



# WATER QUALITY IN SELECTED BARANGAY IN BAY LAGUNA: INPUT FOR A PROPOSED REHABILITATION PLAN

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## ABSTRACT

*The study tried to determine the water quality in Bay Laguna as basis for quantity and quality of fish caught per unit effort and to propose a Laguna de Bay Water Rehabilitation Plan to be used for controlling the continued deterioration of water quality that affects the quantity and quality of fish. The respondents of the study were knowledgeable and capable of answering the questionnaire and interviews. The local community may benefit from this research being a part of the rehabilitation program and from the livelihood program to be developed by the LGUs. The fishermen and the local government unit can develop a plan on how they will provide a good quality of water as a basis for the acceptable quantity/quality of fish they can catch per unit effort in the lake. Analysis revealed that the Phosphate as  $PO_4\text{-P}$ , Nitrate (as  $NO_3\text{-Nitrogen}$ ), Chloride, and Lead of the water analysis has a direct relationship to the appearance, odor, and quantity of the fish caught in Laguna De Bay. It was found that there is a significant relationship between the laboratory results and the quantity/quality of fish catch per unit effort and the quality of water.*

**INDEX TERMS**— quality of water, quantity/quality of fish catch in laguna de bay

## 1 INTRODUCTION

Fish plays role in our lives. It is not only a source of protein and healthy fats. It also gives an essential nutrient like omega – 3, fatty acids that are good for our heart, Iodine, vitamin D, and calcium. Quality of water defines what quality of fish the river will produce. When the water is contaminated, then it will affect the species living in it. According to the United States Environmental Protection Agency (2017) "Water quality affects people, it affects directly from the beach, fish, or dig clams, and indirectly as they enjoy the wildlife and scenery of the area." It shows how important the quality of water is to the entire ecosystem inland and in water.

The status of Laguna De Bay is a very alarming and important issue. Factors contributing to the deterioration of the lake are commonly made by human improper practices although other factors like natural phenomenon and a large number of fish pens are also one of the reasons for the deterioration. According to PEMSEA Report, last 2013 status of the lake water quality is in the class C level means the quality of water in locations tends to be fair, leading to sufficient habitat conditions for aquatic life but, it rates the fisheries level into class F which means there is a very few or no indicators meet desired levels and quality of water in these locations tends to be very poor, most often leading to

unacceptable habitat conditions for aquatic life. Even though the water quality and the level of the fisheries are at the acceptable level we cannot deny that

the lake needs to rehabilitate to stop the deteriorations and to have the prevention methods and actions to improve the health of the lake ecosystem. The report and the conducted interview are giving specific problems that need to take action.

Disclosed were several issues based on an initial interview gathered by the researcher from fishermen in the area where they depend on fishing for a living. Dole out issues from a fraction of fishermen population in the subject localities, and according to these fishermen they have been facing problems that greatly affect the quantity and quality of caught marine life, fish per se. In line with the above discussion, the researcher sought an answer to find out the water quality in Bay Laguna as the basis for the quantity and quality of the fish catch.

## 2 OBJECTIVES

This study is about the importance of water quality for the quality of fish and increased quantity of fish catch per unit effort (CPUE) by the fisherman. Aiming to determine the factors affecting the quality of fish and the continuous decreasing



number of fish catch. It focuses on the water quality in producing an acceptable quantity of fish and the good quality of fish in Sto Domingo Bay, Laguna.

In the case study about Laguna de Bay of Lasco and Javier (2017), Fish production in the lake has declined over the years due to the following factors: operation of the hydraulic control structure which prevented the inflow of seawater that is vital in the natural primary productivity of the lake, decline in algal primary productivity, the introduction of exotic fish species, the use of destructive fishing gears and domestic and industrial pollution that led to rapid deterioration of water quality.

