Water contamination due to oil spill in Ancon

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Abstract

The general objective of the research in charge was to analyze the actual state of the area after the water pollution caused by the oil spill in Ancon 2022; in the same way, it showed a quantitative approach of non-experimental design of descriptive transversal type, the scope of the research was descriptive; Similarly, it reached a sample of 50 people affected, a survey was used as a technique and the questionnaire as an instrument, validated under criteria which was based on 20 questions for the variable of water pollution through the Likert scale, for this, a previous sample of 20 people was used for the reliability of Cronbach's Alpha; likewise, the data collected were compared by the Microsoft Excel program and the statistical software Jamovi cloud 2. 3. 26; finally, it was concluded that the consequences of water pollution from the oil spill were very harmful to the marine ecosystem, the environment, the surrounding people and the economy.

1. Introduction

The oil spill at Ancon beach in 2022 has had serious repercussions on the natural environment, the local community, and the tourism industry. Ancon beach is a very popular destination in Lima during the summer, both for locals and foreigners, who come in search of its waters and sand. However, this disaster caused by an oil spill, caused by a well-known oil company, has left devastating consequences [1].

Peru has more than 3,000 kilometers of coastline and has jurisdiction over highly productive marine ecosystems. Over the last century, priority has been given to the exploitation of natural resources in these areas, such as guano, anchoveta and oil. In addition, the importance of caring for the sea has been ignored for decades, with solid waste and untreated sewage being dumped [2,3].

The oil spill in Ancón occurred on January 15, 2022, when the tanker Mare Doricum was unloading at the facilities of dock 2 Multiboyas of La Pampilla SAA refinery, in charge of Repsol Petróleos. This spill has been catalogued as the worst recent ecological disaster in Lima, affecting 48 beaches in the regions of Ventanilla, Santa Rosa, Ancon, Aucallama, Chancay and Huacho [4–6].

The consequences of this spill have been devastating for the marine environment. The presence of hydrocarbons in the water has caused the death of fish, mollusks, and other organisms, affecting the food chain and marine biodiversity. In addition, there have been serious impacts on public health, increasing the risk of gastrointestinal diseases, dermatitis, and other health problems [7,8].

The tourism industry has also suffered significant consequences.[9] Contaminated beaches have been rendered unusable, resulting in negative socio-economic impacts in the region. Many workers who depend on fishing and seafood trade have lost their jobs. In addition, tourists who

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used to visit Ancon to enjoy the beaches and practice water sports have stopped visiting due to the contamination [10].

Authorities have reported extensive areas affected by the spill, including nature reserves, islands, and beaches.[11] Although more than a year has passed since the incident, many coastal areas along the Ancon coastline remain contaminated. Repsol has provided vouchers to those most affected, but a complete solution to the problem has not been achieved [12].

Water contamination from oil spills is a serious environmental problem with devastating consequences for aquatic ecosystems and human health.[13] It is necessary to take measures to inform and raise awareness among the population about the care of Peruvian sea waters. In addition, actions must be implemented to prevent future spills and guarantee the protection of marine resources.

In the field of research on water pollution caused by oil spills, a series of theoretical bases are presented to support the study.[14,15] To this end, national and international background information is examined to help answer the questions posed in the project and the established objectives.[16]

In the United States, four interconnected points are mentioned: the environmental impacts derived from oil exploitation, the impact of oil on artisanal fishing for the subsistence of local communities, oil growth and the reconstruction of coastal areas, and oil expansion and adequate management by the authorities [17]. These researchers identify socioeconomic impacts as fishing communities have their cultural identity affected.[18] Fishing environments suffer directly with mortality, loss and closure of habitats, altering values and places due to oil development.[19] Therefore, they recommend a more emphatic focus on governance and effective management of oil development, taking into account its cross-cutting impacts.[20,21]

De Oliveira et al [22], conducting interviews and focus sessions with fishermen in Brazil, found a 53.7% decrease in sales by artisanal fishermen, from 37.5 kg to 17.3 kg per week. There was also a 52.5% drop in sales prices.[23] In addition, fish sales decreased by 52.6%. Perceived impacts were also classified according to their importance, highlighting the drop in sales, the decrease in prices, skin and gastrointestinal tract diseases, as well as the reduction in seafood consumption.

