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WATER RESOURCE ASSESSMENT TO PRESERVE THE BIODIVERSITY OF A COASTAL WETLAND

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ABSTRACT

The study revolves around evaluating the quality of the water resource to preserve the biodiversity of a coastal El Paraíso wetland. To achieve this purpose, the work was organized in two stages: first, a compilation of the studies carried out on coastal wetlands was made, and in the final stage, fieldwork was carried out, with the collection of samples for their study and analysis of water quality, which is the primary source of the study. Sampling points were selected, water samples were analyzed, and the process of reviewing the environmental contamination parameters was established and carried out in order to determine the level of quality, which, according to international standards and adapted to Peruvian regulations, corresponds to the Environmental Quality Standards (ECA) and the Maximum Permissible Limits (MPL) for water. The results showed that 50% of the evaluated physical-chemical elements show indicators outside the acceptable range and the other 50% are within the legal parameters. According to these results, it is considered urgent to declare the "El Paraíso" wetland as a natural conservation area and, as a consequence, to protect and preserve the water resource that is being affected by chemical compounds and chemical elements as a consequence, the preservation of the biodiversity of the El Paraíso coastal wetland.

Keywords: Preserve, wetland, ecosystem, biodiversity, quality.

RESUMEN

El estudio gira en torno a la evaluación de la calidad del recurso hídrico con la finalidad de preservar la biodiversidad de un humedal costero El Paraíso. Para alcanzar el propósito, se organizó el trabajo en dos etapas, en primer lugar se hizo la recopilación de los estudios realizados sobre humedales costeros y en la etapa final se realizó trabajo de campo, con la toma de muestras para su estudio y análisis de la calidad del agua, la misma que es la fuente primaria del estudio; se seleccionó puntos muestrales, se procedió al análisis de las muestras de aguas, se estableció y realizó el proceso de revisión de los parámetros de contaminación ambiental, con la finalidad de determinar el nivel de calidad, los cuales, según la norma internacional y está adaptada a la normatividad peruana, correspondiente a los Estándares de Calidad Ambiental (ECA) y los Límites Máximos Permisibles (LMP) para Agua. Los resultados obtenidos nos permitieron conocer que un 50% de los elementos físicos químicos evaluados muestran indicadores fuera del rango permitido y el otro 50% se hallan en el parámetro de ley. Acorde, a estos resultados se considera de suma urgente declarar al humedal "El Paraíso" como área de conservación natural y a partir de ello proteger y preservar al recurso hídrico que viene siendo afectado por compuestos químicos y por elementos químicos, como consecuencia de ello, la preservación de la biodiversidad del humedal costero El Paraíso.
Palabras clave: Preservar, humedal, ecosistema, biodiversidad, calidad.

INTRODUCTION

The study includes the evaluation of the water resource as an axis of preservation of the biodiversity of El Paraíso coastal wetland, in the province of Huaura, the same that belongs to the Peruvian state. Before this, a natural area, like a coastal wetland, came to be a vital support for the planet earth because it generates oxygen, food and water. Thus, considering that nature has a significant richness in flora and fauna, highlighting in the coastal natural areas notably the presence of birds, fish and other species concerning the fauna, concerning the flora, highlights the totora, reeds, among others. In the Peruvian case, there are significant natural areas, and a unique distinction deserves the Peruvian coastal corridor, which endangers the preservation of biodiversity for some factors: economic activities, housing, and agriculture, among others; therefore, the preservation of biodiversity is urgently needed.

The concern for preserving the biodiversity of natural areas is a constant concern of different actors (authorities, organized civil society and professionals belonging to the sector), formally environmental protection begins with the Stockholm declaration, and continues with Brundtland, reaching the COP 25. In this regard, the agreement of the Convention on Biological Diversity (1992) stands out which, in Article 2 generates a definition in this regard, stating that biological diversity is:

The variability of living organisms from any source, including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes they are part of; it includes diversity within species, between species and of ecosystems.

An essential contribution to the definition of biodiversity is found in the contribution of Savard et al. (2000), who indicate that it refers to the variability of life (composition, structure and function); this criterion coincides to a certain extent with the 1992 agreement of the Convention on Biological Diversity, but also points out the complexity of the concept of biodiversity.

