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Assessment of physicochemical parameters with fish identification in selected water areas in Binday Dam, San Fabian, Pangasinan

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Abstract

The indiscriminate discharge of sewage, industrial, and a variety of water from human activities progressively alters and pollutes reservoir water. Investigation of the physicochemical in the water of Binday dam showed a fluctuation of phosphate during the months of October, November, and December. Similarly, low temperature was recorded in the months of September and December and nitrite increased during the month of December which failed to meet the Class C waters. Dissolved Oxygen, pH, electrical conductivity, biochemical oxygen demand, and total dissolved solids meet the standard measurement. Significant differences in physicochemical parameters were recorded between upstream and downstream during the months of September, October, November, and December except for DO, BOD, and EC. Fish identifications are exclusively found in the upstream and downstream namely, *Oreochromis niloticus*, *Channa striata, Clarias gariepinus, Yanica hyalosoma, Carangidae* sp., *Glossogobius* sp., and *Glossogobius circumspectus* classified as native species, and *Sarotherodon melatheron* and *Gambusia affinis* classified as invasive species. Fish distribution revealed that *Carangidae* sp. only thrives in the upstream whereas *Gambusia affinis* are exclusively found in the downstream.

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Introduction

Water satisfies humans, communities, animals, and all biotics. It also serves to be the fundamental requirement to provide an essential advantage of services such as the production of electricity, manipulating floods, and production of water supplies (Jéquier & Constant, 2010). Water contributes to the restoration of a more natural flow regime in rivers, creeks, and wetlands as well as the maintenance of a healthy, productive, and resilient river system. Although the country has abundant water resources, usable water is becoming scarce due to contamination and its physicochemical factors partly responsible in maintaining water quality (Angagao *et al.,* 2017).

Since most living species require water for survival, water quality analysis is vital in assessing its current state and may be used for the maintenance of dependable and safe water supplies, thereby reducing numerous potential health hazards associated with it. Primarily, water contamination may take effect in terms of fish deaths, major hazard diseases to its consumers, and the impact on other marine organisms (Environmental Protection Agency, 2021). Hence, water quality analysis can be used to determine the root causes of such contamination and alternatively formulate sustainable solutions for water source monitoring, community awareness, health-related problems, and effect to the economy (Son *et al.,* 2020). In addition, evaluating water quality may also help secure the safety of multiple species, including humans and animals. Thus, it is essential to determine water composition to elucidate whether it is safe (Batil *et al.,* 2012).

According to Bhateria and Jain (2016), it is necessary to test the water before using it for household, agricultural, or industrial purposes. Notably, a variety of physicochemical parameters are used to efficiently assess water quality. These include physical parameters like water temperature, total dissolved solids (TDS), electrical conductivity (EC) and chemical parameters like pH, biochemical oxygen demand (BOD) dissolved oxygen (DO), phosphate and nitrite. These parameters have been understood to influence the rate of all chemical reactions in the established systems in aquatic environments.

The Binday dam is situated along the borders of several barangays in San Fabian, Pangasinan which includes Colisao, Ambalangan Dalin, Anonang, Santa Cruz, Casanfernandoan, and Bolanay. The Binday dam supplies water sources in different barangay such as Palapad, Anonang, Aramal and Mabilao, as well as to the municipality of San Jacinto and Manaoag. The areas are characterized by agricultural fields, residential and industrial domestic animals. Farming, fishing, and livestock are the common livelihood source of the people. The water from this dam is a tributary from another water system called the Bued River through a canal leading to the North side of the river as it flows in the direction of the sea from the mountains of Benguet (Lubrica, 2013).

The purpose of this study is to investigate the physicochemical characteristics of the water in Binday Dam, including temperature, pH, DO, BOD, TDS, EC, phosphate, and nitrite. Furthermore, this study aimed to identify and classify fishes in terms of their distribution status. Importantly, this research study will greatly benefit the community in terms of their ecological and agricultural purposes. Lastly, it will also provide data information regarding water quality in Binday dam.

