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POLLUTION OF COASTAL WATERS BY EFFLUENTS FROM THE FISH MEAL INDUSTRY IN THE BAY OF MALABRIGO-TRUJILLO PERÚ

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ABSTRACT: The research is applied with experimental design, which aimed to determine to what extent the effluents of the fishmeal factories generate pollution in the coastal waters and trigger environmental impacts in the Bay of Malabrigo-Trujillo-Peru. A monitoring work was carried out in June 20018, which found that the effluents from the fishmeal factories generate pollution in the coastal waters and trigger environmental impacts in the Bay of Malabrigo. Trujillo, Peru (p-value = 0.018). Regarding the specific hypotheses, it was found that the liquid effluents of the fishmeal factories generate pollution in the coastal waters and trigger environmental impacts in the Bay of Malabrigo-Trujillo, Peru. (P-value = 0.0001).The solid effluents from fishmeal factories generate pollution in coastal waters and trigger environmental impacts in the Bay of Malabrigo- Trujillo, Peru. (P-value = 0.039).

KEYWORDS: Pollution, coastal waters, effluents, fish meal industry, environmental impact.

I. INTRODUCTION

In Peru, the coastal zone in the last decades has generated opportunities and services to the population ofthis part of the territory with the consequent environmental deterioration. The sources of marine pollution from land-based sources are mainly domestic wastewater, industrial effluents, agricultural, urban, and mining runoff. [1]

The fishmeal and oil industry is one of the activities that contribute to the pollution of the coastal marine area, including the sea, beaches, and air. The discharge of liquids from the factories has a high organic matter content, which is the result of the use of water for pumping the fish to the processing plants (pumping water) and of the production process itself. These emissions, when they reach the sea, consume the oxygen in the water, since they need it to decompose their organic matter content, causing the death of fish and other organisms living in the environment and on the seafloor. Besides, deficiencies in the capture and conservation of fish on board the fleet (since not all vessels have cooling systems) produce additional environmental impacts. [1, 2, 3]

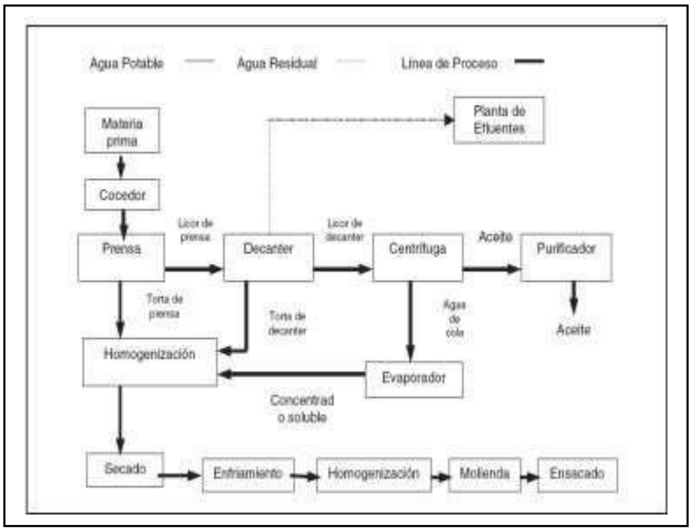

Figure 1: Flow chart of the fishmeal plant

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This has a significant impact on the ecosystem in which it operates, affecting the welfare and health of people. However, fishmeal factories generate foreign exchange for Peru; they give work to many people. The discharge of their effluents into the sea generates significant environmental impacts, as their untreated effluents are dumped into the sea, contaminating the fish fauna of the coast where these fishing industries are located. In addition to the pollution generated by fishing activities in the bays, tourism is also affected, since the presence of only one fishmeal factory causes tourists to flee. On the other hand, determining the types of effluents that are being discharged into the seas, especially from the Bay of Malabrigo, will allow us to identify the components that are being discharged into the sea and to what extent these are contaminating the ichthyologic fauna of the same. This work will also serve as a model to carry out other similar evaluations along the Peruvian coast, to determine to what extent the effluents from the fishmeal industry generate pollution in coastal waters and which trigger environmental impacts in the Bay of Malabrigo-Trujillo-Peru. [1] [2]

As shown in figure 1, the fishmeal process has 11 steps from the unloading and reception of raw material to the packaging of the final product. This is presented along with the Peruvian coast, the following places; Chimbote Bay, Callao Bay, Supe, Pisco and Ilo ports, Ite Bay, Malabrigo Bay, and Talara Port centers of contamination.