Concerning the conceptual line of water resources, there is the contribution of the Dublin Declaration on Water and Sustainable Development (1992), in its Principle 4, where it defines water resources as follows:

Water has an economic value in all its various competing uses to which it is put and should be recognized as an economic good, under this principle (...) Therefore, as an economic good, water management is an important means of achieving efficient and equitable use and promoting water resource conservation and protection.

In the Peruvian context, Article 68 of the Peruvian Constitution (1993) states that "the State is obligated to promote the conservation of biological diversity and protected natural area;" however, it should be noted that the El Paraíso wetland is not protected or recognized as a regional conservation area or any other conservation mechanism.
At the level of infra-constitutional norms, the Peruvian state has the General Environmental Law No. 28611 (2005), which in its Preliminary Title, Article V of the principle of sustainability, indicates that:
The management of the environment and its components, as well as the exercise and protection of the rights established in this Law, are based on the balanced integration of the social, environmental and economic aspects of national development, as well as on the satisfaction of the needs of present and future generations.
In addition, taking into account the Peruvian legal system, there is Law No. 29338, Law on Water Resources, which in its Article 1, enshrines the concept of water resources, indicating that "water is a renewable natural resource, indispensable for life, vulnerable and strategic for sustainable development, the maintenance of systems and natural cycles that sustain it, and the security of the Nation." This norm points out the importance of preserving life; in this line, the study of this scientific article is justified.
The study of the water resource, in terms of its quality considering parameters included in this research work, has its legal basis in the Supreme Decree N° 004-2017-MINAM, Art. 03, in which the Environmental Quality Standards for Water, groups four categories, which, for the study of the preservation of the ecosystem and biodiversity, is in **category four of conservation of the aquatic environment**, subcategory E1 of Lagoons and lakes.
The scientific work has vast literature on water, about which the study of Hernandez & Posada (2018) considers that "the water resource has an environmental, economic and social relevance; the same requires having scientific research that leads to a comprehensive management." Therefore, this study is vital for the work developed, in the sense that it considers the water

resource as the axis for the preservation of the ecosystem and biodiversity of the "El Paraíso" wetland.

In their research, Castro et al. (2014) "established that one of the most important methodologies to determine water quality is the use of ica indicators: a mathematical tool that allows transforming large amounts of data into a single measurement scale." This work allows comparing the results obtained from the samples with the parameters of the Peruvian environmental quality regulations.

About biodiversity conservation, water resource is of vital importance, which can be noted in the study by Meza et al. (2012), indicating that "there are significant differences in terms of macroinvertebrate richness between stations with riparian vegetation and without vegetation. Furthermore, the studies indicate differences between the water quality of stations 1 and 2 for station"; which allows the interpretation that the quality of continental water favors the development of biodiversity.

A similar case, Nuñez & Fragoso (2020), in their study on aquatic macroinvertebrates, indicated that:

The results obtained show the dominance of the order Diptera. The BMWP/Col index indicates differences in water quality in the different stabilization ponds. The alpha and beta ecological indices showed medium to low diversity values and associations between the different families of taxa. In conclusion, the highest diversity of aquatic macroinvertebrates was obtained in the maturation ponds, with the order Diptera having the highest presence of individuals in each treatment phase.

Studies related to wetlands, in which more than one can be seen that the result of the evaluation of the quality of water resources indicate that they are outside the acceptable range, whose effect is an impact on the ecosystem and biodiversity, so the work of Huamán et al. (2020) in his study on the Pantanos de Villa, shows us pointing out that:

They show that the parameters of electrical conductivity, nitrates, total phosphorus and thermotolerant coliforms exceed the value established in category 4 of the ECA for water at the three sampling points and the pH value at PM-01 and the total ammonia value at PM-02. The conclusion is that the water quality of Marvilla Lagoon is fair, i.e., it is occasionally threatened or impaired.

