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Water Quality Assessment of the Benig River: Implication to Environmental Management

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ABSTRACT

The problem of climate change and scarcity of water supply is currently experienced globally and in the Philippines particularly in Regions I, II, and III. Thus, in response to this problem, the Tarlac City Environment and Natural Resources Council (TCENRC) launched a project for the adoption of Benig River into a watershed. This will serve as an alternative water source for the people of Tarlac.

However, effluent wastes are continuously discharged to the Benig River by piggery farms at the vicinity. To check its present condition and adverse effects to health and in the environment, water samples were drawn at three sampling points: the upstream, downstream, and the effluent. The samples were analyzed for oil and grease (O/G), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and dissolved oxygen (DO) as test parameters. The data obtained in the laboratory tests were compared, correlated, and interpreted based on existing laws and standards of the Department of Environment and Natural Resources. The results will be used as an initial base data for the conduct of continuous monitoring of the Benig River for its improvement or reclassification. Hence, this study.

INTERPRETATION OF RESULTS

Three (3) water samples were drawn from the Benig River: Upstream and Downstream portion interpreted using DAO 34 and the effluent sample from a piggery at Sto. Domingo using DAO 35 standards.

From DENR Memorandum Circular 13 of 2004, the Benig River is classified as Class B (Recreational Water) for Upstream and Class D (For Agricultural Irrigation) for Downstream. These classifications are found in DAO 34 of 1990 otherwise known as the Revised Water Usage and Classification. Inland freshwaters are classified as follows:

TABLE 1. DENR Administrative Order 34 Classification of Inland Waters

Class AA **Public Water Supply Class I.** This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A **Public Water Supply Class II.** For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
Class B **Recreational Water Class I.** For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes).
Class C 1) **Fishery Water** for the propagation and growth of fish and other aquatic resources; 2) **Recreational Water Class II** (Boatings, etc.) 3) **Industrial Water Supply Class I** (For manufacturing processes after treatment).
Class D 1) For agriculture, irrigation, livestock watering, etc. 2) **Industrial Water Supply Class II** (e.g. cooling, etc.) 3) Other inland waters, by their quality, belong to this classification.

TABLE 2. Laboratory Data of Benig River-Upstream

Sample Commodity: Benig Water Upstream
Classification : Class B
Description : Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes).

PARAMETERS	METHODOLOGY	DAO 34 STANDARDS FOR CLASS B	RESULTS IN PPM (mg/L)	REMARKS
Dissolved Oxygen (DO, minimum)	Modified-Azide (Winkler Method)	5.0	6.7	Passed
Chemical Oxygen Demand (COD)	Open-Reflux Dichromate Digestion	-	35	-
Biochemical Oxygen Demand (BOD_5)	Winkler Method (5-day incubation)	5.0	<2	Passed
Oil and Grease	Partition-Gravimetric	1.0	1.1	Slightly above the maximum limit; Failed

The upstream portion represented the "uncontaminated" part of the river. The oxygen-demand parameters DO, COD, and BOD are within acceptable levels. The theoretical values of BOD based on COD values should be from 14.0-21.0 mg/L. The average theoretical BOD value is 17.5 mg/L. Comparing the COD-BOD ratio obtained in the test is just 5.7%, below the ideal level of 40-60%. This means that the water sample has a low biodegradable organic matter. The possible cause for the increase in COD level is the mineral content as oxidizable inorganic constituents. The oil and grease content with 1.1 mg/L, on the other hand, has slightly exceeded the maximum tolerable limit of 1.0 mg/L. Continuous testing should be done to monitor and improve the water quality of the upstream portion.

TABLE 3. Laboratory Data of Benig River-Downstream

Sample Commodity: Benig Water Downstream
Classification : Class D
Description : Industrial Water Supply Class II. For agriculture, irrigation, 1 livestock watering.

PARAMETERS	METHODOLOGY	DAO 34 STANDARDS FOR CLASS D	RESULTS IN PPM (mg/L)	REMARKS
Dissolved Oxygen (DO, minimum)	Modified-Azide (Winkler Method)	3.0	2.7	Slightly below The minimum level; failed
Chemical Oxygen Demand (COD)	Open-Reflux Dichromate Digestion	-	52.0	-
Biochemical Oxygen Demand (BOD_5)	Winkler Method (5-day incubation)	10.0	11.0	Slightly above the maximum tolerance level; failed
Oil and Grease	Partition-Gravimetric	5.0	1.2	passed

The downstream portion of the Benig River falls under Class D, for agricultural and irrigation purposes. This is the portion of the river where effluent discharges mix with the river water. The oxygen-demand parameters have exceeded the tolerance limits. The theoretical BOD values based from the COD is from 20.8-31.2 mg/L with an average value of 26.0 mg/L. The COD-BOD ratio is at 21 % slightly below the ideal ratio of 40-60%. The oil and grease of 1.2 mg/L on the other hand, is within acceptable level.