Materials and methods

Study Area

Binday dam is situated along the borders of the different barangay in San Fabian Pangasinan. This study selected two sampling sites namely Colisao and Aramal. Barangay Colisao (16.1292°N, 120.4645° E) represents the upstream portion and barangay Aramal (16.1240° N, 120.4352°E) represents the downstream (Fig. 1).

This study is descriptive and experimental in nature and was conducted at Binday, San Fabian, Pangasinan during the rainy season from September to December 2021 between 6 o'clock to 7 o'clock in

the morning with two to four weeks interval difference collection from two stations.

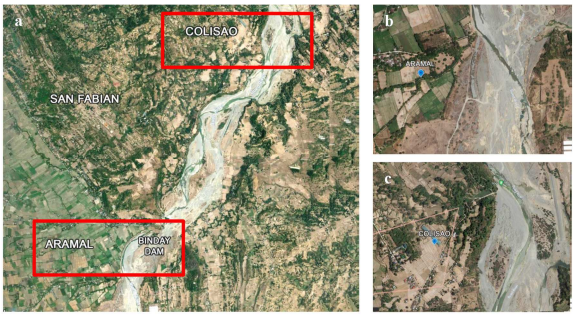

Fig. 1. Satellite Images Showing the (a) Binday Dam Emphasizing Barangay Colisao and Aramal, (b) Upstream Site and (c) Downstream site.

Colisao is surrounded and characterized by different types of woods, mountains, and several houses. Planting root crops, selling vegetables and fruits, and fishing, are the main sources of income of those individuals living in the area. The small reservoirs known as Binday dams are vital for the nearby house and barangays because they provide irrigation, agricultural, and freshwater sources. Binday dam serves to be an excellent means to manage and regulate floodwaters, preventing damage to both people and property.

Aramal is a barangay from the municipality of San Fabian in the province of Pangasinan. Most of the people there rely their daily living on the existence of livelihoods that can sustain and support their everyday life. Additionally, fishing and farming in this area are very essential to provide their necessities since it covers some water reservoirs and broad agricultural fields.

Field Sampling

Physicochemical parameters like temperature, pH, electrical conductivity, and TDS were measured on-site during the collection of water samples using a calibrated multi-meter. The measurements were taken by slowly submerging the meter in the water surface for about five to ten minutes to take the accurate reading then slowly remove it. To test the nitrite level of water samples, the API Nitrite Test Kit Solution was used which is calibrated solution for fresh and saltwater.

Collected water samples placed in clean plastic bottles were submitted to the Bureau of Fisheries and Aquatic Resources-National Integrated Fisheries Technology Development Center (BFAR-NIFTDC), Bonuan-Binloc, Dagupan City for the determination of phosphate content. Similarly, water samples were also submitted to the Department of Environment Natural Resources (DENR), San Fernando City La Union for the determination of DO and BOD contents. A fish data survey was also conducted. Data were obtained and carefully investigated through a survey questionnaire answered by the fishermen in both stations with the Free Prior Consent Form (FPIC). There was a total of 32 volunteer participants who answered the survey. Sixteen of them are from the downstream area while the remaining 16 are from the upstream area.

Also, the catch and release methods were conducted during the third and fourth sampling to support and assure that these are the species they usually caught. The actual collection of data was recorded every sampling period and used to classify according to their distribution status, total numbers of each species, and size estimation of fish. The actual survey form as well as the catch and release method were taken and submitted to BFAR San Fernando City, La Union verification and certification.

Statistical Analysis

The data were evaluated, computed, tabulated, and validated using a non-parametric test, Kruskal Wallis test with a significance level of 0.05 to see if there were any changes between the data collected in the four sampling months of September to December 2021. The Mann-Whitney U test was another test utilized. This tool is used to compare data from both upstream and downstream sources. The software used was IBM SPSS version 21.

Results and discussion

Table 1 shows the summary of the mean average for the selected physicochemical parameters during the

four sampling months upstream and downstream. The Class C Standard Measurement was derived from the Department of Environment and Natural Resources which is utilized to compare the measured values of each parameter (Department of Environment and Natural Resources, 2016). The water temperature of Binday dam in the months of September and December in both stations as well as in the upstream portion during month of October failed to meet the permissible ranges for Class C Waters of 25°C to 31°C. According to (Laude *et al.,* 2016), the unexpected changes value of the water temperature is due to the factors such as the location of the tributaries of water and the elevation of amount of oxygen.