Figure 2: Facilities for the improvement of the fishing industry

Therefore, the contributions to the fishing industry through the implementation of a KROFTA SUPERCELL, as shown in figure 2, have been dedicated to the treatment of pumping water (AB). These have as objectives the recovery of fat, oil, and proteins, the clarification of water, and the reuse of water. In other words, investment in AB treatment technologies brings not only environmental benefits but also greater economic returns through the recovery of these elements and their reincorporation into the fish meal and oil production process. [2] [3]

The result of the implementation of this series of equipment and treatment technologies is a recovery of 95% of the solids and fats present in the BA that, until a few years ago, were discharged directly into the sea and that today are still dumped without any treatment by several fishing companies along the Peruvian coast. A large part of this problem lies in the lack of legislation regarding marine environmental standards and maximum permissible limits for fishing effluents and the lack of long-term vision on the part of certain actors in the fishing industry.

It has been estimated that recovery represents a 4% increase in total fishmeal production. An investment of more than $1 million can be recovered in approximately three years of fishing at the current rate, all this without considering additional sales for recovery oil. The medium and long term perspectives are to achieve an increasing AB treatment and recovery efficiency and the implementation of this system in all TASA's fishmeal factories. [2] [4]

II. METHODOLOGY

2.1. Stage 1

It includes environmental analysis, which will analyze the natural physical subsystems and the main environmental problems in the area of study. A bibliography of the main institutions, such as the Ministry of Fisheries, was consulted. Instituto del Mar del Perú (IMARPE), Dirección de Hidrológica (HIDRONAV), Instituto de Recursos Naturales (INRENA), Centro Peruano de Investigación Sanitaria (CEPIS)

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Instituto Nacional de Estadística (INEI), Dirección General de Salud Ambiental - (DIGESA), Municipalidad Distrital de Rázuri - Puerto de Malabrigo among others.

Figure 3: Malabrigo bay study area

The beach area for data collection is shown in figure 3. It is the part of Malabrigo Bay, located in front of the town. It is used as a rest and recreation area by the population and visitors to Puerto Malabrigo, whose main attraction is bathing, especially in the summer.

2.2. Stage 2

It included the evaluation and assessment of environmental impacts generated by industrial fishing activity. It allowed us to prioritize the most relevant impacts and determine the measures to recover the marine environment of Puerto Malabrigo.

2.3. Stage 3

It included applying parametric and non-parametric statistical methods (Sánchez, 2009), such as the Difference Test of Means and the Analysis of Variance Block applied to Effluents blocking Pollution and Environmental Impacts and the Signs Test contrasting the results of the Leopold Matrix.

Figure 4: Diagnostic kit for determining dissolved oxygen

The samples were collected in 500 ml glass bottles, as in figure 4, 2.5 ml of sulfuric acid was immediately added and kept in refrigeration until it was transferred to the laboratory. Likewise, current measurements were made at the pre-established stations, using gelatinous pendulum current meters. The samples visualized in figure

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4 were taken at the surface and bottom of the sampling point, a water sample was collected in a 250 ml plastic bottle, and the measurement was immediately performed in situ using a diagnostic kit for this parameter based on Winkler's technique. [3]

Figure 5: Dissolved oxygen measurement in the field

Figure 5 shows how the vertical line distance from the surface to the bottom of the sea was measured at each of the sampling stations, using a depth gauge. The samples were obtained directly from the seafloor at the predetermined stations, using 500 ml plastic containers preserved at 4°C to minimize microbiological decomposition. The samples were taken at the surface and bottom except for the sampling points in the shore area, which were done only at the surface, 250 ml plastic containers were used. The reading was taken immediately after the sample was collected using a mercury thermometer (reversible thermometer). A Secchi disc was used as a standard instrument to measure the relative visibility or depth of light in the water. The measurement was taken by submerging the disc in the water until it was no longer visible by measuring the horizontal distance, noting the depth. [1] [4]

3. Results

We used the Factorial Design of individual differences proposed by Jonckheere-Terpstra, which deals with the relationships between the scores of one measure (variable) and the scores of another or other measures. The basic idea on which the procedures are based is that any given measure of a variable of individual differences can be considered as consisting of several components. By studying the relationships between a set of measures, it is possible to identify these components. The components can be seen as latent variables, while the measures themselves can be seen as indicator variables. [5] [8]

Table 1: Hypothesis contrast statistics

	Solid and liquid effluents
Number of levels or reference	3
N	39
J-T Statistics	303,000
Average J-T Statistics	216,000
J-T Standard Deviation Statistics	36,865
Standard error	2,360
p-value (2-tailed)	**,018**

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As indicated in Table 1, the value p = 0.018 < 0.05, we can affirm that the effluents of the fishmeal factories generate contamination in the coastal waters and cause environmental impacts in the Bay of Malabrigo - Trujillo, Peru. [6] [8].

