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Water Quality Assessment of Padada Watershed, Davao del Sur, Philippines

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Abstract: Water and its importance cannot be understated. Its greatest value lies in its ability and capacity to provide biological and environmental services. Water quality is an essential parameter to be studied when the overall focus is sustainable development keeping mankind at a focal point. The study assessed the water quality and its suitability for drinking purposes in most areas of Padada Watershed. In this study, nine identified sampling points were analyzed for different physico-chemical parameters such as turbidity, BOD (Biological Oxygen Demand), TSS (Total Solid Suspended), fecal coliform, pH, temperature, DO (Dissolved Oxygen), and SC (Specific Conductivity). Results found turbidity range from 0.74-19.7 NTU; BOD range from 0.04-2.2 mg/L; TSS range from 1-411 mg/L; fecal coliform range from < 1.8-160,000 MPN/100mL. The temperature value ranges from 24.8-31.9 °C; pH value ranges from 7.05-7.92; SC ranges from 119.7-551 μS/cm while DO range from 4.87-8.14 mg/L. Moreover, the results revealed that most sampling sites exceeded the permissible limits. The highest concentration of fecal coliform indicates contamination which may cause possible human health infection. Thus, the water of Padada River Watershed is not potable for drinking and it is recommended to take beneficial steps to prevent adverse health effects to the community.

Key words: Water quality, physico-chemical, fecal coliform, turbidity, Padada Watershed.

1. Introduction

Padada Watershed is identified as one of major river basins in the entire Philippines [1, 2]. It is located at Davao del Sur, Philippines and is ranked 11th as a classified body of water in Davao Region's 27 river basins. It has an area of 125,300.72 hectares and has a length of 58.93 km.

The significance of Padada Watershed is relative to the services it provides to maintain life, sustaining and providing ecological services, and consequently supporting the economy. However, the services it provides depend on the quality for different uses such as domestic use, recreation, industry, agriculture, irrigation, and livestock watering. Because of perceived improper management of the surface water quality within the Padada Watershed, Davao del Sur, it is important to identify sources of water pollution and create strategies for maintaining its quality and continuous supply [3].

This study hopes to provide relevant information, and data, and among others for the attainment of a higher vision—a sustainable water supply. Hence the result of this study would serve as a useful reference in water quality management and forest protection.

2. Methods

Padada Watershed has a total land area of 125,300.72 hectares. It comprised of four major sub—watersheds

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namely Miral Sub-watershed, Magsaysay—Matanao Sub-watershed, Mainit Balasiao River Watershed and Matanao River Watershed as shown in Table 1. These 4 major sub-watershed channel its water to Guihing River in Hagonoy, Davao del Sur before finally draining off into Davao Gulf, see in Fig. 1.

Table 1 Municipalities Coverage of Sub watersheds in Padada Watershed, Davao del Sur, Philippines.

Subwatershed	Municipality	Area (has)
Miral (SW1)	Bansalan, Digos City, Hagonoy, Magsaysay, Matanao	19,879.74
Magsaysay-Matanao (SW2)	Bansalan, Digos City, Hagonoy, Kiblawan, Magsaysay, Matanao, Padada, Sulop, Makilala, Tulunan and Columbio	52,815.02
Matanao River (SW3)	Kiblawan, Matanao, Tampakan, Columbio, Kiblawan, Malalag,	16,984.13
Mainit-Balasiao (SW4)	Matanao, Padada, Sulop, Tampakan, Columbio	35,621.84