The Huaura River basin emerges in the high Andean zones of the provinces of Huaura and Oyón, and it has an annual flow of approximately 850 million m^3 of water, which is distributed in agricultural activities with approximately 420 million m^3 distributed in the planting of different food crops; industrial activities in approximately 21 million m^3, population use approximately 11 million m^3; mining activities with approximately 2 million m^3, which make a total of 454 million m^3 of water used annually and where there is a deficient use of water that can be improved in all the uses indicated with different techniques and existing technologies, likewise, a no less important issue is that there is 396 million of water that is not used due to different limitations and that requires further analysis and planning for its use.

Likewise, the water supply of the "El Paraíso" wetland is provided by the Huaura River Basin, whose waters take approximately six months to move from the headwaters to the wetland, allowing

the formation of water reserves, which rise to the surface very close to the wetland, whose characteristics vary, showing high levels from July to October. In addition, it has been observed that the 30 thousand agricultural hectares located in the middle and upper zone of the basin and the wetland area, including the Santa Rosa Irrigation, contribute to the accumulation of water through filtration.

Also, there are two bodies of water in the wetland; the first is the lotic water body, located in the southern zone, whose aquifer formation is through the filtration of the subsoil and is very appropriate for the concentration of shorebirds; the second is the lentic water body, located in the northern zone, which only has one source that provides its formation and it is through filtration.

The development of the wetland is in a eutrophic state, that is, it is in full growth or development at different levels of flora and fauna, whose ecosystem is fragile, even more by the water dynamics, represented by the irrigation and drainage canals from the Santa Rosa Irrigation, whose sediments of physical, chemical and biological origin, constitute a latent and persistent risk to the biota of the lagoon and its ecosystem.

As a result of all the above, the evaluation of the water resource in order to preserve biodiversity in the "El Paraíso" wetland, located in the province of Huaura, department of Lima, Peru, is of utmost importance in the scientific, legal, environmental, social and economic aspects, since in the case of the water resource of "El Paraíso" wetland is vital for the conservation and preservation of biodiversity; therefore, this research seeks to contribute to the preservation of biodiversity, through a review of scientific literature and fieldwork; highlighting the study and analysis of water quality in the same, considering the physical-chemical parameters of hydrogen potential (pH), oxygen, total phosphorus, free cyanide, ammonia and nitrate, the inorganic parameters copper, chromium VI and dissolved cadmium; and the organic parameter fluoranthene whose effect should generate its declaration as a regional conservation area, in addition, it will significantly favor the ornamental and ecotourism development of the small north of Peru.

MATERIALS AND METHODS

a.- Location

The research was conducted in "El Paraíso" wetland located at kilometer 136 of the Panamericana Norte, in Lima's Huaura department and region. At a distance of 10 km before reaching the city of Huacho. The wetland is made up of two lagoons, the north water mirror and the south water mirror, both of which can be accessed by the detour located at Km 136.6 and by the León Dormido beach.