According to the Laguna de Bay Ecosystem Health Report Card (2013), the quality of the water measures using indicators to identify the life of the habitat in the river. In the said year, Laguna de Bay scored a low passing mark, 76%, a C-, in water quality. The Lake consistently is within the Department of Environment and Natural Resources (DENR) guidelines for class C waters in dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrate, and total coliforms. However, it scored 0% in chlorophyll and 59% in phosphates (comes from agricultural runoff, animal waste, and sewage. It is also one of the main components of synthetic detergents). Water quality was affected by high population and industrialization. The Lake received fishing mortality (F) of (48%), with 53%, 68%, and 22% scores in fish native species composition, zooplankton ratio, and catch per unit effort (CPUE), respectively. Invasive fish species and competition among fisherfolk contributed to the low scores.

It has been classified as Class C waters, indicating good for fishery production. However, results of water quality monitoring studies have shown in the annual report that many water quality parameters have exceeded the standards prescribed for class C waters indicating the worsening condition of the lake. Among these are temperature, turbidity, dissolved oxygen, ammonia, nutrients, coliform bacteria, and heavy metals. This continued deterioration in water quality must be stopped by identifying and controlling the factors causing it.

According to Tolga Cavas (2008), in his book entitled "In vivo genotoxicity of mercury chloride and lead acetate: Micronucleus test on acridine orange-stained fish cells" that the effects of mercury, chloride, and lead to the fish evaluated in vivo using the micronucleus (MN) assay on acridine-orange (AO) stained peripheral blood erythrocytes, gill and fin epithelial cells of *Carassius auratus*. Fish were exposed to three different concentrations of the said elements and became contaminated.

Cinco (2017) mentioned in an article in Philippine Star many factors are contributing to the death of the Laguna de Bay and it is becoming a public hazard. Former President Gloria Macapagal Arroyo made the rehabilitation of Laguna de Bay a "presidential priority." Based on the effects of the typhoon Ondoy she raised a lot of funds for the rehabilitation but, unfortunately, when P-Noy became president in 2010, he ordered the deal to be dropped. Sadly, the bidding for the project failed when the pre-qualified bidders – Trident Infrastructure and Development Corp. (composed of Ayala Land Inc., Megaworld Corp., Aboitiz Equity Ventures Inc., and SM Prime Holdings Inc.), and San Miguel

Holdings Corp. and Alloy Pavi Hanshin LLEDP Consortium backed out. As a result, not one flood control structure was built.

In the first State of the Nation Address by President Duterte, he stated that he wanted issues on watershed destruction, land conversion, and pollution in Laguna de Bay stopped and he asked the DENR accomplishment after the clearing operations, mentioning the massive number of fish pens affecting the low average of (CPUE) Philippine Star, (2018).

Due to the industry development, the quality of the Laguna de Bay diminishes and can be possibly a cause of its death. Humans need water and food to survive but, how do humans survive when the water where the food catches die. Sooner or later, the quality of the fish caught in Laguna de Bay will become contaminated and not safe to eat or maybe the number of fish to catch is undetermined.

### 3. METHODOLOGY

This study used the causal research design in determining the water quality in selected Barangays Along Bay Laguna as a basis for the quality and quantity of fish catch needed data were extracted through the designed questionnaire, and a portion shall exhibit the quality of water result-laboratory based through the testing done by Alpha Laboratory Calamba Phils Corps. The result from Alpha Laboratory Calamba Phils Corps testing will tell of the water quality and shall give veracity whether it affects the quality of fish and the number of fish catch per unit effort of the fishermen of the subject places.

In the study, the fishermen in Laguna de Bay were selected based on the given list by the "Samahan ng mga Mangangisda ng Bay". They are chosen based on their experiences and being fishermen for more than 30 years, in the subject area. Five (5) selected fishermen to provide an audio-recorded oral interview. The audio recorded oral interviews have different lengths of time and the number of words in the transcription. The audio-recording oral interviews were transcribed into printed utterances are the primary data collection strategy to obtain information about the Laguna de Bay concerns of the fishermen. The transcribed oral interviews were also a consideration in the data gathering to better equip this study of evidence that will give veracity/reliability of the answers to what has been hypothesized in the preceding chapter and as a basis for the proposal in Laguna De Bay water rehabilitation.