Soares[24], synthesizing information from 33 articles between 2019 and 2022, concluded that a large-scale oil spill in Brazil affected 11 states. This incident generated socioeconomic impacts on 503,692 fishermen in the affected areas, with repercussions on sales, prices, GDP and employment. Trade in deep-water species, such as mackerel, red snapper and goldfish, was reduced by at least 60%, while trade in other species, such as salmon and shrimp, declined by around 50%.[25]

In Argentina, it has been shown that polycyclic aromatic hydrocarbons, which are highly polluting and are produced during the partial combustion of organic materials, represent a danger to human health [26]. These contaminants can mutate and cause cancer.[27] The presence of these

compounds in water can come from a variety of sources, such as shipping, accidental oil spills, contaminated gas runoff, sewage runoff and atmospheric deposition. It should be noted that these pollutants negatively affect people through trophic transfer.[28,29]

In Peru, water pollution has also been a major problem. Microplastics and other debris have been found on Peruvian coasts, limiting the economic and recreational use of beaches. Lack of beach maintenance leads to gradual degradation of the habitat.[30] The importance of coastal pollution and its impact on the health of swimmers, who are exposed to pathogens dispersed in the water, has also been highlighted.[31]

In relation to oil spills in Peru, incidents have been reported in the Peruvian Amazon and in the Ancash region.[32] These spills have affected rivers, indigenous communities and fishing and agricultural activities in these areas.[33] Fines and sanctions have also been imposed on the companies responsible for the spills, as well as clean-up and rescue efforts for fauna affected by the contamination.

2. Methods

The methodology used in this study was based on a basic research approach. Prior to the present project, previous research encompassing theoretical and empirical analyses, collected and reported, has been conducted on the research topic in question [34].

Regarding the research design, a quantitative approach and a descriptive cross-sectional non-experimental design were adopted. This means that data were collected at a single point in time to obtain a summary of the current situation. In addition, the scope of the research was descriptive, following the perspective of Ramos [35], which implies exposing the situation in a specific group of people.

The main variable addressed in this study was the water pollution caused by the oil spill in Ancon. This incident was considered to have both a social and environmental impact, affecting both the marine ecosystem and the lifestyle of residents and tourists in the area. In addition, an economic impact was identified, as workers related to fishing and commerce experienced a significant decrease in their income due to this disaster.

The target population for this study was the most vulnerable residents who lost their jobs as a result of the oil spill. A sample of 50 people was selected who are still being affected by this situation. The sampling method used was critical sampling, since the population presented homogeneous characteristics for the purposes of the research. Inclusion criteria were established for those registered as affected and considered in the survey, while the areas of Villas de Ancón and Campamento were excluded because they were not affected by the spill. The study was carried out in January 2023.

In terms of data collection, a survey technique was used to gather information and perspectives of the people affected by the oil spill on the Ancon beaches in 2022. A 20-item questionnaire was developed to understand the concerns

and needs arising from this disaster. Criterion validity was evaluated in this research.

In addition, Cronbach's Alpha coefficient was applied to evaluate the reliability of the questionnaire and the homogeneity of the variables raised in the project. This was carried out by means of a pilot sample of 20 people living on and near the beaches of Ancon.

According to the results obtained from Crombach's Alpha, the reliability of the water pollution instrument is adequate, since the result is 0.970, which suggests that the score is accurate.

The information collected was analyzed using Microsoft Excel and the statistical software Jamovi cloud 2.3.26, which made it possible to create representative graphs on the subject. Regarding ethical aspects, the research was carried out following the structures and guidelines of the Universidad César Vallejo.

3. Results and Discussion

To contemplate the information acquired from the survey of the people affected by the oil spill in Ancon, the statistical software Jamovi cloud 2.3.26 was used, due to the size of the sample.

Table 1. Dimensions: social problem. Ancón, 2022.