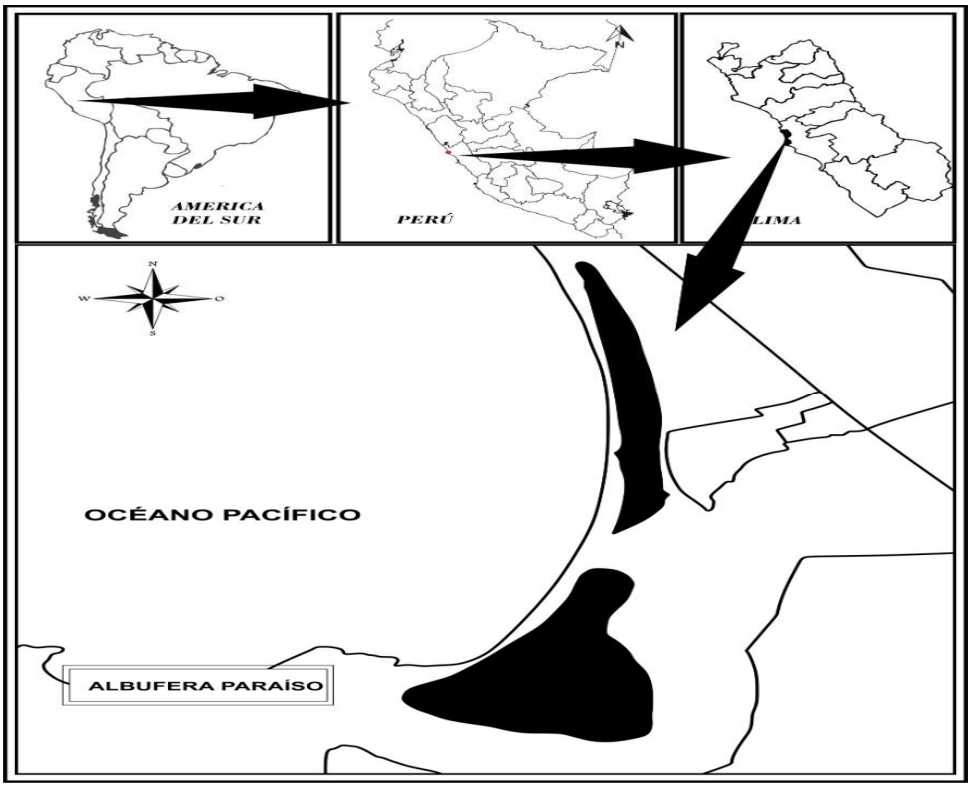

Fig. 01 Location map of the "El Paraíso" wetland.

b. - Methodology

The study was developed in two stages, and the first consisted of collecting secondary information from studies conducted on the wetland; secondly, samples were taken for study and analysis of water quality, which was considered the primary source of the study.

b.1.- Characteristics of the methodology used

The methodology used had the following sequence:

- A review of secondary sources was carried out to standardize, expand and reaffirm concepts and results on wetland studies, following a systematic recognition of bibliographic sources, as well as the reliability of the information and the origin of each source.
- The work team was trained to collect water samples from the selected points in the wetland context.
- Once socialized with the work team, it was implemented with the materials, instruments and equipment necessary to obtain the primary information.
- The work team took water samples from the three sampling points.
- The study and analysis of the water quality evaluation were carried out, considering the physical-chemical parameters of Hydrogen Oxygen Potential, Total Phosphorus, Free Cyanide, Ammonia and Nitrate, the inorganic parameters of Copper, Chromium VI and dissolved Cadmium, and the organic parameter Fluoranthene.

❖ The results obtained after the study and analysis of water quality were organized and evaluated based on the parameters of environmental contamination in order to compare the results obtained from the samples with the parameters established in Peruvian legislation, corresponding to the Environmental Quality Standards (ECA) and the Maximum Permissible Limits (MPL) for water.

❖ The study results allowed the establishment of conclusions and final recommendations to determine the preservation of the ecosystem and biodiversity of "El Paraiso" wetland

b.2.- Sampling

Consideration for sampling in the study of water for the preservation of the ecosystem and biodiversity of the El Paraíso wetland was grouped as follows:

a. Water before entering the lagoon
b. Water from the center of the lagoon
c. Lagoon outlet water

This classification, sampling and subsequent analysis are shown in Table 1, taken from February 2018 to March 2022, while Table 2 shows the results of the sample taken from March 2018 to March 2022 and finally shows Table 3, with the results of the sample taken from November 2018 to March 2022 and is located as sample points to the water sources, the biota present and the related presence of seawater.

b. 3.- Element analysis:

The elements present in the water were considered to evaluate the quality, taking as reference the physical-chemical parameters Hydrogen Potential, Oxygen, Total Phosphorus, Free Cyanide, Ammonia and Nitrate, the inorganic parameters Copper, Chromium VI, and dissolved Cadmium, the organic parameter Fluoranthene, to preserve the ecosystem and the biodiversity of "El Paraíso" wetland.

