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Advancing Sustainable Practices: Exploring Alternatives for Wastewater reuse and Nutrient Recovery from Production Effluents

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Abstract

A systematic review was carried out on the production and publication of research papers related to the study of the variables Wastewater, Reuse, Recovery and Production Effluents, the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) approach. The purpose of the analysis proposed in this document was to know the main characteristics of the publications registered in the Scopus and Wos databases and their scope in the study of the proposed variables, achieving the identification of 31 publications in total. Thanks to this first identification, it was possible to refine the results through the keywords entered in the search button of both platforms, which were WASTEWATER, REUSE, RECOVERY, PRODUCTION EFFLUENTS, reaching a total of 13 documents, excluding duplicates and those that did not meet the analysis criteria. From this analysis, it is expected to know the contributions of the scientific community to the study of the ethical implications of each advance registered in the field of wastewater reuse, as sustainable and innovative practices in order to design alternatives for the recovery of nutrients from production effluents.

Keywords: *WASTEWATER, REUSE, RECOVERY, PRODUCTION EFFLUENTS.*

1. Introduction

In the emergence of a sustainable economy, several economic sectors such as agriculture and environmental management have been interested in applying sustainable development models based on the practice of wastewater reuse and nutrient extraction from animal production sources, as this practice has emerged as an innovative solution to address the present challenges caused by water scarcity. the impact of nutrient pollution and environmental damage from agriculture. As governments and government entities around the world face a shortage and a high market supply and demand for food to feed an ever-growing world population, it has become in the general interest to find effective and eco-friendly solutions to properly manage the waste generated by the animal production area.

The development of the agricultural sector has been the most important and initial phase in the economic development and well-being of many countries, and agriculture remains

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key to food security and growth in much of the world. "Water reuse for agriculture and the environment" Likewise, the use of water reclaimed by agriculture could play a complementary source of water that helps minimize overexploitation and thus reduce the amount of fertilizers used in agriculture. However, animal production facilities, whether livestock, aquaculture or others, generate large amounts of wastewater loaded with organized matter and essential nutrients. Traditional models of production, where wastewater was often considered a problem, as it led to water pollution and the waste of valuable resources. "Elimination and recovery of nutrients from wastewater" based on the data presented, the aim is to ensure the quality of water, and a constant need for the recovery of nutrients, such as nitrogen and phosphorus, for future use, taking a step towards the circular economy.(Melián-Navarro, 2016)(Cid Rubio, 2023)

This prominent change to achieve the adoption of good sustainable practices such as wastewater treatment, reuse and recovery of nutrients present in these waters such as nitrogen and phosphorus "Wastewater from the fishing industry: Challenges and opportunities in the recovery of proteins and peptides with high biological and functional value" these reuse practices not only seek to mitigate the environmental impacts present in aquaculture or Other areas of animal production such as livestock farming, it also offers significant advantages such as increased agricultural productivity, better water consumption of water resources and reduced dependence on synthetic fertilizers. (Aarón Jonary Santiaguín-Padilla, 2023)

In this vast path of exploration of good sustainable practices, the present innovative strategies employed for the recovery and reuse of wastewater, where the integration of advanced treatment technologies, up to nutrient-rich by-products and the various applications of wastewater "Sustainable technologies for the purification and treatment of wastewater" these future changes lead us to greater sustainability which is vital for Guarantee food security over time and at the same time correctly preserve limited natural resources that we have at our disposal and protect the health of our environmental ecosystems. (Morató Farreras, 2016)

2. General Objective

To analyze, from a bibliometric and bibliographic perspective, the production of research papers on the variables Wastewater, Reuse, Recovery and Production Effluents, published in high-impact journals indexed in the Scopus and Wos databases by Latin American institutions.

3. Methodology

The present research is qualitative, according to Hernández, et al., qualitative approaches correspond to the investigations that carry out the procedure of obtaining information to review and interpret the results obtained in these studies; To do this, it searched for information in the Scopus and Wos databases using the words WASTEWATER, REUSE, RECOVERY, PRODUCTION EFFLUENTS. (2015)

Scopus

TITLE-ABS-KEY (wastewater, AND reuse, AND recovery, AND production AND effluents) AND PUBYEAR > 2016 AND PUBYEAR < 2023 AND (LIMIT-TO (AFFILCOUNTRY , "Brazil") OR LIMIT-TO (AFFILCOUNTRY , "Mexico") OR LIMIT-TO (AFFILCOUNTRY , "Venezuela")

Wos

Publication Years: 2022 or 2021 or 2020 or 2019 or 2018 or 2017. Click to remove this refine from your search. Countries/Regions: BRAZIL or MEXICO or CHILE or ECUADOR. Click to remove this refine from your search.