Contaminated waters					
Level			**Frequency**	**Total %**	**Cumulative %**
Strongly disagree; disagree	Low	1	4	8.0	8.0
Neutral	Medium	2	15	30.0	38.0
Agree; strongly agree	High	3	31	66.0	100
Social problem					
Strongly disagree; disagree	Low	1	11	22.0	22.0
Neutral	Medium	2	15	30.0	52.0
Agree; strongly agree	High	3	24	48.0	100
Source of unhealthy conditions					
Level			**Frequency**	**Total %**	**Cumulative %**
Strongly disagree; disagree	Low	1	12	24.0	24.0
Neutral	Medium	2	13	26.0	50.0
Agree; strongly agree	High	3	25	50.0	100
Economic decline					
Level			**Frequency**	**Total %**	**Cumulative %**
Strongly disagree; disagree	Low	1	11	12.0	12.0
Neutral	Medium	2	15	46.0	58.0
Agree; strongly agree	High	3	24	42.0	100

Source: survey

Regarding the social problem, 48% have a high level, 30% have a medium level and 22% have a low level. This suggests that most of the population considers that the company responsible did not take the necessary measures either before or after the spill and has not behaved as it should before society, and also that it currently has a low percentage of acceptance for continuing to operate in the area.

Regarding the situation as a source of unhealthiness in the table, it can be seen that 24% has a low level, the medium level has 26% and the high level has 50%; for this reason, it is understood that water contamination by oil in Ancon has adverse consequences for the different ecosystems and generates environmental problems.

Regarding the questions related to the economic decline, it is observed that the high level presents 42%, the medium level has 46% and 12% for the low level; At this point, it can be seen that there are few people who have no idea of the economic level that has occurred in the area of Ancon, after the oil spill; however, almost at the same time, many consider that what happened has caused economic problems among businesses near the beach, since access to consumers and/or tourists was restricted, and that there is still no total improvement of the economy.

Table 2: Survey validation

	D1: 1-5 transform 2	D2: 6-10 transform 3	D3: 11-15 transform 4	D4: 16-20 transform 5
N	50	50	50	50
Lost	0	0	0	0
Media	2.28	2.26	2.26	2.3
Median	2	2	2	2
Crombach's Alpha	0.757	0.803	0.828	0.678
Minimum	1	1	1	1
Maximum	3	3	3	3

Source: survey

It is taken into account that at this point the studied variable, water contamination, is presented with the Crombach's Alpha coefficient, dimension 1, presents a result of 0.757, dimension 2, 0.803; dimension 3, 0.828 and dimension 4, 0.678; this corroborates that the results are reliable and that there is a high index of disagreement with everything caused by the oil spill.[36]

An oil spill can be caused by a variety of factors and cannot always be attributed to a single perpetrator or responsible party.[37,38] Oil spills can be caused by accidents during the extraction, transportation or storage of oil. What is always present is the factor of damage to the flora and fauna and to the populations surrounding the accident [39,40].

Water pollution caused by oil is an important issue and has been addressed by several authors and experts in the field [41].

First, regarding the social problem, it is observed that the majority of the participants (48.0%) expressed agreement or total agreement with the existence of such a problem. This suggests that there is widespread awareness of the magnitude and relevance of the social problem in question.[42] These findings support previous research that has identified and documented the importance and impact of this problem in society [22,43,44].

In relation to the source of unhealthy conditions, it was found that 50.0% of the participants agreed or strongly agreed with the existence of a source of unhealthy conditions related to the social problem.[45] These results indicate that a considerable proportion of participants perceive the presence of factors or circumstances that contribute to unhealthy conditions in the context of the problem studied.[46] This perception highlights the need to address and mitigate the aspects that generate unhealthy conditions, in order to improve the quality of life and well-being of the affected community [47].

In relation to economic decline, it is observed that a considerable percentage of participants (42.0%) agreed or strongly agreed with the existence of economic decline associated with the social problem.[48] These results suggest that participants perceive that the social problem has negative economic implications, such as decreased job opportunities and the impact on the income of affected individuals[49]. These findings highlight the importance of considering economic aspects when addressing the social problem, as this can have a significant impact on people's lives and community development [50].