Table 1. Mean Average of Physicochemical Parameters in the Upstream and Downstream Portions of Binday Dam at the Last Quarter of 2021.

Parameters	September		October		November		December		Class C Standard Measurement
	U	D	U	D	U	D	U	D	
Temperature	24.60	18.13	24.13	27.13	26.27	27.17	23.00	23.53	25-31°C
DO	8.63	8.00	8.76	8.06	8.10	8.26	8.50	7.80	≥5 mg/L
pH	8.07	8.36	8.37	8.39	8.55	8.60	8.18	8.63	6.5-9.0
TDS	186	191	186	160	210.67	203.33	224.33	208.67	50-400 ppm/mg/L
Phosphate	0.02	0.048	0.008	0.006	0.054	0.054	0.01	0.07	0.02-0.005 mg/L/ppm
Nitrite	0	0	0	0	0	0	0	0.25	≤1 mg/L
BOD	0.98	1.94	1.88	1.97	0.67	1.75	1.38	2.10	≤7 mg/L
EC	347.33	390	372.67	366.67	256.33	387.33	439.67	417.67	200-500µ/cm

Legend: "U" stands for upstream, and "D" stands for downstream

Dissolved oxygen in the two stations meet the Class C Standards measurement (>5mg/L), this indicates that the water is relatively stable and considered a healthy ecosystem that has the capability to support different kinds of aquatic organisms including fishes. However, organisms must adapt changing levels of DO because if it has an extreme level, it may cause stress to aquatic life such as fishes (Environmental Protection Agency, 2021). DO levels are constantly affected by changes in the level of other parameters such as pH, nitrite, phosphate, and temperature.

The nutrient (nitrite) is essential for plant growth and nourishment (Environmental Protection Agency, 2021). Nitrite in Binday dam indicates that the level of upstream and downstream portions meets the allowable ranges for Class C Standards of Waters (<1ppm/mg/L) due to several factors such as the increase of agricultural runoffs, improper waste disposal and animal feces.

All total dissolved solids measured still meet the Class C Waters of 50 to 400mg/L (Department of Environment and Natural Resources, 2016). According to Bhateria and Jain (2016), factors and parameters that are the main cause of this change is the flow of water in Binday dam. Also, TDS correlates positively with conductivity that affects pH, the presence of TDS in water may affect its taste (Islam, 2017). All the recorded phosphate in the whole sampling period, only the month of September in both stations meet the allowable ranges for Class C Waters of 0.02mg/L to 0.005mg/L indicates that the water was affected by the excess nitrogen and phosphorous nutrients cause expansion and the rapid development of algae in the body of water.

Biochemical oxygen demand is crucial for determining relative oxygen that is required for waste management, effluents, and polluted water. All measured BOD meets the Class C Waters (<7mg/L) and this indicates that the oxygen demand in all sampling periods is enough to oxidize the organic matter in the water of Binday since other studies have this kind of amount of BOD. Other water parameters that can influence the BOD are pH, temperature, and phosphate. Certain changes in the environment and other human-induced causes such as excessive fertilizers in a body of water can lessen the dissolved oxygen level in a water body, hence affecting the biochemical oxygen demand and causing stress to aquatic life (Bajpai, 2018).

All pH values obtained were in the permissible range (6.5-9.0) for Class C standard measurement. According to Boyd (2017), most species can tolerate a pH between 6-9 well. This range has a high abundance of biological activity such as growth and reproduction of fishes. This indicates that all the pH value is suitable for the marine organism.

Electrical conductivity in both stations meets the permissible ranges for Class C Standard of Waters (200-500µS/cm) indicating that the salinity of water in Binday dam is good for the marine aquatic organisms (Environmental Protection Agency, 2021).