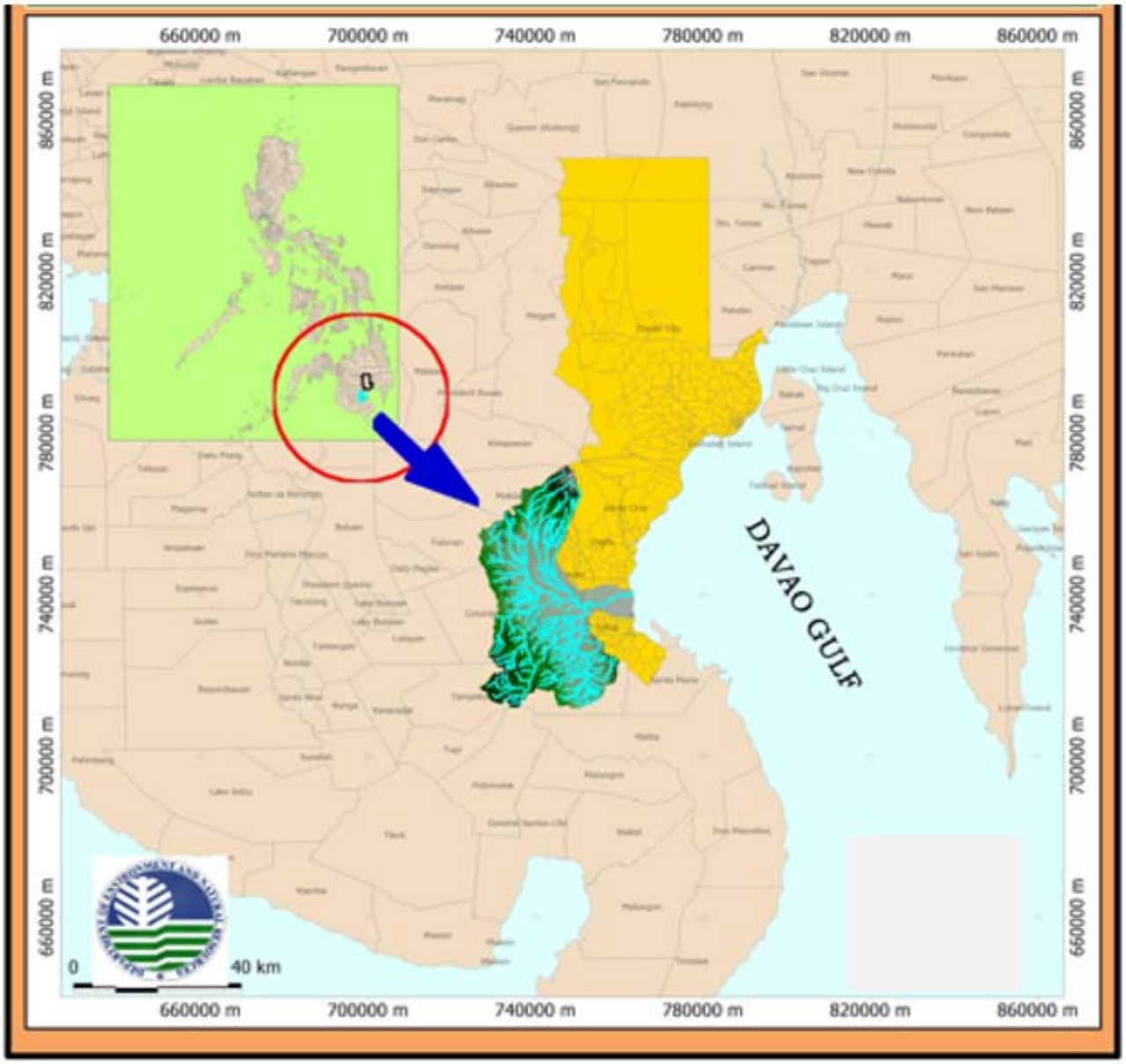

Fig. 1 Location map of the study.

