and pollutants dissolved in water, then the total amount of these dissolved solids gives an indication of water's quality ("Determining the Total Dissolved Solids of a Solution", 2008). And also according to Campbell (2009), the normal TDS of freshwater is less

than 100ppm. So this means that the water quality on dry season is poor compared to the wet season.

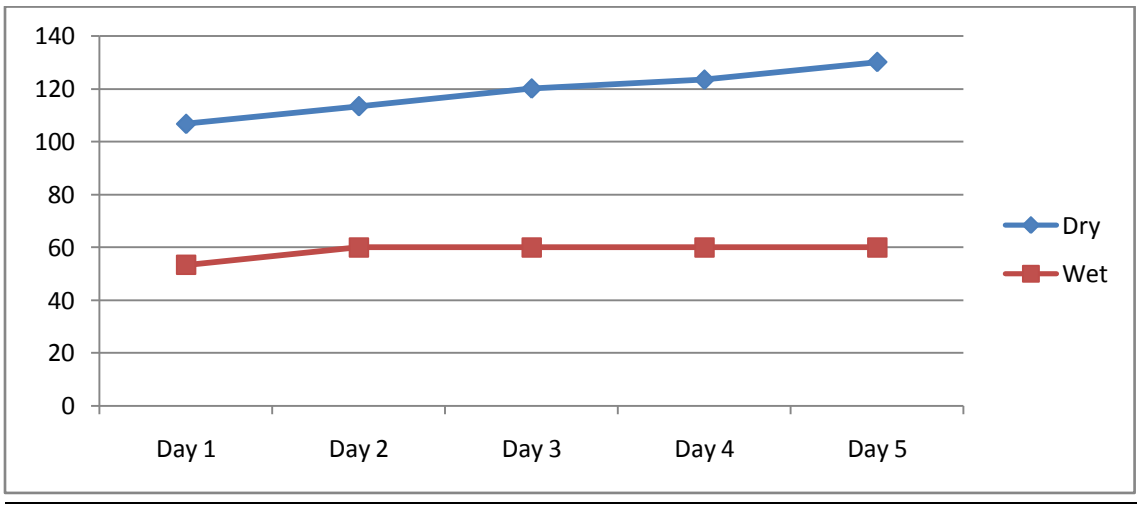


Figure 6.Average Total Dissolved Solid (TDS) of the water of Brgy.Napolanriver obtained from three periods (morning, noon, afternoon) per day during the two seasons (dry & wet)

Electrical Conductivity (EC)

As indicated in Figure 7, during dry season, the average EC of the water on day 1 was 0.16 millisiemens(mS), while the average TDS of the water during wet season was 0.13mS. On day 2, the average EC on dry season was 0.17mS, while the average EC of wet season was 0.14mS. On day 3, the average EC on dry season was 0.17mS, while the average EC of wet season was 0.15mS. On day 4, the average EC on dry season was 0.17mS, while the average EC of wet season was 0.15mS. On day 5, the average EC on dry season was 0.17mS, while the average EC of wet season was 0.15mS.

The data indicates that the electrical conductivity of the water if very small. This might be because the data were collected after a heavy rainfall such that electrical conductivity depends on the temperature of the river water. As the water's temperature increases, conductivity increases. Also, if a river does not receive enough rain,conductivity increases ("Conductivity", 2014).

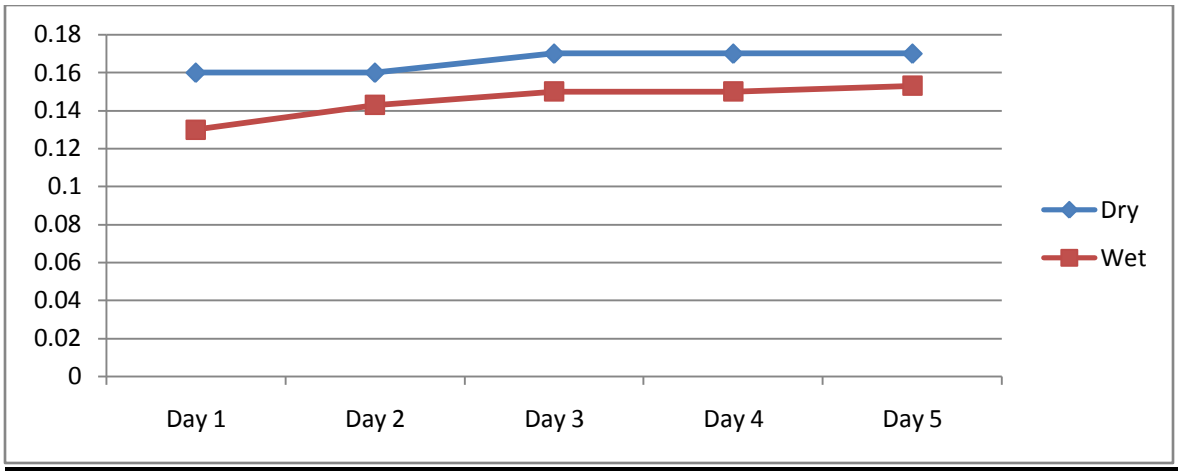


Figure 7.Average Electrical Conductivity of the water of Bryg.Napolanriver obtained from three periods (morning, noon, afternoon) per day during the two seasons (dry & wet)

B. Coliform Analysis

The results for the PHC bottle test (conducted by a technician in the PCWD) for water samples collected in the morning, noon and afternoon both during dry and wet seasons are positive for bacteriological test. Based on the said results, the color of the medium changed into charcoal black and that the sample source was found to be positive of the coli form group of bacteria, thus, it does not conform with the Philippine National Standard for Drinking Water (PNSDW).