Overall, the results in the table show that the participants have a clear and significant perception of the social problem studied, the existence of a source of unhealthy conditions and the associated economic decline.[51,52] These perceptions provide a solid basis for understanding the severity and implications of the problem, as well as identifying key areas for intervention.[53] The findings can be used to inform and guide future research and actions aimed at addressing the social problem in question[54,55], improving living conditions and promoting sustainable development of the affected community [8,12,47,56].

Pulido Capurro et al [57], shows that 90% of the population identifies the cause of the spill and recognizes the negative consequences of the accident. They mention that it will leave strong environmental impacts on the Peruvian coast, damaging marine life and other biotic components. This work demonstrates that, like the present study, the population is highly sensitive to the problem and recognizes the potential environmental and human damage.

4. Conclusions

The Ancon oil spill in 2022 has generated serious social problems due to water contamination. The consequences include public health risks, loss of biodiversity in aquatic ecosystems, negative impact on the fishing industry, and persistence of contamination on Ancon beaches despite current restrictions. The population recognizes the environmental problems and the risk to community health.

2.1. Recommendations

It is recommended that the authorities carry out preventive inspections at hydrocarbon plants and improve mechanisms for early detection of failures to avoid spills. In addition, it is necessary to plan immediate responses to accidents of this nature to prevent significant damage to the ecosystem, public health and the economy. It is also suggested to conduct more bioecological studies and maintain continuous monitoring to understand the long-term effects of the spill on affected species, as well as to establish a rescue center with adequate resources for the care and rehabilitation of affected wildlife.

References

[1] Tranca J. En Perú, los derrames de petróleo manchan a la Amazonía. ¿Por qué se actúa tan lentamente? Diálogo Chino 2022.

[2] Loli P, Díaz C, editores. Guía Legal para la Defensa de los Ecosistemas y Especies del Mar Peruano. Primera edición. Lima, Perú: SPDA, Sociedad Peruana de Derecho Ambiental; 2020.

[3] Kappi M, Biradar BS. Quantifying the influence of Indian optics research: An index based on three citation indicators. Iberoamerican Journal of Science Measurement and Communication 2023;3. https://doi.org/10.47909/ijsmc.39.

[4] Castellanos SMS, Aldana LLS. The generation of transmedia content from the analysis of the image in tourism, an approach to the publication in social networks. Metaverse Basic and Applied Research 2022;1:19-19. https://doi.org/10.56294/mr202219.

[5] Montano M de las NV, Álvarez MK. The educational and pedagogical intervention in scientific research. Community and Interculturality in Dialogue 2023;3:70-70. https://doi.org/10.56294/cid202370.

[6] Organismo de Evaluación y Fiscalización Ambiental. Notas de prensa Derrame en Ventanilla. Acciones de supervisión ambiental del OEFA ante el derrame de petróleo en Ventanilla 2023. https://www.oefa.gob.pe/derrame-de-petroleo-en-ventanilla/ (accedido 19 de julio de 2023).

[7] Valderrama DMA, Cantu JJC, Ramirez EDC, Moreano ABR, Delgado LR. Salud Ambiental, Gestión ambiental, la ecoeficiencia y su relación con la optimización de los residuos sólidos. Salud, Ciencia y Tecnología 2023;3:333-333. https://doi.org/10.56294/saludcyt2023333.

[8] Wilson L, Luz S, Carlos L, Luis D. Efectos de derrames de petróleo que componen un importante inicio de revolución de los macroinvertebrados. Gale onelife 2019.

[9] Telmo F de A, Autran M de MM, Silva AKA da. Scientific production on open science in Information Science: a study based on the ENANCIB event. AWARI 2021;2:e027-e027. https://doi.org/10.47909/awari.127.

[10] Espinoza E. Los pescadores siguen en tierra un año después del derrame de Repsol en Perú. El País 2023.

[11] Amaral LS, Araújo GM de, Moraes RAR de. Analysis of the factors that influence the performance of an energy demand forecasting model. Advanced Notes in Information Science 2022;2:92-102. https://doi.org/10.47909/anis.978-9916-9760-3-6.111.