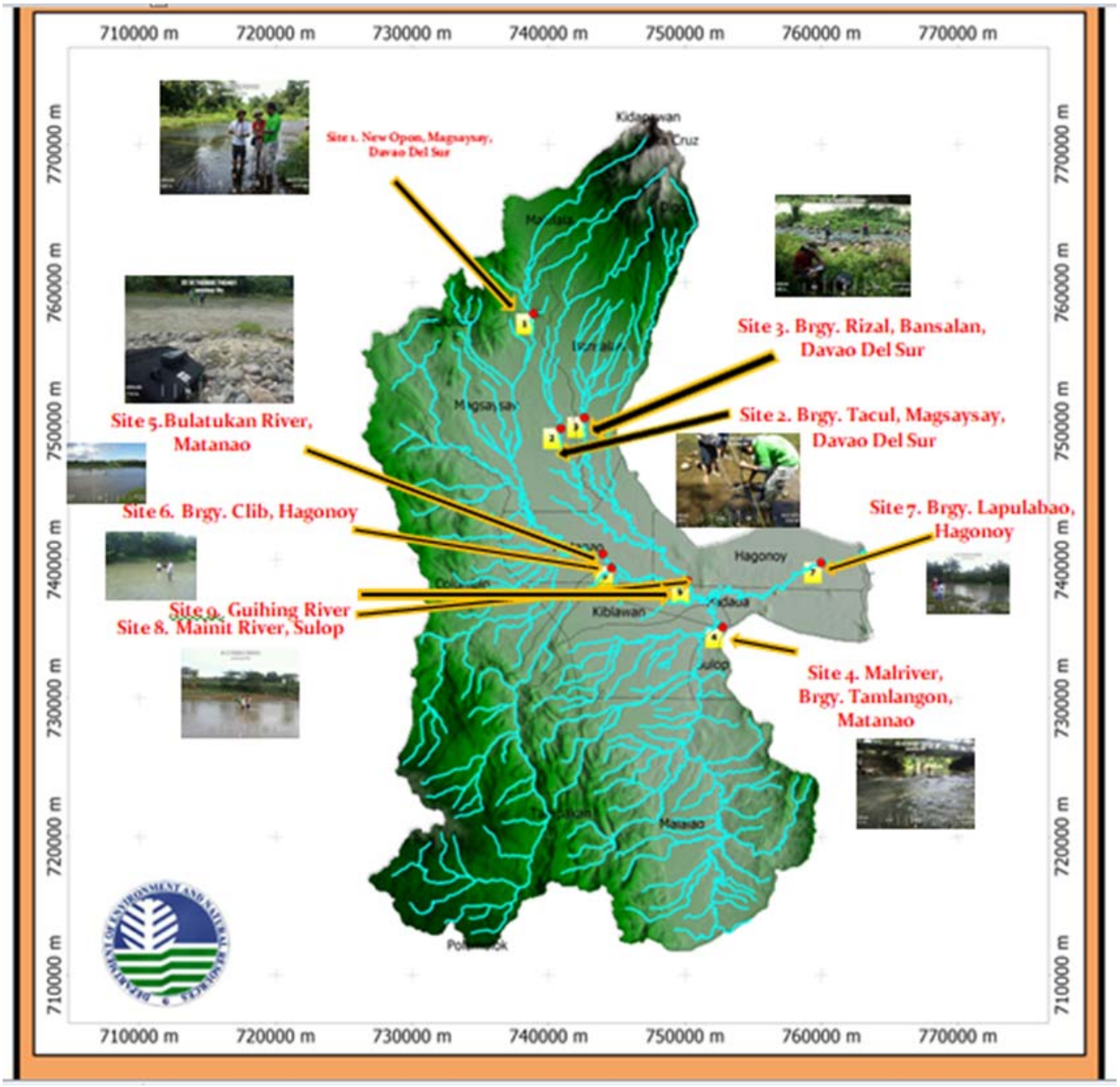

Fig. 2 Water sampling map of Padada Watershed, Davao del Sur.

Predetermined sampling sites were established and coordinated with the barangay officials for the entry of the working team. Presented in Fig. 2, the nine (9) water sampling sites for nine (9) tributaries within the Padada Watershed namely; Brgy. New Opon, Magsaysay; Brgy, Tacul, Magsaysay; Brgy. Rizal, Bansalan; Malriver, Brgy. Tamlangon, Matanao; Bulatukan River, Matanao; Brgy. Clib, Hagonoy; Brgy. Lapulabao, Hagonoy; Mainit River, Sulop; and Guihing River, Hagonoy.