3.1 Research design

The research design proposed for the present research was the Systematic Review that involves a set of guidelines to carry out the analysis of the collected data, which are framed in a process that began with the coding to the visualization of theories On the other hand, it is stated that the text corresponds to a descriptive narrative since it is intended to find out how the levels of the variable affect; and systematic, because after reviewing the academic material obtained from scientific journals, theories on knowledge management were analyzed and interpreted. (Strauss & Corbin, 2016) (Hernandez, Baptista, & Fernandez, 2015)

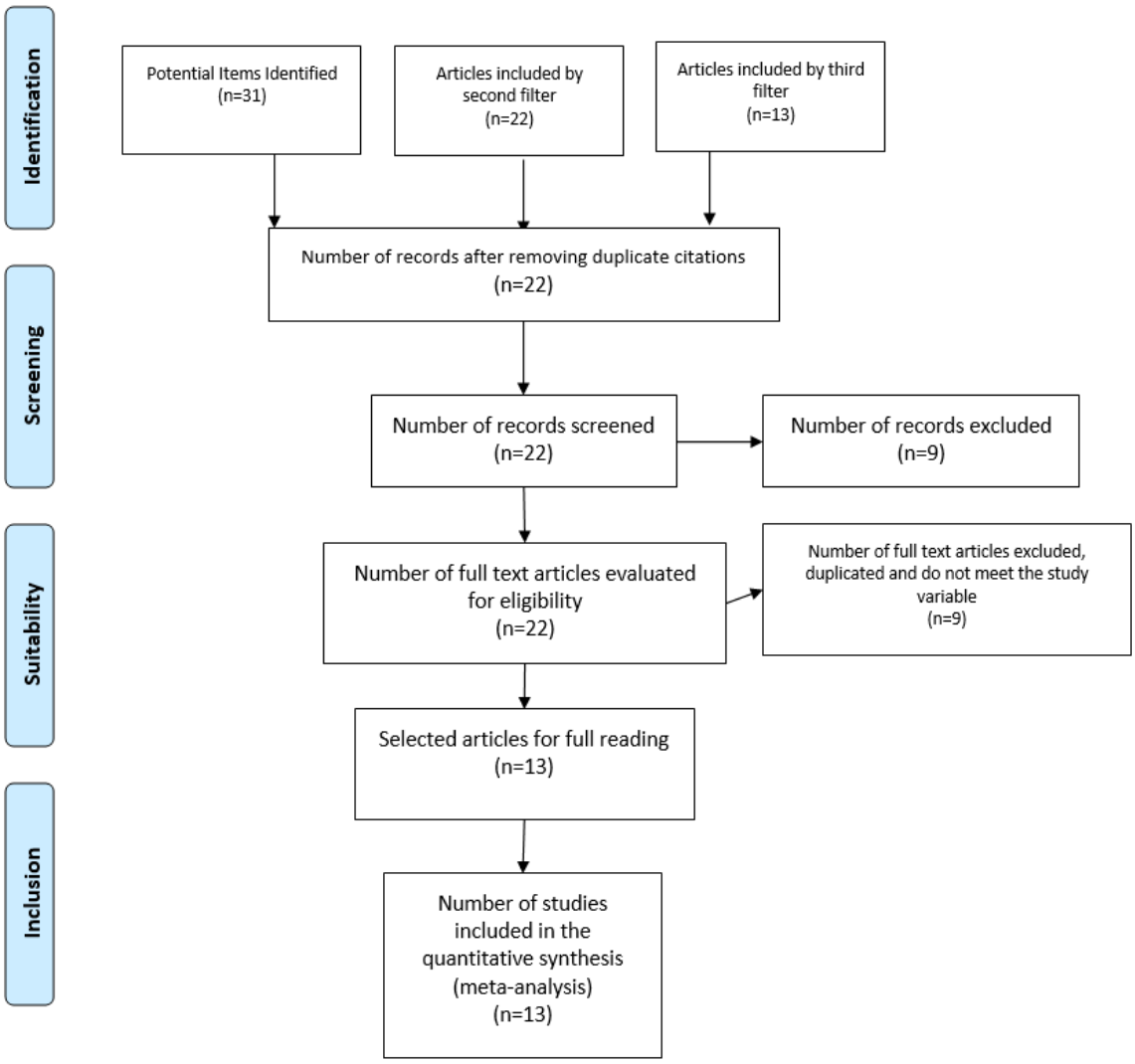

Figure 1. Flowchart of a systematic review carried out under the PRISMA technique (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