Comparing the Upstream and Downstream portions of the river, an increase of 17.0 ppm for COD, around 10 ppm for BOD and decrease in DO level at 4 ppm were noted. These indicate that the piggery waste effluent continually discharged at the Benig River contributes to water pollution.

A slight increase of 0.1 ppm for O/G was noted. However, the increase in COD and BOD values are due to other oxidizable organic matter other than oil and grease.

Since the effluent discharge is in between the Upstream and Downstream portion, the sample is categorized under Class C of DAO 35 for Wastewater-effluent Standards.

TABLE 4. Laboratory Data for the Effluent Sample

Sample Commodity: Effluent Discharge from Sto. Domingo
Classification : Class C
Description : Inland waters NPI (New Proposed Industry)

PARAMETERS	METHODOLOGY	DAO 35 STANDARDS FOR CLASS C	RESULTS IN PPM (mg/L)	REMARKS
Dissolved Oxygen (DO, minimum)	Modified-Azide (Winkler Method)	-	<2.0	failed
Chemical Oxygen Demand (COD)	Open-Reflux Dichromate Digestion	100	640	failed
Biochemical Oxygen Demand (BOD_5)	Winkler Method (5-day incubation)	50	283	failed
Oil and Grease	Partition-Gravimetric	5.0	5.6	Slightly above the maximum tolerance level; failed

All oxygen-demand parameters exceeded the allowable limits. The experimental COD-BOD ratio is at 44%. Theoretically, the ideal BOD value based from COD value of 640 ppm should be between 256-384 ppm. The oil and grease content of the sample also has exceeded the maximum allowable limit.

CONCLUSION

Three (3) water samples were drawn namely: Benig River-Upstream which assessed the water quality of the "uncontaminated" sample; Effluent Discharge from Sto. Domingo Stock Farm to check if the piggery conducts proper treatment and disposal; and Benig River-Downstream, the "mixture" of water from the upstream and effluent discharge.

The Benig River falls under two categories based from DENR Memorandum Circular 13 of 2004. The upstream is classified as Class B while the downstream portion as Class D following the rules and standards prescribed in DAO 34. The effluent discharge on the other hand, follows a different set of standards which are under DAO 35. For purposes of classification and reclassification, the following parameters are to be considered: DO, pH, BOD, and total coliforms; and for effluent samples-color, temperature, pH, COD, BOD, solids, surfactants, oil and grease, phenolic substances, total coliforms, heavy metals, and pesticide residues depending on the nature of the industry. Water sampling was done last October 19, 2007. Four test parameters were tested to assess the level of pollution in the Benig River. These are dissolved oxygen, chemical oxygen demand, biochemical oxygen demand, and oil and grease. DO, COD, and BOD are oxygen-demand parameters. High DO levels indicate that the water sample is clean with less microbial activity. High COD and BOD levels on the other hand, indicate that the water sample contains appreciable to high amounts of oxidizable matter, particularly organic components. During microbial activity, microorganisms consume these organic materials as food. Dissolved oxygen is utilized in the process forming carbon dioxide and water. The oil and grease is one of the components that contribute to the increase in COD and BOD.

Generally, the water quality of the upstream portion of the Benig River is within the permissible level complying with the Standards indicated in DAO 34-Class B. However, the oil and grease content of 1.1 ppm is slightly high compared to the maximum tolerable limit of 1.0 ppm.

The effluent sample discharged from Sto. Domingo Piggery Farm exceeded the normal levels of DO, COD, BOD and O/G, hence failed the allowable limits in DAO 35. Regular monitoring should be done to check if proper treatment is conducted.

The downstream water sample slightly exceeded the normal levels. However, the oil and grease content is within acceptable level.

The effluent discharged from the piggery farm is a source of pollution in the Benig River. However, the oil and grease content in the effluent does not contribute much to the total oil and grease found in the water sample collected from the downstream. The COD and BOD levels increased as it approaches the downstream. Nevertheless, the oil and grease content is not a significant source for increase in these values.