RESULTS

Due to the work method applied for the development of the study of this scientific article, we present the results of the fieldwork, the same that is presented taking into consideration the selected samples, the same that has as the main objective the study of the water resource, evaluating its quality in the physical, chemical parameters of hydrogen potential (pH), Oxygen, Total Phosphorus, Free Cyanide, Ammonia, Nitrate, the inorganic parameters Copper, Chromium VI and dissolved Cadmium, the organic parameter Fluoranthene; as a fundamental element to preserve the ecosystem and biodiversity of "El Paraíso" wetland reaching the organic parameter Fluoranthene; the inorganic parameters Copper, Chromium VI and dissolved Cadmium, the organic parameter Fluoranthene; as a fundamental element to preserve the ecosystem and the biodiversity of "El Paraíso" wetland reaching the following results:

1.1 Water analysis results

RESULT OF THE FIRST WATER SAMPLING

Table 1. Characterization of the water sampled at the lagoon inlet -February 2018, March 2022.

Water	pH	Oxygen	Total phosphorus	Free cyanide	Ammonia	Copper	*Fluoranthene*	Chromium VI	Nitrate	Dissolved Cadmium
				mg/L						
I1	7,25	8,1	1,15	0,0075	0,087	0,0	0,77	0,076	0,166	0,167
C1	7,4	8,7	4,9	0,017	0,003	0,089	0,85	0,07	0,1	0,114
S1	7,66	9,2	2,7	0,007	0,897	0,085	1,345	0,098	0,33	0,100
±	7,44	8,67	2,92	0,0105	0,329	0,058	0,988	0,081	0,199	0,127
ECA	6,5-9	≥ 5	0,035	0,0052	1,985	0,1	0,001	0,011	13,0	0,00025

Note: I = Input, C: Center, S= Output ±: Average

Source: Own elaboration

Table 1 shows ten lines of study of the quality of water resources, identified as those that must be worked on to preserve the ecosystem and biodiversity in a natural area and for each of them, there are several internal results that belong to their sub-lines, corresponding to the collection of the first samples compared with the regulations of the Peruvian environmental quality assessment. The results obtained indicate that five parameters are outside the acceptable range.

RESULT OF THE SECOND WATER SAMPLING

Table 2. Characterization of water sampled in the center of the lagoon - February 2018 March 2022.

Water	pH	Oxygen	Total Phosphorus	Free Cyanide	Ammonia	Copper	*Fluoranthene*	Chromium VI	Nitrate	Dissolv Cadmium
				mg/L						

I2	7,45	7,75	1,35	0,009	0,052	0,0	0,78	0,857	0,216	0,169	
C2	7,1	3,1	1,5	0,000	0,008	0,059	0,97	0,11	0,14	0,115	
S2	7,78	6,9	1,69	0,009	0,995	0,063	1,36	0,086	0,415	0,095	
±	7,44	5,92	1,51	0,006	0,352	0,041	1,037	0,351	0,257	0,126	
ECA	6,5-9	≥ 5	0,035	0,0052	1,985	0,1	0,001	0,011	13,0	0,00025	

Nota: I = Ingreso, C: Centro, S= Salida ± : Promedio

Source: Own elaboration

Table 2 shows the results with the parameters established for the study of the quality of the water resource obtained during the second sampling, which is compared with the parameters established in the DS N° 004-2017 -MINAM, which determines the evaluation of the environmental quality of the water of lakes and lagoons. The data indicate that 5 parameters evaluated indicate results above the permitted range

RESULT OF THIRD WATER SAMPLING

Table 3. Characterization of water sampled at the lagoon outlet - February 2018 March 2022

Water	pH	Oxygen	Total Phosphorus	Free Cyanide	Ammonia	Copper	*Fluoranthene*	Chromium VI	Nitrate	Dissolved Cadmium
				mg/L						
I3	7,35	7,925	1,25	0,009	0,05	0,0	0,78	0,479	0,19	0,168
C3	7,25	5,9	3,2	0,016	0,004	0,078	0,9	0,09	0,12	0,116
S3	7,68	7,4	2,16	0,009	0,796	0,092	1,345	0,60	0,367	0,142
±	7,43	7,08	2,20	0,011	0,286	0,057	1,008	0,39	0,226	0,142

ECA	6,5-9	≥ 5	0,035	0,0052	2,052	0,1	0,001	0,011	13,0	0,00025

Note: I= Output, C= Center, S= Output ± : Average
Source: Own elaboration

Table 3 shows the results of the physicochemical parameters established for the study of the quality of the water resource, corresponding to the third sampling, which is compared with the parameters established in the DS N° 004-2017 that determines the evaluation of the environmental quality of water in lakes and ponds. The parameters of total phosphorus, free cyanide, fluoranthene, chromium VI and dissolved cadmium are outside the range established in the environmental standard.