Source: Authors' own creation; Based on the proposal of the Prisma Group (Moher, Liberati, Tetzlaff, Altman, & Group, 2009)

4. Results

Table 1 shows the results after applying the search filters related to the methodology proposed for this research, after recognizing the relevance of each of the referenced works.

No	RESEARCH TITLE	AUTHOR/YEAR	COUNTRY	TYPE OF STUDY	INDEXING
1	Treatment of real wastewater by photoelectrochemical methods: An overview	Divyapriya, G., Singh, S., Martinez-Huitle, C. A., Scaria, J., Karim, A. V., & Nidheesh, P. V. (2021).	INDIA, UNITED STATES, BRAZIL	Qualitative	Scopus
2	Optimization of flocculation with tannin-based flocculant in the water reuse and lipidic production for the cultivation of Acutodesmus obliquus	Hesse, M. C. S., Santos, B., Selesu, N. F. H., Correa, D. O., Mariano, A. B., Vargas, J. V. C., & Vieira, R. B. (2017).	BRAZIL	Qualitative	Scopus
3	Nutrients recovery and organic matter degradation from cropland wastewater by an optimized UV/H2O2 system	Reyes-Prado, M. A., Ramírez-Pereda, B., Ramírez, K., Huitrón, V. G., Rodríguez-Mata, A. E., Uriarte Aceves, P. M., & Amabilis-Sosa, L. E. (2022).	MEXICO	Quantitative	Scopus
4	Characterization of the stratigraphic column in an extra heavy oil field to optimize production costs, from the disposal of wastewater effluents to the evaluation of shallow aquifers for water production. Cerro Negro Area, Venezuela	Rodríguez, I., Hernández, E., Velásquez, R., Fernández, J., Yegres, F., Martínez, R., ... & Korabelnikov, A. (2018, December)	VENEZUELA	Quantitative	Scopus
5	Direct membrane filtration (DMF) of municipal wastewater by mixed matrix membranes (MMMs)	Subtil, E. L., Ragio, R. A., Lemos, H. G., Scaratti, G.,	BRAZIL, SPAIN, AUSTRALIA	Quantitative	Scopus

	filled with graphene oxide (GO): Towards a circular sanitation model	García, J., & Le-Clech, P. (2022)			
6	Dairy manure wastewater in serial UASB reactors for energy recovery and potential effluent reuse	Montoya, A. C. V., Mazareli, R. D. S., DA Silva, D. C., de Oliveira, R. A., & Leite, V. D. (2017)	BRAZIL	Qualitative	Scopus
7	Electrocoagulation coupled adsorption for anaerobic wastewater post-treatment and reuse purposes	Pizutti, J. T., Santos, R. D. C. D., Hemkemeier, M., & Piccin, J. S. (2019).	BRAZIL	Qualitative	Scopus
8	Membrane Water Treatment for Drinking Water Production from an Industrial Effluent Used in the Manufacturing of Food Additives	Hernández, K., Muro, C., Monroy, O., Díaz-Blancas, V., Alvarado, Y., & Díaz, M. D. C. (2022).	MEXICO	Qualitative	Scopus
9	Industrial reuse of effluent in the integrated urban water management	Bilotta, P; Souza, CMD; de Aguiar, PD; Sampalo, CAC	BRAZIL	Qualitative	WOS
10	Optimization of Coagulation/Flocculation Treatment of Brewery Wastewater Employing Organic Flocculant Based of Vegetable Tannin	Tonhato Junior, A., Hasan, S. D. M., & Sebastien, N. Y. (2019).	BRAZIL	Quantitative	WOS
11	Electrochemical treatment of slaughterhouse and dairy wastewater: Toward making a sustainable process	Sandoval, M. A., & Salazar, R. (2021)	CHILE	Qualitative	WOS
	Eco-efficiency analysis of desalination by precipitation integrated with reverse osmosis for zero liquid discharge in oil refineries	Ronquim, F. M., Sakamoto, H. M., Mierzwa, J. C., Kulay, L., & Seckler, M. M. (2020).	BRAZIL	Quantitative	WOS