The researcher identified (15) fishermen in the area, and Alpha Laboratory Calamba Phils Corps evaluator for water quality for safe fishing and pollutants level from Real Calamba, 4020 Laguna. As respondents and shall be given survey questionnaires.

### 4. LITERATURE REVIEW

According to [1], (2008) discusses in his study the factors that affect the quantity of fish caught in laguna de bay. The researcher made an observation of fish caught in a fish cage and in the open area determining the quantity of fish caught and the availability of Zooplankton which is the major food source of the fish. In line with this study, it connects the availability of food supply in the area and the content of the water for fish



production.

The water quality can be attributed to the continued rise in human population leading to an overall degradation of water quality and serious modifications in land use characteristics. Kaur impact of human waste can be a source of water deterioration that needs to focus on the linkages between land and water use [2].

According to [3], (1998) the study is about the effects of bacteria on the fish in Laguna de Bay. Bacteria causes the disease to the fishes that gives foul odor. It is the effect of human practices like dumping of industrial and agricultural waste. This study relates to the impact of the waste collected by the fishermen in the area as of this current study.

According to [4], Heavy metals such as lead (Pb), chromium (Cr), iron (Fe), mercury (Hg), etc. are of special concern because they produce water or chronic poisoning in aquatic animals. These are the heavy metals produced by some of the waste disposed of by human activities that mainly concern in the deterioration of water deterioration and production of good quality of fishes

Laguna de Bay scored a low passing mark. 76%. a C-, in quality the bay consistently is within the Department of Environment and Natural Resources guidelines C waters in Dissolved Oxygen (DO). Biochemical oxygen demand (BOD), Nitrate, and Total Coliforms. However, it scored in Chlorophyll and in Phosphate Water quality was affected by high population and industrialization. The lake received an F in Fisheries (48%), with a 53%. 68%, and 22% in fish native species composition. zooplankton ratio. and catch per unit effort respectively. Invasive fish species and among fisher folks contributed to low scores [5]

[6] conduct a study about the freshness of the fish based on the appearance. He mentioned the physical attributes of the fish to determine its freshness.

In the study of the effects of human practices to the increasing of chemical content like lead, mercury, chloride and others to the quality of water in production of fish. The study results in determining the levels of total solid suspended in the water [7].

They study the effects of industrialization and Eutrophication on the quality of water that affects the quality of fish in the laguna de bay [8]. The relationship of this current study is the discussion of the effects of toxic in the water quality like: Nitrates, Phosphates, Chloride, and Lead.

Based on POS Sector, Restaurant Management Software [9] discusses the quality of fish on how it is said to be fresh in seven (7) observable characteristics of good quality of fish. These are; the smell of fresh fish is specific to its origin (sea, lake, river, fish pond) and it is pleasant and neutral. Eyes of fresh fish are bulging and shiny. Gills and fins of fresh fish are moist. Healthy gills are of a nice, bright red color. Skin in live and fresh fish is moist, must be unharmed and have a naturally metallic glow. Scales must be tightly attached to the body. The surface of healthy, fresh fish must be tight and shiny so that fish slides out of your hands. Slime is equally distributed over the fish, it is clear and odorless. The body of a fresh fish is firm and has a specific

consistency and appearance. When pressed it should bounce back. And Belly of a live and fresh fish is shiny and undamaged, and the anal opening is tight.