The statistical analysis (Table 3) revealed that there is a significant difference in upstream and downstream of four sampling periods between the mean ranks across time frames except DO, BOD, and EC (Table 4). One of the reasons that cause changes in nitrite might be due to planting and watering of crops that causes runoff of fertilizers coming from an agricultural site nearby (Aries *et al.,* 2013). DO recorded in the upstream and downstream revealed no significant difference between the mean ranks of DO when grouped as to the date of sampling wherein for upstream (x^2= 6.568, p =0.087>0.05) and for downstream (x^2=5.001, p= 0.172>0.05). Furthermore, statistical analysis of phosphate showed that upstream portion of station has no significant difference between the mean values when grouped as to date as for upstream (x^2= 9.528, p= 0.087>0.05) and has significant differences for downstream wherein (x^2=8.805, p= 0.032<0.05) (from September to December 2021) implying that the level of phosphorous across time has stayed or are more or less closely the same for a particular period of time.

Table 2. Results of *p*-value Between the Comparison of Upstream and Downstream.

Parameters	Mann-Whitney U	Asymp. Sig. (2-tailed)
Nitrite	54.000	0.070
pH	51.000	0.225
Temperature	64.500	0.665
DO	21.000	0.003*
BOD	34.000	0.28*
EC	55.500	0.339
Phosphate	44.500	0.112
TDS	67.000	0.773

Table 3. Fish Collection from Four Sampling Months.

Scientific Name	Local Name	Taxonomy	Distribution/ Occurrence	Description	Location
Clarias gariepinus	North African catfish/Hito/ Paltat	Class Actinopterygii Order Siluriformes Family clariidae	Invasive species	Fish with darker or black back that fades to a white belly.	U D
Oreochromis niloticus	Nile tilapia	Class Actinopterygii Order Cichliformes Family Cichlidae	Native species	it grows fast as well as it is hardy, and well adapted for farming in warm tropical countries	U D
Gambusia affinis	Mosquito fish/ isdang canal/itar	Class Actinopterygii Orde Poeciliidae Family Cynprinodontifomes	Invasive species	it occupies a variety of waters and compromises the aquatic ecosystems	D
Sarotherodon melanotheron	Blackchin tilapia/Gloria	Class Actinoperygii Order Cichliformes Family Cichlidae	Invasive species	pale fish with dark patches on its chin and dark coloration on the posterior border of gills	U D
Carangidae sp.	Trevally/ Talakitok	Class Actinoperygii Order Crangiformes Family Carangidae	Native species	Yellowish silver sides and a silver belly, with a bluish silver top body	U
Yanica hyalosoma	Dangat	Class Actinoperygii Order Kurtiformes Famil: Apongonide	Native species	It is mostly live in freshwater with the temperature that is not too high or low	U
Chana striata	Striped headed/ Dalag	Class Actinoperygii Order Perciformes Family Channidae	Native species	it has sub-cylindrical body and rounded caudal fin and as well as dark mottled dorsal surface	U D
Glossogobius sp.	Goby/ Bunog	Class Actinoperygii Order Gobiiformes Family Gobiidae	Native species	The body is oblong and slender, with five square to rectangular spots on the lateral midline and a wavy stripe on the head	U D
Glossogobius circumpectus	Circumspect goby/ bunog ipusan	Class Actinoperygii Order Gobiiformes Family Gobiidae	Native species	Body has 5-6 irregular brown stripes and staggered rows of spots.	U D

Legend: “U” for upstream, “D” for downst

Likewise, BOD recorded no significant difference between the mean ranks from the months of September, October, November, and December 2021 as for upstream (x^2= 7.000, p= 0.118>0.05) and for downstream wherein (x^2= 1.462, p= 0.691>0.05). This indicates that the BOD in the whole sampling period remained constant due to the factors like organic waste, temperature, and dissolved oxygen being within minimal ranges only. The pH revealed that it statistically has no significance for upstream (x^2= 4.880, p= 0.181>0.05) and has a significant difference downstream wherein (x^2= 10.385, p = 0.016<0.05) which indicates that the pH in the upstream had a bit fluctuation and downstream has significant difference due to the factors that influence the different changes of pH.