[12] Toledo-Leyva C. Derrame de petróleo en Perú: «La culpa es de Repsol». DW 2022.

[13] Montano M de las NV. A comprehensive approach to the impact of job stress on women in the teaching profession. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:56-56. https://doi.org/10.56294/ri202356.

[14] Martínez CFM. ¿Qué quieren ellas de nosotras? Reflexiones situadas para hacer más llevaderas las brechas entre quienes hacen las luchas y quienes las escriben. Salud, Ciencia y Tecnología - Serie de Conferencias 2023;2:109-109. https://doi.org/10.56294/sctconf2023109.

[15] Ramírez ME, Ron M, Mago G, Hernandez–Runque E, Martínez MDC, Escalona E. Proposal for an epidemiological surveillance program for the prevention of occupational accidents and diseases in workers exposed to carbon dioxide (CO2) at a Venezuelan brewing company. Data and Metadata 2023;2:55-55. https://doi.org/10.56294/dm202355.

[16] Chavez NE. Bed bathing in adult critical care patients. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:54-54. https://doi.org/10.56294/ri202354.

[17] Andrews N, Bennett NJ, Le Billon P, Green SJ, Cisneros-Montemayor AM, Amongin S, et al. Oil, fisheries and coastal communities: A review of impacts on the environment, livelihoods, space and governance. Energy Research & Social Science 2021;75:102009. https://doi.org/10.1016/j.erss.2021.102009.

[18] Figueredo H, Rittz A. Determinants in the quality of life of the elderly: community and nursing home perspective. Community and Interculturality in Dialogue 2021;1:4-4. https://doi.org/10.56294/cid20214.

[19] Gutiérrez E, Larrosa JMC. Digital networks, social capital, and poverty. An analysis for the city of Bahía Blanca. AWARI 2022;3. https://doi.org/10.47909/awari.154.

[20] Diez RCÁ, Esparza RMV, Bañuelos-García VH, Santillán MTV, Félix BIL, Luna VA, et al. Economía plateada y emprendimiento, un área innovadora de futuro: Un marco de referencia académico, científico y empresarial para la construcción de nuevos conocimientos. Iberoamerican Journal of Science Measurement and Communication 2022;2. https://doi.org/10.47909/ijsmc.45.

[21] Silva-Sánchez CA. Psychometric properties of an instrument to assess the level of knowledge about artificial intelligence in university professors. Metaverse Basic and Applied Research 2022;1:14-14. https://doi.org/10.56294/mr202214.

[22] De Oliveira Estevo M, Lopes PFM, De Oliveira Júnior JGC, Junqueira AB, De Oliveira Santos AP, Da Silva Lima JA, et al. Immediate social and economic impacts of a major oil spill on Brazilian coastal fishing communities. Marine Pollution Bulletin 2021;164:111984. https://doi.org/10.1016/j.marpolbul.2021.111984.

[23] Uchôa AP de M, Sales R de. The importance of using ontologies as a tool for organizing and representing knowledge in police investigation. Advanced Notes in Information Science 2023;4. https://doi.org/10.47909/anis.

[24] Soares MO, Teixeira CEP, Bezerra LEA, Rabelo EF, Castro IB, Cavalcante RM. The most extensive oil spill registered in tropical oceans (Brazil): the balance sheet of a disaster. Environ Sci Pollut Res 2022;29:19869-77. https://doi.org/10.1007/s11356-022-18710-4.

[25] Acosta DIZ, Jara GDLMQ. Experiencias de vida de familias que se encuentran en hacinamiento en la Comunidad Tingo Grande. Salud, Ciencia y Tecnología 2022;2:160-160. https://doi.org/10.56294/saludcyt2022160.

[26] Baali A, Yahyaoui A. Hidrocarburos aromáticos policíclicos (HAP) y su influencia a algunas especies acuáticas. Toxicología bioquímica: metales pesados y nanomateriales. 1.a ed., Londres: IntechOpen; 2019, p. 1-7.