The statistical test "t ", of the difference of means, according to areas of effluents carried out, was used.

Table 2: Test of the difference of means.

		t	P-value (2-tails)	Mean difference
SOLID AND LIQUID EFFLUENTS	Equal variance	,338	,039	,07447
	Uneven variance	,387	,043	,07447

Table 2 indicates the value p = 0.039 < 0.05 is possible can affirm that the solid effluents of the fishmeal factories generate contamination in the coastal waters and trigger environmental impacts in the Bay of Malabrigo-Trujillo, Peru.

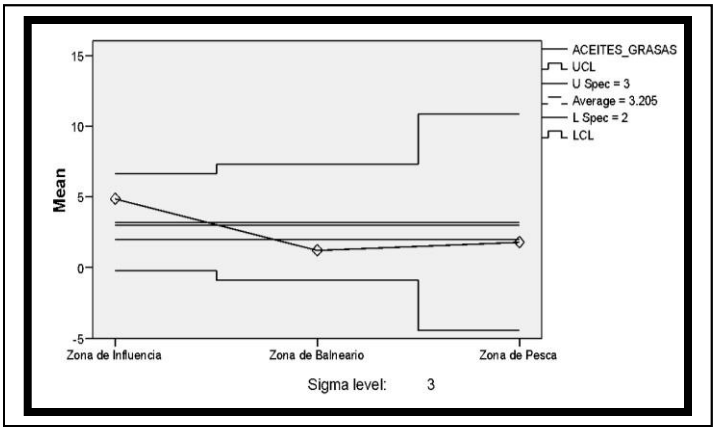

Figure 6: Oils and fats values of Malabrigo bay

The results of Figure 6 indicate that the values of oils and fats for the zone of influence (critical) exceed the average values, in comparison with the values reached for the zones of Spa (Beach) and Fishing; consequently, there is a higher degree of environmental pollution in the critical zone [7,9].

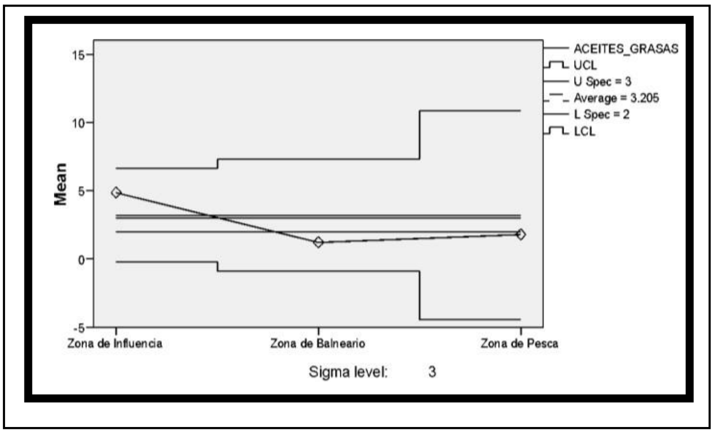

Figure 7: Oxygen biological demand values

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The values obtained in Figure 7 of BOD5 show us that for the zone of influence (critical), they exceed the average values compared to the values reached for the Spa (Beach) and Fishing zones, indicating that there is a higher degree of contamination in the critical zone.

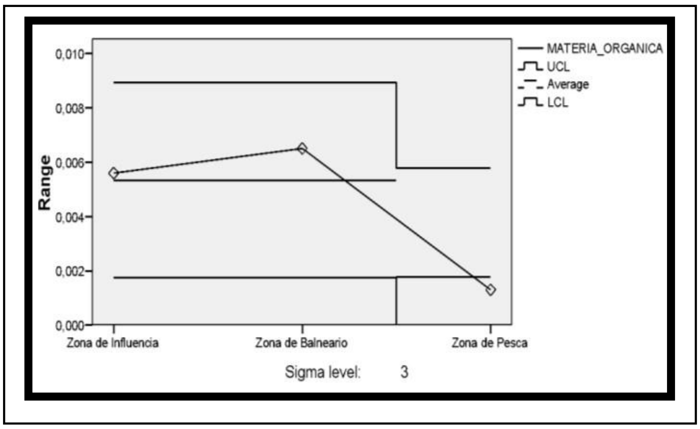

Figure 8: Organic material values

From the results of Figure 8 organic matter, it can be seen that the values for the zones of Influence (Critical) and of Spa (Beach) exceed the average values, unlike what was achieved for the Fishing zone, indicating that there would be more significant contamination in the first two zones mentioned. [3] [8]