TDS in both stations also revealed significant differences when grouped as to the date of sampling wherein as for upstream (x^2= 7.942, p=0.047<0.05) and for downstream wherein (x^2=10.495, p = 0.015<0.05). This might be primarily due to the minimal changes in TDS recorded.

Electrical conductivity recorded in four sampling periods in the upstream and downstream revealed no significant difference when grouped as to date. This indicates that the salinity of water in Binday is within the optimal level and has stayed in the same range.

The comparison of upstream and downstream in all the parameters such as nitrite (x^2= 54.000, p=0.070>0.05), phosphate (x^2 =44.500, p=0.112>0.05), pH (x^2 =51.000, p=0.225>0.05), temperature (x^2=64.500, p=0.665>0.05, EC (x^2= 55.500, p=0.339>0.05), and TDS (x^2= 67.000, p=0.773>0.05), revealed that both stations are statistically similar in both upstream and downstream. However, the DO (x^2= 21.000, p=0.003<0.05) and BOD (x^2= 34.000, p=0.28<0.05) between upstream and downstream showed that there is a significant difference. This might be accounted with the factors that may influence the following parameters (Environmental Protection Agency, 2021).

Fish Distribution Status

Fig. 2 shows the collection of fishes in both stations in Binday dam. The fishes collected were belonging to the following families. Family Channidae includes (a) *Chana Striata*; family Cichlidae includes (b) *Oreochromis niloticus* and (c*) Sarotherodon melanotheron*; family Gobiidae that includes two species the (d) *Glossogobius circumspectus* and (e) *Glossogobius sp.*; family Clariidae that includes the (f) *Clarias gariepinus;* family Carangidae includes (g) *Carangidae sp.;* family Apogonidae that includes (h) *Yarica hyalosoma*; and the last family belongs to Poeciliidae that includes (i) *Ganbusia affinis*. Table 2 shows the fish classification according to their distribution status in the upstream and downstream stations of Binday dam.

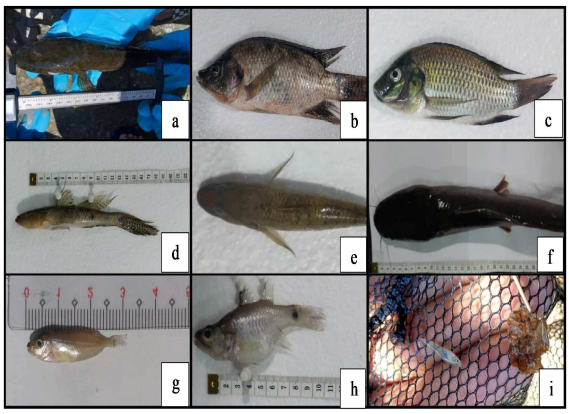

Fig. 2. Fish Collection in Upstream and Downstream.

During the investigation, a total of nine (9) species and seven (7) families of fishes in the two stations were identified (Table 3). The seven families were represented by a one or more species. The *C. gariepinus, C. striata, S. melanotheron, O. niloticus Glossogobius sp. a*nd *G.circumspectus* are all found in the two stations (upstream and downstream), while the Dangat and Talakitok are present only in the upstream portion of Binday dam.

The *C. gariepinus* catfish locally known as catfish or hito, is classified as native or invasive species belongs to the family Clariidae is totally fit for freshwater since it grows quickly and source of a large variety of freshwater derivation. This species can tolerate high concentrations of nitrite and can resist low oxygen

concentrations in water since it has the ability to utilize atmospheric and dissolved oxygen since it has well- developed air-breathing organs (Cao *et al.,* 2020). Catfish can also live in cold water and their feeding behavior does not change with cold water but tend to go deeper (Shahjahan, 2018). However, the optimum water temperature for their growth is 23-27°C, and can tolerate high salinity as 10g/L.