## 5. DISCUSSION

### Result of laboratory testing in terms of levels of Phosphate, Nitrates, Lead, Chlorine and Lead in water quality.

Analysis	Analytical Method	Results	Remarks
Phosphate (as $PO_4-P$ )	Ascorbic Acid Method, SMEWW 4500-P E	0.119 mg/L	Passed
Nitrate (as $NO_3$ -Nitrogen)	Nitrate Electrode Method, SMEWW 4500- $NO_3$ -D	1.021 mg/L	Passed
Chloride	Tiremetric (Argentometric SMEWW part 4500 Cl-)	43 mg/L	Passed
Lead	ICP Method, SMEWW 3120 B	<0.001 mg/L	Passed
Total Remarks: Passed			

Table 1 shows the Analytical Test Results for Wastewater, in terms of Phosphate as  $PO_4-P$  with analytical method of Ascorbic Acid Method, SMEWW 4500-P E has a test result of 0.119 mg/L and below the standard measurement of 1 mg/L has a remark of Passed. The Nitrate (as  $NO_3$ -Nitrogen) with analytical method of Electrode Method, SMEWW 4500- $NO_3$ -D has a test result of 1.021 mg/L and below the standard measurement of 14 mg/L has a remark of Passed. And the Chloride with analytical method of Tiremetric (Argentometric SMEWW part 4500 Cl-) has a test result of 43 mg/L and below the maximum measurement of 250 mg/L has a remark of Passed. While the Lead with analytical method of ICP Method, SMEWW 3120 B has a test result of <0.001 mg/L and below the standard measurement of 0.1 mg/L has a remark of Passed.

According to the Laguna de Bay Ecosystem Health Report Card (2013), Laguna de Bay has a level of 59% of Phosphates and an acceptable level of nitrates that indicates it is still a good level for fishery or fish production. Tolga Cavas book of "In vivo genotoxicity of mercury chloride and lead acetate: Micronucleus test on acridine orange stained fish cells" Mentioned the effects of lead and chloride to the fish and how do these factors (elements) affect the quality of fish.

Although the level of the said elements in the waste water is acceptable and passed for fish production it is still cannot deny that the level is alarming and needs to be controlled.



**Table 2. Level of quantity of fish catch per unit effort (CPUE) in Laguna De Bay.**

Statements	Mean	SD	Remarks
Fish catch is a considerable number.	4.33	0.49	Always
More fish are caught in areas away from companies.	4.93	0.26	Always
Fish catch is at average number, size and good quality.	4.47	0.52	Always
Fish catch does not indicate any sign of poisoning.	3.87	0.64	Often
It usually takes 2 hours or more before the first catch.	4.93	0.26	Always
<b>Weighted Mean: SD</b>	<b>4.51: 0.601</b>		
<b>Remark</b>	<b>Always</b>		

The fisherman agreed that more fish are caught in areas away from companies and usually takes 2 hours or more time before the first catch (M=4.93, SD=0.26) based on the respondents' perception in terms of fish caught. Fish catch is at average number, size and good quality (M=4.47, SD=0.52). Fish catch does not indicate any sign of poisoning (M=3.87, SD=0.64).

The weighted mean of 4.51 and with supported value of the standard deviation of 0.601 interpreted as very high indicated that the fisherman often sees the level of effect of water quantity of fish caught in Laguna De Bay. It implies that the quantity in fish in Sto. Domingo Bay, Laguna is still acceptable and defines the quality of water as safe to produce fish. It also inferred that the number of fishes is high enough in the area away from the companies even though it takes time to get hold of the first fish catch.

**Table 3. Level of quality of fish catch in terms of appearance.**

Statements	Mean	SD	Remarks
The color of the skin is shiny. It has a naturally metallic glow.	4.60	0.51	Always
The colors of the gills are bright red.	4.80	0.41	Always
The eyes of the fish are bright and clear.	4.73	0.46	Always
The skin of the fish is shiny with slime on the surface.	4.33	0.62	Always
The fins of the fish are clearly defined and perky, not scraggy or broken.	3.47	0.74	Often
<b>Weighted Mean: SD</b>	<b>4.39: 0.733</b>		
<b>Remark</b>	<b>Always</b>		

The fisherman agree that the colors of the gills are bright red (M=4.80, SD=0.41) based on the respondents' perception in terms of appearance. The eyes of the fish are bright clear (M=4.73, SD=0.46). The fins of the fish are clearly defined and perky, not scraggy or broken (M=3.47, SD=0.74). The weighted mean of 4.39 and with the supported value of the standard deviation of 0.733 interpreted as very high that the fisherman always saw the level of effect of water quality on the quality of fish caught in terms of appearance. The characteristics of the fish fins with the remark of "often" is the outcome of the effects of changing climate from hanging amihan to hanging habagat that is not observable through the year. Implications of water quality to the fish quality in terms of appearance are very high. It shows that there is still a good quality of water for producing good quality fish in Sto Domingo Bay, Laguna.