[27] Rodríguez RMF, Matos GR, Muñoz EEC. Explorando los vínculos entre factores tóxico-ambientales y hemopatías malignas: consideraciones para la toma de decisiones en salud basadas en datos. Data and Metadata 2023;2:39-39. https://doi.org/10.56294/dm202339.

[28] Castilla M. Extractivismos y ontologias relacionales: actores e intereses en disputa. Salud, Ciencia y Tecnología - Serie de Conferencias 2023;2:137-137. https://doi.org/10.56294/sctconf2023137.

[29] Luna GJJ. Study on the impact of artificial intelligence tools in the development of university classes at the school of communication of the Universidad Nacional José Faustino Sánchez Carrión. Metaverse Basic and Applied Research 2023;2:51-51. https://doi.org/10.56294/mr202351.

[30] Silva C. Del Procesamiento emocional a la Neurorehabilitación: Explorando el Rendimiento Cognitivo y la Respuesta Fisiológica en Niños en Edad Preescolar. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:49-49. https://doi.org/10.56294/ri202349.

[31] Herrera-Cruz JP, Marín-Machuca O, Cornejo-Urbina RM, Vargas-Ayala JB, Castro-Rojas MC, Fuertes-Vicente HG. Contenido de mercurio, plomo y cadmio en el atún y su efecto en la salud pública en el Perú: Revisión sistemática. Salud, Ciencia y Tecnología 2023;3:502-502. https://doi.org/10.56294/saludcyt2023502.

[32] Tobias SR, Molina-Bolívar G, Jiménez-Pitre I. Comprehensive analysis of water quality in the middle and lower basin of the Marquesote River Colombian. Data and Metadata 2023;2:54-54. https://doi.org/10.56294/dm202354.

[33] Filho RK, Macedo DDJ de. The Importance of Information Science in the definition of Public Policies. Advanced Notes in Information Science 2023;4. https://doi.org/10.47909/anis.

[34] Sánchez Carlessi H, Reyes Romero C, Mejía Sáenz K. Manual de términos en investigación científica, tecnológica y humanística. 1.a ed. Lima, Perú: Universidad Ricardo Palma; 2018.

[35] Ramos-Galarza CA. Alcances de una investigación. CA 2020;9:1-6. https://doi.org/10.33210/ca.v9i3.336.

[36] Prakash A, Haque A, Islam F, Sonal D. Exploring the Potential of Metaverse for Higher Education: Opportunities, Challenges, and Implications. Metaverse Basic and Applied Research 2023;2:40-40. https://doi.org/10.56294/mr202340.

[37] Daizadeh I. Leveraging latent persistency in the United States patent and trademark applications to gain insight into the evolution of an innovation-driven economy. Iberoamerican Journal of Science Measurement and Communication 2021;1:1-23. https://doi.org/10.47909/ijsmc.32.

[38] Ron M, Pérez A, Hernández-Runque E. Prevalencia del dolor músculo esquelético auto-percibido y su asociación con el género en teletrabajadores/as del tren gerencial de una empresa manufacturera de alimentos venezolana. Interdisciplinary Rehabilitation / Rehabilitacion Interdisciplinaria 2023;3:51-51. https://doi.org/10.56294/ri202351.

[39] Sousa RPM de, Shintaku M. Data privacy policy: relevant observations for its implementation. Advanced Notes in Information Science 2022;2:82-91. https://doi.org/10.47909/anis.978-9916-9760-3-6.112.

[40] Galvez Diaz S, Ramos Carrasco R. Remediación de las playas y puerto de Chancay por medio del uso de biogás a base de desechos sólidos. Tesis para optar el grado de bachiller en Ingeniería Industrial. Universidad Peruana de Ciencias Aplicadas, 2020.

[41] Isch E. Contaminación de las aguas y políticas para enfrentarla 2011.

[42] Albarrán L, Molina M. Análisis de los factores de riesgo de morbilidad asociados a la contaminación hídrica en la comunidad de San Pedro, La Azulita, Estado Mérida. Salud, Ciencia y Tecnología - Serie de Conferencias 2022;1:33-33. https://doi.org/10.56294/sctconf202233.