O. niloticus is locally known as tilapia and classified as native species belonging to the family Cichlidae. It is an African freshwater fish and it is one of the most important food fishes in the world. *O. niloticus* also has water quality tolerance such manifested in its pH range between 7-8, and the optimal range for their growing temperature in a controlled environment is approximately 27-30°C. *O. niloticus* are more tolerant of nitrite than the other fishes depending on their sizes as small tilapias can highly tolerate than the bigger one (King & Sardella, 2017). Survival levels of *O. niloticus* for DO level below 2.3mg/L as long as temperature and pH remain favorable in highly acidic water. In contrast, the DO level of 5mg/L support the optimum growth of *O. niloticus* but higher or lower than that inhibits its growth. It can also survive at electrical conductivity ranging between 1.73 to 1.98mS cm-1 (Stickney, 2017).

Mosquito fish scientifically known as *Gambusia affinis* belongs to the Family Poeciliidae and is classified as an invasive species. It was found out that this fish is exclusively present in the downstream section of Binday dam since it prefers to inhabit slow water moving area rather than fast streaming such as the upstream portion in Barangay Colisao. Also, the species of *Carangidae sp.* are the predators of small fishes like the mosquito fish.

The tolerance level of *G. affinis* is most likely due to the high temperature found in the downstream portion of Binday dam. Their tolerance level to pH is very minimal and cannot tolerate high levels of pH which may lead to their death. *G. affinis* thrives in high DO with 8.76 mg/L as well as a high concentration of phosphorous (Magellan *et al.,* 2019). *G. affinis* can only survive if certain parameters are met. *G. affinis* preferred prey that is pollution-tolerant. Preferential prey may be abundant where agricultural land usage is spatially extensive, sustaining huge populations of *Gambusia affinis* (El-Boray, 2014).

Sarotherodon melanotheron locally known as Blackchin tilapia belongs to the family Cichlidae and is usually found in the upstream and downstream portion because it can tolerate higher salinities, lower or higher temperature but not less than 6.9°C with DO levels as low as 0.1 ppm. *S. melanotheron* can /reproduce rapidly, and classified as invasive species since it can spread disease to compete with native fishes (Guerrero III, 2019). This species is sometimes called saltwater tilapia due to its ability to survive in pure seawater.

Carangidae sp. locally known as trevally belonging to the family Carangidae is found only in the upstream section of Binday dam and is classified as native species in the coastal area. All trevally species and subspecies originated from saltwater and accidentally or intentionally migrated to freshwater for breeding. Since they have originated from saltwater, they have a higher tolerance level for water parameters that causes them to adapt to a certain environment that cannot be found downstream due to the low level of water and slow water flow (Valenza *et al.,* 2022).

Yanica hyalosoma locally known as Dangat belongs to the family Apongonidae and is classified as native species in coastal areas. Similarly, it also has high tolerance when it comes to water quality. *Y. hyalosoma* or humbacked cardinal fish is found only in upstream portion of Binday dam. The pH testing with cardinal tetra revealed 100% survivability for pH ranging from 4.0 to 8.5.

The *Channa striata* locally known as stripped headed or dalag belongs to the family Channidae and is classified as native species due to natural distribution and as a longer resident species. This species can be found in both stations since it possesses a high tolerance pH level between 4.25 to 9.4.

This species can be found in shallow and fresh habitats, it can also survive in the dry season by burrowing in the bottom of lakes, canals, and swamps since the texture of the soil in both stations is muddy type (Sharipudin *et al.,* 2016).

Glossogobius sp. locally known as Goby or Bunog belongs to the family Gobiidae and is classified as native species in Binday dam. It can be found in both upstream and downstream. According to Hadijah et. al (2021) these species also have a limitation in water quality parameters such as the temperature of 27.7°C, DO of 4.48- 6.96 mg, and pH of 6-7.5. All water quality indicators were deemed adequate for *Glossogobius sp*. fish survival. It can be found in both stations because it has tolerance and can adapt to survive.

G. circumpectus also known as circumspect goby or Ipusan belongs to the family Gobiidae and is also classified as a native species in Binday dam. At present, there are no study existing that evaluated the limitation of this species but considering its relative species previously mentioned, *Glossogobius sp.,* it is possible that their tolerance is within the same ranges.

In the downstream area, *G. affinis* are found. Among the nine species found in the two sampling areas, two distribution status were identified. Six out nine belonged to native species and these are the species of the family Clariidae, Gobiidae, Carangidae, Poeciliidae, Apogonidae and Chaniidae while the remaining species belonged to invasive species.