In this study, stream flow meter was used, specifically, YSI Professional Plus instruments. This YSI Professional Plus handheld multi-parameter provides extreme flexibility for the measurement of a variety of combinations for DO (Dissolved Oxygen), conductivity, specific conductance, salinity, resistivity, TDS (Total Dissolved Solids), potential hydrogen (pH), Oxidation -reduction potential (ORP), and temperature.

In this study, water quality parameters measured were temperature, potential hydrogen (pH), Specific

Conductivity (SC), dissolved oxygen (DO) concentration (mg/L), and salinity.

Other analyses of quality measurement like microbial agents, BOD(Biological Oxygen Demand), among others have to be sent to the laboratory at the DOST-XI (Department of Science and Technology), Dumanlas, Bajada, Davao City and Davao Analytical Laboratories, Inc., McArthur Hi-way, Corner Union Avenue, Matina , Davao City, Davao del Sur, Philippines.

3. Results and Discussion

This study assessed the water quality of Padada Watershed, Davao del Sur, Philippines. All established and identified sampling sites were evaluated using these physico-chemical parameters, namely: DO (mg/L), pH (in pH units), BOD (mg/L), temperature (°C), TSS (Total Solid Suspended, mg/L), turbidity (expressed in NTU), SC (µS/cm), and fecal coliform (MPN/100 mL). In terms of units of measurement, this study adapted Philippine government guidelines as stated in DAO (DENR (Department of Environment and Natural Resources) Administrative Order) 2016-08 [4] and Water Quality Guidelines and General Effluent Standards of 2016 [5, 6, 9]. Table 2 presents the water quality analysis of Padada Watershed, Davao del Sur, Philippines.

3.1 DO

DO usually expressed in milligrams of oxygen per liter of water, or mg/L. Result shows that majority of the 9 sampling sites failed in this environmental monitoring parameter as outlined in the Philippine Government's regulation specifically DAO 2016-08. The exceptions are Brgy. Lapulabao, Hagonoy and Brgy. New Open, Magsaysay which are classified AS Class AA-C. This water classification is intended for public water supply class 1, recreational, fishery water, agriculture, irrigation, and livestock watering.

3.2 Alkalinity Level (pH)

The pH value of the nine (9) sampling sites is generally alkaline or has basic pH value of between 6.5-8.5. Most freshwater fish prefer this level of alkalinity to live and reproduce. Philippine government regulations (specifically, DAO 2016-08) state that Class AA to Class C water should have a pH value between 6.5-8.5. In other words, the pH results of the nine (9) sampling site placed Padada Watershed in Class AA to Class C category or classification.

3.3 BOD

BOD indicates a greater degree of organic pollution and most of the aquatic organisms cannot survive if the BOD level is above 7 mg/L [17]. The 9 sampling sites, were classified as Class AA and Class A based on DAO 2016-08. DO in all sampling sites failed on DAO 2016-08 standards except Brgy. Lapulabao, Hagonoy which is under DAO permissible limits.

3.4 Temperature (°C)

The highest rate of recorded temperature in all sampling sites is at Malriver, Brgy. Tamlangon and Bulatukan River, Matanao; these rivers are classified as Class C. The rest of the sampling sites are classified under Class B [7].

3.5 Total Suspended Solid (TSS)

TSS measure the concentration of undissolved solid particles in water, such as silt, decaying plant and animal matter, and domestic and industrial wastes [8]. In terms of TSS, Brgy. New Opon, Magsaysay; Bulatukan River, Matanao; Brgy. Rizal, Bansalan; Brgy. Tacul, Magsaysay are classified as Class AA while Malriver, Tamlangon, Matanao and Brgy. Lapulabao, Hagonoy falls under Class A water classification. The rest sampling sites were classified to Class B and D.

3.6 Turbidity

The highest turbidity is in Guihing, Digos City, Davao del Sur with 19.7 NTU (nephelometric turibidity units). It means that the clarity of the water

Table 2 Water quality analysis in all sampling sites of Padada Watershed, Davao del Sur, Philippines.