**Table 4. Level of quality of fish caught in terms of odor**

Statements	Mean	SD	Remarks
The smell of the fish is the smell of the lake.	4.27	0.59	Always
The fish does not smell similar to dirty mud (Burak)	3.93	0.46	Often
The odor of the fish does not show any indication of poisoning.	3.40	0.51	Sometimes
We never caught a fish that had "Liya" unless it is the time where most of the plankton are in the lake.	3.87	0.64	Often
We never caught any fish that had a smell when cooking.	4.67	0.49	Always
<b>Weighted Mean: SD</b>	<b>4.03: 0.667</b>		
<b>Remark</b>	<b>Often</b>		

The fisherman never caught any fish that had a smell when cooking (M=4.67, SD=0.49) based on the respondents' perception in terms of odor. The smell of the fish is the smell of the lake (M=4.27, SD=0.59). The odor of the fish does not show any indication of poisoning (M=3.40, SD=0.51). The weighted mean of 4.03 and with the supported value of standard deviation 0.667 indicated very high that the fisherman often smells the level of effect of water quality to the quality of fish caught in terms of odor. This interpretation of high is the repercussion from the indications of the existence of too many zooplankton in the lake give low scores of some indicators in the level of quality of fish caught in terms of odor. It can be possibly the effects of waste disposal of the community based on the study of Robert Allen about the "Waste Not Want Not." Bacteria can



cause a disease to the fish that gives a foul odor according to Sabino and Torno these bacteria are coming from the waste present in the lake. Factors that affect the odor of the fish are not always noticing and only manifest during changing climates and too much presence of lavish. The quality of water indicates that the odor of the fish is still acceptable in Sto Domingo Bay, Laguna, and it shows safe and freshness.

## 6. CONCLUSION

In view of the aforementioned findings, it is concluded that the water in Laguna de Bay is in good condition. The results of the laboratory test and statistical treatment of the provided questionnaire as well as the transcribed interviews are showing that fishing in the Sto. Domingo Bay Lake is safe and healthy. On the other side of the transcribed interviews, this shows that there are issues that we will need to focus on to prevent the lake water deterioration that reflects the result of the quality of fish that has overall remarks of often. Proposed programs are indicated in this study, and this will help the government and communities to prevent/ improve the water quality as the basis for the quantity/quality of fish to be a catch in the future.

## 7. RECOMMENDATION

In the light of the foregoing findings and conclusions of this study, the following recommendations are offered:

1. The Proposed Rehabilitation plan needs to be strengthened in the future and be based on community practices on how Laguna de Bay becomes contaminated.
2. The fisherman has to practice proper ways of catching fish to maintain the habitat of the species and must cooperate with the LGU's Ordinance on how to treat the lake water by collecting different types of waste regularly and habitually that they found on the lake to lessen the chemical content of the lake that will contaminate the fishes in the area.
3. The local government needs a tough ordinance about the proper waste disposal to the community living nearby the lake shore. They also need to have a program on how to maintain the cleanliness of the Laguna de Bay. Rules and regulations have to be imposed properly and maintained, rules regarding the giving of permits to the fishermen who want to have their personal fish cage on the lake. Also, to improve the existing regulations for the fishermen and community regarding the lake water rehabilitation and species propagations in the area.
4. The future researcher has to study the reason why fish died and looked poisoned during the amihan period. They also find ways on how to control and avoid the effects of the phenomenon.

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