Native species are abundant compared to other species since the quality of water in both stations is suitable for their growth and survival and the water parameters measured in this study belongs to the optimal ranges of the class C standard measurement. However, the fishes belonging to another distribution status (native and invasive species) were also present in both upstream and downstream area. Freshwater fishes are ecologically important in rivers, streams, and other water sources as biological indicators of freshwater, they contribute significant food, recreation, and conservation value for humans and ecosystems.

Numerous abiotic and biotic factors are known to influence the distribution of fish species within sampling period. Predation and competition are major elements among abiotic factors. Additionally, the abiotic factors such as the water temperature DO, BOD, pH phosphate, nitrite, EC, and TDS have an influence on the fish distribution and population viability in the area. The distribution status of abiotic factors is closely similar to each other particularly the water physicochemical parameters (Lynch *et al.,* 2016).

Based on findings, species such as *S. melanotheron, C. gariepinus* and *G. affinis* are considered as invasive species. Also, these species can be found in water that is not too cold or hot and can adapt to the environment which is between the acceptable ranges of Class C Standard Measurement. Thus, we can infer that the physicochemical parameters such as the temperature, pH effects and correlates with the survival of the native fishes found in both areas. The most abundant fish are found both in upstream and downstream while the two species are only present in the upstream. Also, *G. affinis* was found in the downstream section of study area which has brownish water color. Further, it was found out that the fish species that are most common are those that are highly adaptable to adverse environmental variables such as water pollution, habitat deterioration and physicochemical parameters. The presence of a native species in both sampling site indicates that there is a healthy fish population and thus, tend to mean a healthier aquatic environment. Based on the findings, the upstream portion has abundant native species compared to the downstream portion and one of the factors was the water quality. In contrast, having a large volume of native species in one area can also indicate a negative impact in a way that this will lead to the competition of food, oxygen, and habitat that will affect their survival and growth (Simberloff, 2020). Furthermore, aside from the native species, there are also invasive species recorded. The presence of the invasive species might have negative and/or positive impacts to the ecosystem wherein a large population of invasive species can destroy the balanced ecosystem (Havel *et al.,* 2015).

Conclusions and recommendations

Based on the findings of this study, the following conclusions were drawn. Investigation of water quality of Binday Dam in San Fabian Pangasinan showed remarkable differences in the physicochemical parameters between the two sampling sites in all sampling periods. All the parameters met the allowable range for Class C. The results indicate that the identified water parameters have significant differences in phosphate and DO values. Similarly, recorded values were high for TDS and BOD concentrations. In contrast, pH and Temperature showed medium fluctuations across the investigation period. The results met the permissible levels for Class C standards waters.

Lastly, fishes identified in Binday Dam were exclusively found upstream and downstream, namely the following fish species, *Oreochromis niloticus, Channa striata, Clarias gariepinus, Yanica hyalosoma, and Carangidae sp*. However, nine species were identified belonging to seven families. Fish distribution status revealed that the fishes mostly abundant in the two sampling stations like *Glossogobius sp. and Glossogobius circumpectus* are native while *Gambusia affinis and Sarotherodon melanotheron* are exclusively considered as invasive species. Therefore, the most abundant fish found from selected stations known as native species.

In assessing the physicochemical parameters in selected areas in Binday dam, there should be joint, concerted and committed efforts not only by BFAR and DENR but also by community headed by the local government unit of Binday Dam in San Fabian, Pangasinan. Since water is so important for daily life, all federal agencies, as well as the corporate sector, non-profit organizations, and academic institutes, must collaborate to monitor and address water quality challenges. There should be active participation of the Department of Environment and Natural Resources (DENR), National Irrigation Administration (NIA), Bureau of Fisheries and Aquatic Resources (BFAR) and other agencies as well as the residents of barangay Colisao and barangay Aramal of San Fabian Pangasinan.

Moreover, research on complete floristic assessment should also be made in the future. To better provide the LGU and concerned stakeholders of the Binday dam, it is suggested that ventures similar to this research should be continuously supported.

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