Sampling site	DO	pH	BOD	Temp.	TSS	Turbidity	SC	Fecal coliform
New Opon, Magsaysay	4.9*	7.67*	2.1*	24.8*	1*	0.74*	169.6**	3,500**
Bulatukan River, Matanao	7.10**	7.69*	0.04*	31.3**	8*	0.9*	432.6**	7.8**
Brgy. Rizal, Bansalan	8.14**	7.50*	1.6*	29*	3*	0.9*	119.7**	54,000**
Brgy. Tacul Magsaysay	8.13**	7.05*	2*	24.8*	10*	4.1*	186.6**	160,000**
Mainit River, Sulop	6.09**	7.65*	2.2*	30.5**	411*****	3.5*	551*	<1.8**
Brgy. Lapulabao, Hagonoy	4.87*	7.41*	1.5*	30.5**	38**	3.1*	351.2**	130**
Malriver, Brgy. Tamlangon	7.91**	7.92*	2.2*	31.9**	30**	4.5*	243.1**	54,000**
Clib, Hagonoy	7.71**	7.25*	1*	29.9*	53***	8.1**	354.2**	240**
Guihing, Hagonoy	7.10**	7.55*	1.6*	30.8**	290*****	19.7**	469**	7,900**

Source: Data were analyzed by DOST XI, Dumanlas, Bajada, Davao City and Davao Analytical Laboratories, Inc., McArthur Hi-way, Corner Union Avenue, Matina, Davao City.

DO: * Passed means Class AA-C not exceeds to 5 mg/L; ** Failed.

pH: *Class AA-B means 6.5-8.5 ;**Class C means 6.5-9.0; *** Class D means 6.0-9.0.

BOD: *Class AA means 1 mg/L; ** Class A means 3 mg/L.

Temperature (°C) : * Class AA-B means 26-30°C, ** Class C means 25-31°C, ***Class D means 25-32°C.

TSS: *Class AA means 25 mg/ L, **Class A means 50 mg/ L,***Class B means 65 mg/ L, ****Class C means 80 mg/L,*****Class D means 110 mg/ L.

Turbidity: * 5 NTU means passed; **greater than 5 NTU means failed.

SC: *between 50-1,500 µS/cm means natural waters; **500 µS/cm means interior streams.

Fecal coliform: *<1.1 MPN/100 mL (Dao Standards); **failed.

is low. The lowest turbidity level (read: highest water clarity) is in New Opon River. This indicates that the lower the turbidity values the higher is the water clarity while the higher values indicate lower water clarity [10, 14]. Based on the standards, less than 5 NTU requires an effective disinfection and ideally, for drinking water, it must below 1 NTU [12, 15].

3.7 Specific Conductivity (SC)

The natural waters are found to vary between 50 and 1,500 µS/cm [13]. The coastal streams have SC values of 100 µS/cm while the interior streams range up to 500 µS/cm. Only Mainit River, Sulop is considered natural waters while the 8 sampling sites are classified as interior streams.

3.8 Fecal Coliform

The total coliform intended for drinking is < 1.1 MPN/100 mL [11, 16]. Based on the result of the nine sampling sites of Padada Watershed, it is greater than the standard which shows that the nine (9) sampling sites are contaminated (see Table 2).

4. Conclusion and Recommendations

Based on the foregoing results, Padada Watershed is compromised by water contamination. Water quality did not meet the standards set by the Philippine Government specifically DAO 2016-08, which defines the environmental monitoring parameters for water quality assessment. Further, Padada Watershed is classified under Class A-C; which indicated for Public Water Supply Class 11, recreational water class 1, fishery water, recreational water class 11, for agriculture, irrigation, and livestock watering.

Thus, it is recommended the utilization of this study in crafting watershed management plan; conducting a periodic sampling study to attain its physico-chemical pattern, and conducting strategic planning for maximal use of the water resources especially for its domestic use (potable water) and other uses. The

ultimate goal is sustainable support for the projected growing water needs of the community in the said watershed area.

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