AVERAGE VALUES OF WATER EVALUATION RESULTS

Table 4. Mean values found in the water at the three sampling points.

Water	pH	Oxygen	Total Phosphorus	Free Cyanide	Ammonia	Copper	*Fluoranthene*	Chromium VI	Nitrate	Dissolved Cadmium
				mg/L						
PAI	7,35	7,925	1,25	0,0085	0,066	0,0	0,78	0,47	0,19	0,168
PAC	7,25	5,9	3,2	0,011	0,005	0,075	0,9	0,09	0,12	0,115
PAS	7,7	7,83	2,18	0,008	0,896	0,08	1,35	0,26	0,37	0,112
PF	7,43	7,218	2,21	0,0092	0,322	0,052	1,01	0,27	0,23	0,132
ECA	6,5-9	≥ 5	0,035	0,0052	2,052	0,1	0,001	0,011	13,0	0,00025

Note: PAI = Average water at entry
PAC = Average water to center
SBP = Average water at outlet
FP = Final average
ECA= Values of Quality Standards

Table 4 shows the results of the averages of the incoming, center and outgoing samples of the physicochemical parameters established for the study of the quality of the water resource, corresponding to the third sampling, which is compared with the parameters established in the DS N° 004-2017 that determines the evaluation of the environmental quality of water in lakes and lagoons. The averages of the parameters indicate that 50% of the chemical elements are outside the permitted range.

Table 5. Mean values found in the water at the three sampling points.

Water	pH	Oxygen	Total phosphorus	Free cyanide	Ammonia	Copper	*Fluoranthene*	Chromium VI	Nitrate	Dissolved Cadmium
				mg/L						
PAM1	7,44	8,67	2,92	0,0105	0,329	0,058	0,988	0,081	0,199	0,127
PAM2	7,44	5,92	1,51	0,006	0,352	0,041	1,037	0,351	0,257	0,126
PAM3	7,43	7,08	2,20	0,011	0,286	0.057	1,008	0,39	0,226	0,142
PF	7,44	7,22	2,21	0,0092	0,322	0,052	1,011	0,274	0,227	0,132
ECA	6,5-9	≥ 5	0,035	0,0052	1,985	0,1	0,001	0,011	13.0	0,00025

Note: PAM1 = Average of water sample 1
PAM2 = Average of water sample 2
PAM3= Average of water sample 3
FP = Final average
ECA= Values of Quality Standards

Table 5 shows the results of the averages of the physicochemical parameters established for the study of the quality of the water resource, corresponding to the third sampling, which is compared with the parameters established in the DS N° 004-2017-MINAM that determines the evaluation of the environmental quality of water in lakes and lagoons. The data obtained from the sampling averages report that the total phosphorus, free cyanide, fluoranthene, chromium VI and dissolved cadmium are above the standards of environmental regulations.

DISCUSSION OF RESULTS

The objective of the scientific study was to evaluate the water resource quality as an axis for preserving the biodiversity of the "El Paraíso" wetland. The hypothesis of the research has

been corroborated by the results obtained, in which the water quality is partially allowing the preservation of biodiversity in the context of the study.

The results obtained indicate that the evaluation of the hydrogen potential (pH) yields a value of 7.44, which, compared to the Peruvian environmental standard, is within the permitted range; therefore, this parameter indicates purity in terms of the quality of the water resource, which is a vital element for the preservation of the ecosystem and biodiversity.

Regarding the evaluation of oxygen, the results indicate that the parameter of 7.22 mg/L compared to the range of Peruvian environmental regulations indicates that it is within the permitted range. Furthermore, considering that if the level of dissolved oxygen is low, it indicates contamination with organic matter, poor water quality and inability to maintain certain forms of life (Ocasio, 2008), the data obtained indicate that the preservation of the ecosystem and biodiversity meets the required oxygen quality.