C. Profile of the Respondents

Table 1: Profile of the Respondents in Brgy. Napolan, Pagadian City

Profile of residents	10-20 meters	21-40 meters	41 meters above
Approximate distance from the river	14 (43.75%)	12 (37.5%)	6 (18.75%)
	Below 5 years	5-10 years	11 years above
No. of years in the residence	11 (34.38%)	13 (40.63%)	8 (25%)
	Single	Married	Widow
Marital Status	5 (15.63%)	27 (84.38%)	0 (0%)
	Below 3	3-5	5 above
No. of dependents	6 (18.75%)	15 (46.88%)	11 (34.38%)
	Below 5,000	5,100-10,000	10,100 above
Approximate Monthly Income	16 (50%)	11 (34.48%)	5 (15.63%)
	Elementary	High School	COLLEGE
Educational Attainment	10 (31.25%)	14 (43.75%)	8 (25%)

Table 1 shows that out of 32 respondents of Brgy. Tugas, Pagadian City, most of them (43.57%) were 10-20 meters away from the river, 37.5% were 21-40 meters, and 18.75% were in 41 meters and above. Most of the residents (40.63%) lived along the river banks for 5-10 years, while 34.38% of them lived below 5 years, and 25% lived for 11 years and above. Majority of the respondents were married (84.38%) and few were single (15.63%). Respondents who have below 3 dependents compromise 18.75%, 46.88% have 3-5 dependents, and 34.38% have 5 dependents and above. Most of the residents' approximate annual income (50%) is below 5,000, some (34.48%) have 5,000-10,000, and few (15.63%) have 10,100 and above.

Table 2: Responses of the Respondents in Brgy. Napolan, Pagadian City regarding their awareness on water quality

Residents' Responses	1	2	3	4	5
1. Water from the river is used in watering crops.	46.87	6.25	25	12.50	9.37
2. Water from the river is used in household chores.	81.25	12.50	6.25	0	0
3. Water from the river is used as a source of drinking water for livestock.	96.77	0	0	3.13	0
4. Water from the river is used for bathing.	71.88	6.25	9.38	12.50	0
5. Water from the river is used in washing laundry.	62.50	12.50	18.75	6.25	0
6. They considered the quality of the water in Napolan,as contaminated with bacteria.	0	0	93.75	6.25	0
7. Our family has experienced amoebiasis or any water related diseases due to use of river water.	43.75	6.25	18.75	31.25	0
8. The river is used for small-scale fishing.	62.50	9.38	18.75	9.38	0
9. The river is considered as a source for a living.	87.1	0	3.23	9.68	0

Legend: 1 - strongly disagree 3 - strongly agree 5- undecided
2 - disagree 4 - agree

Table 2 indicates that some of the respondents (46.87%) strongly disagree, 6.25% disagree, 25% strongly agree, 12.50% agree and 9.37%wereundecided that the water in the river is used in watering crops as shown in Table 8. About 81.25% strongly disagree, 12.50% disagree, and 6.25% strongly agree of the respondents used the water in household chores. Most of the respondents (96.77%) strongly disagree, and 3.13% agree that the water is used as a source of drinking water. About 71.88% of the respondents strongly disagree of using the water for bathing, 6.25% disagree, 9.38% strongly agree, and 12.50% agree. Most of the respondents (62.50%) strongly disagree, 12.50% disagree, 18.75% strongly agree, and 6.25% agree of using the water for washing their laundry. Almost all the respondents (93.75%) strongly agree that the water in Napolan River is considered as contaminated with bacteria,

while 6.25% agree. About 43.75% of the respondents strongly disagree, 6.25% disagree, 18.75% strongly agree, 31.25% agree that one of their family members have experienced amoebiases or any water related diseases due to use of river water. Some of the respondents (62.50%) strongly disagree, 9.38% disagree, 18.75% strongly agree, and 9.38% agree for small-scale fishing. Most of the respondents (87.1%) strongly disagree that the river water is very important to their day-to-day living, while 3.23% strongly agree and 9.68% agree.

CONCLUSION

Based from the data gathered, the chemical properties support the growth and reproduction of coliform bacteria.The water is contaminated with coliform bacteria as reflected in PHC test; the water taken during dry season contains more Colifom Bacteria than those taken during wet season; there is a significant difference between dry season and wet season; the residents became aware that the water is not good for drinking, cooking and even for washing dishes.

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