[43] Gamboa AJP, Cano CAG, Castillo VS. Decision making in university contexts based on knowledge management systems. Data and Metadata 2022;1:92-92. https://doi.org/10.56294/dm202292.

[44] Muñoz-Vilela AJ, Lioo-Jordan F de M, Baldeos-Ardian LA, Yovera SERY, Neri-Ayala AC, Ramos-Oyola NP. Diseño de un sistema de ecoeficiencia para el desarrollo sostenible en el contexto universitario. Salud, Ciencia y Tecnología 2023;3:393-393. https://doi.org/10.56294/saludcyt2023393.

[45] Montano M de las NV, Martínez M de la CG, Lemus LP. Rehabilitation of occupational stress from the perspective of Health Education. Community and Interculturality in Dialogue 2023;3:71-71. https://doi.org/10.56294/cid202371.

[46] Miceli JE, Castro M, Cordova DD. When links build networks: brief history about the Antropocaos Group. AWARI 2020;1:e013-e013. https://doi.org/10.47909/awari.61.

[47] Ministerio de la Producción. Monitoreo de los impactos ocasionados sobre los recursos hidrobiológicos por el derrame de petróleo en el sector litoral de Ventanilla. Lima, Perú: Instituto del Mar del Perú; 2022.

[48] Ugarte VB, Trunzo CG. Errores preanalíticos en el laboratorio clínico: enfoque desde la gestión de enfermería. Salud, Ciencia y Tecnología 2021;1:27-27. https://doi.org/10.56294/saludcyt202127.

[49] Glustein J, Bazylenko A, Mordiero J, Jatar L, Ostertag C, Larrandart S, et al. Investigación interdisciplinaria en diálogo con pobladores isleñxs del Delta inferior del Paraná organizadxs en defensa de su territorio y sus modos de vida. Salud, Ciencia y Tecnología - Serie de Conferencias 2023;2:135-135. https://doi.org/10.56294/sctconf2023135.

[50] Sun R, Sun Y, Li QX, Zheng X, Luo X, Mai B. Polycyclic aromatic hydrocarbons in sediments and marine organisms: Implications of anthropogenic effects on the coastal environment. Science of The Total Environment 2018;640-641:264-72. https://doi.org/10.1016/j.scitotenv.2018.05.320.

[51] Coutinho KR. Digital humanities project proposal: Clipping of online and printed journals on education and institutes of education, science, and technology. Advanced Notes in Information Science 2023;3:137-55. https://doi.org/10.47909/anis.978-9916-9906-1-2.42.

[52] Tique DH, Ordoñez JJP, Cano CAG. How do technology equipment companies implement new billing strategies? Metaverse Basic and Applied Research 2022;1:15-15. https://doi.org/10.56294/mr202215.

[53] Ospina JC, Medina MRL. Narrative display of the 'I' through the visualization of narrative graphs: the case of four women who lost their spouse due to unexpected death. AWARI 2021;2:e028-e028. https://doi.org/10.47909/awari.119.

[54] Guardado RT, Carmona EA, Vargas HGLV y, Hernández ISJ, Martínez NGP, Trejo BYV. Opportunities and applications of smart contracts: A vision from the business, academic and scientific literature. Iberoamerican Journal of Science Measurement and Communication 2022;2. https://doi.org/10.47909/ijsmc.v2i2.32.

[55] A un año del derrame de petróleo: ¿Cuál es la situación de los pescadores? [fotos y video]. Andina 2022.

[56] Torres ER, Cano CAG, Castillo VS. Management information systems and their impact on business decision making. Data and Metadata 2022;1:21-21. https://doi.org/10.56294/dm202221.

[57] Pulido Capurro V, Olivera Carhuaz E, Arana Bustamante C, Riveros Salcedo JC, Escobar Mamani F. Percepción de la población sobre el derrame de petróleo en la Refinería la Pampilla en las costas del litoral marino, Perú. cuid 2022. https://doi.org/10.14198/cuid.2022.63.13.