The data obtained in the evaluation of total phosphorus show a parameter of 2.21 mg/L; comparing with the environmental regulations of the ECA, this is above the permitted range, causing eutrophication (Vollenweider, R.A. et al. 1980), depleting the oxygen that significantly affects the preservation of the ecosystem and biodiversity.

The results obtained from the evaluation of free cyanide indicate that the parameter is 0.0092 mg/L, compared to the parameter of the Peruvian environmental regulations; this is above the permitted range. In that sense, the study by Montenegro (2006) indicates that "cyanide impacts the biodiversity," whose effect could be the decrease of biodiversity in that ecosystem.

The evaluation results of the Ammonia parameter show that the parameter of 0.322 mg/L, compared to the Peruvian environmental quality assessment parameter, is within the permitted range and does not affect the preservation of the ecosystem and biodiversity.

The evaluation of the copper parameter yielded a result of 0.052 mg/L, which, compared to the parameter established in the regulations on environmental quality in Peru, indicates that it is within the permitted range and does not affect the ecosystem and biodiversity.

The results obtained for the evaluation of Fluoranthene indicate a parameter of 1,011 mg/L; making a comparison with the parameter of the Peruvian environmental regulations, it can be seen that it is above the permitted range. According to frequent studies, fluoranthene, being present in the water column, sediment, and food base of many species, represents a great threat to marine ecosystems, as its bioaccumulation in mollusks and harmful effects on the development of marine larvae has been detected (Paul-Pont et al., 2016; Finch and Stubblefield, 2016), consequently affecting the ecosystem and biodiversity of the wetland under study.

The evaluation of the Chromium VI parameter yields a result of 0.274 mg/L, which, compared to the parameter established in the environmental regulations, is significantly above the permitted range. Hence, the study by Cuellar (2016) indicates that the effect is "carcinogenic and highly harmful," which causes an imminent danger to preserving the wetland's biodiversity.

The data obtained on the evaluation of nitrate indicate that the parameter found is 0.227 mg/L, a result that, compared with the parameters established in the Peruvian environmental

standard, is within the acceptable range, therefore, does not affect the preservation of the ecosystem and biodiversity of "El Paraíso" wetland.

The result reached regarding the evaluation of dissolved Cadmium indicates the parameter of 0.132 mg/L. Comparing this figure with the parameter of the environmental quality regulations in Peru, it is above the established range; thus the work of Del Olmo (2017) points out that it is one of the "most toxic metals, and so it is considered since the fateful event of Itai - Itai in Japan" bringing negative effect to the ecosystem and biodiversity of the wetland under study.

CONCLUSIONS

To conclude, it was demonstrated with the results obtained that the"El Paraís" wetland is in danger of threatening its biodiversity due to the impact produced on the water resource because 50% of the physical-chemical parameters evaluated are outside the range established by environmental regulations, affecting the ecosystem and biodiversity; the other 50% of the physical-chemical parameters are within the permitted range, unlike the previous parameters, these are favoring the preservation of the ecosystem and biodiversity of the wetland under study.

In addition to those above, it is pertinent to highlight the following points:

- The water analysis and the chemical elements evaluated provided information for the characterization of the lagoon water for the purposes of the environmental protection and tourism development project.
- In the study area, there are primary extractive activities that affect the environment with some elements that exceed the limit values of the Environmental Quality Standard.
- The pH, oxygen, ammonia, copper and nitrate meet the Environmental Quality Standards, which favors the presence of biota in the lagoon, which is the basis for the environmental protection and tourism development project.
- The parameters total phosphorus, free cyanide, fluoranthene, chromium VI and dissolved cadmium greatly exceed the Environmental Quality Standard limit, which is very necessary to control in the environmental management of primary extractive activities in the area.
- It is recommended that the Regional Government of Lima generate before the corresponding instances the management of the creation of the study site; as a regional conservation area to the "El Paraíso" wetland in order to preserve the ecosystem and biodiversity.

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