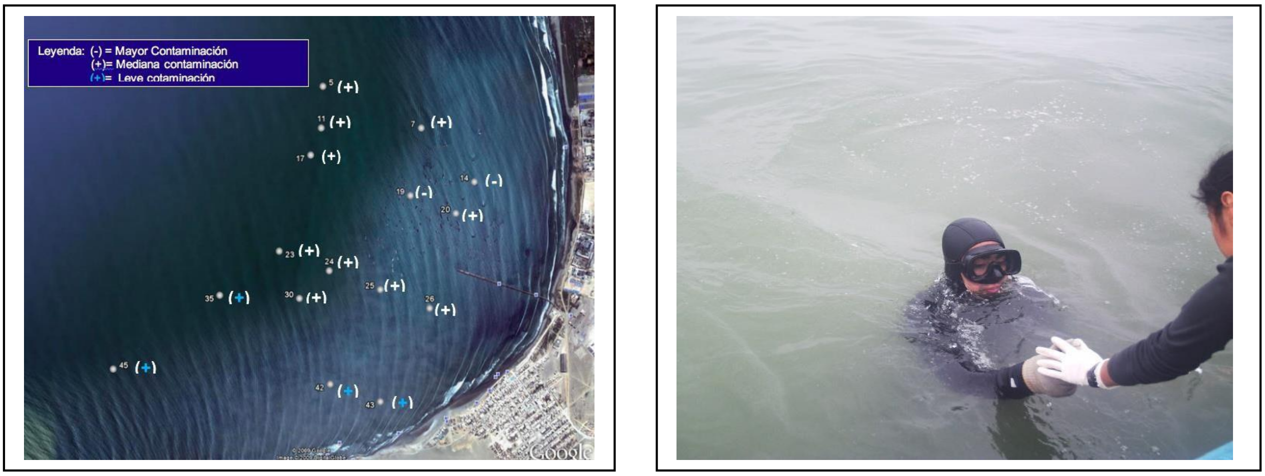

Figure 9: Matrix of environmental impact Bahia Malabrigo.

Table 3: Comparison of environmental quality indicators in the wrap bay.

	Surface oxygen 2018 - oxygen	Background oxygen 2018- oxygen	Dbo5 2018 - oxygen
Z	-2.936(a)	-2.769(a)	-2.666(a)
P value (bilateral)	.003	.006	.008
P-value (theoretical)	0.025	0.025	0.025

Table 3 and Figure 9 show higher BOD5 levels indicating higher contamination levels and lower oxygen levels in the bay water body. Surface oxygen is less than the amount of bottom oxygen, probably due to increased movement of the water at the bottom.

Colder water can hold more oxygen. But compared to June 2003 (Carbajal 2003), our study shows increases in temperature values in the order of 4º C, which would have its explanation because in the last years in the area of the present study, no cold-water currents have been reported, and it would be related to the phenomenon of global warming of the planet. [10]

Table 4: Correlation of BODS5 with pollution of wrap bay.

		Value	The standard error (a)	T Approximately (b)	Approximately value
Interval per interval	R for Pearson	-.733	.124	-3.233	.010(c)
Ordinal by ordinal	Spearman Correlation	-.664	.216	-2.665	.026(c)
Valid cases		11			

Table 4 shows as a contribution of the research the Pearson Correlation between the study areas, whose relationship is inverse and was estimated at 0.733.

The result is interpreted because the BOD5 values found to indicate that Malabrigo Bay is contaminated, with higher values in the Critical and Beach Zones, and a lower value in the Fishing Zone.

5. Conclusions

The p-value gives us a general idea about certain areas of the fishmeal factories when $p= 0.018 < 0.05$ refers to the effluents, when $p = 0.0001 < 0.05$ refers to the liquid effluents and when $p = 0.039 < 0.05$ refers to the solid effluents. These generate pollution in the coastal waters and cause environmental impacts in Malabrigo Bay. Trujillo, Peru. It is considered that the effluent discharge points of the fishmeal industry in Malabrigo Bay should be located at least 1000 meters offshore from their current location since this would achieve a greater dissolution of the contaminating load and would not be concentrated in the study area. [11]

Likewise, the Pearson Correlation has been determined between the study areas, whose relationship is inverse and was estimated at 73%. This is because the BOD5 values found to indicate that Malabrigo Bay is contaminated, especially in the Critical and Beach Zones, and a lower value in the Fishing Zone.

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