	Adsorption of naphthalene polycyclic aromatic hydrocarbon from wastewater by a green magnetic composite based on chitosan and graphene oxide	Queiroz, R. N., da Silva, M. G. C., Mastelaro, V. R., Prediger, P., & Vieira, M. G. A. (2023).	BRAZIL	Qualitative	WOS

Table 1. List of articles analysed

Source: Authors' own creation

4.1 Co-occurrence of words

Figure 2 shows the relationship between the keywords used to search for the study material for the systematic analysis proposed for this research.

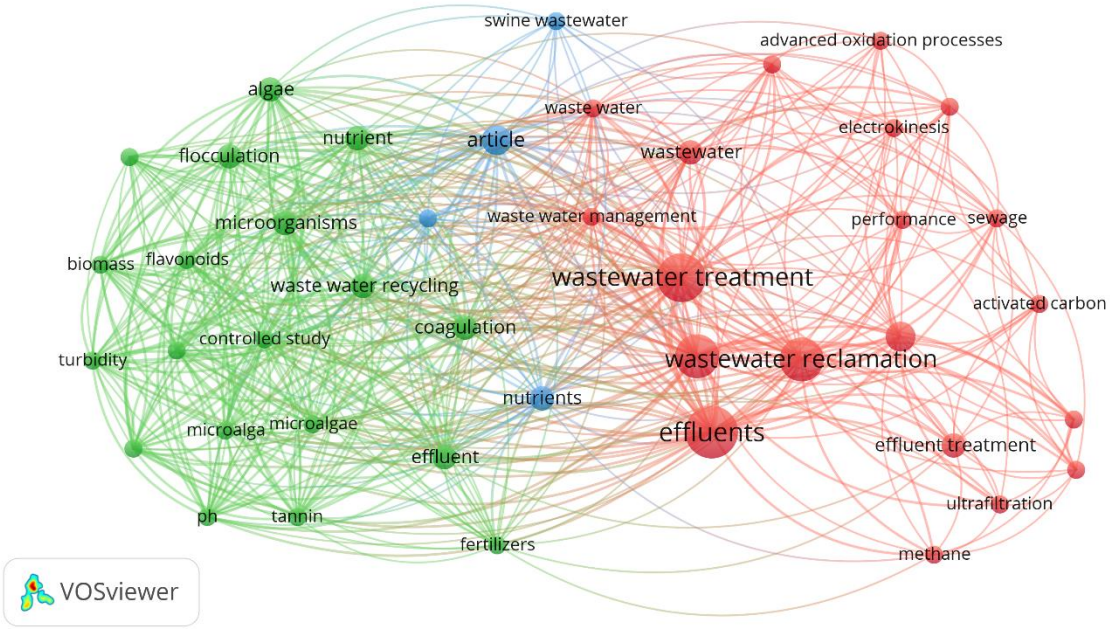

Figure 2. Co-occurrence of keywords.

Source: Authors' own creation

Figure 2 shows the most frequently used keywords and their correlation with research on topics associated with the problems of Wastewater, Reuse, Recovery and Production Effluents. In this way, it is possible to affirm that Wastewater Treatment is the central axis of the research identified for the analysis developed in this article, directly related to research in Wastewater Recovery, Microorganisms, Effluent Treatment, Effluents, Sustainable Practices, Waste Recycling, among others, which allow confirming the reuse of treated wastewater for irrigation and other non-potable uses. demand for freshwater resources, especially in areas facing water scarcity. Improving water use efficiency and conserving limited freshwater reserves leads to nutrient recovery as this not only reduces the need for synthetic fertilizers, but also utilizes valuable nutrients from animal waste, creating a closed-loop system that minimizes nutrient waste. Considering sustainability over time, the implementation of such practices is crucial for the long-term sustainability of livestock farming. As global populations and demand for food continue to grow, managing the environmental impacts of animal production is essential to ensure a resilient and sustainable food system. These practices can help mitigate the negative

externalities associated with animal production, thereby fostering a more harmonious coexistence between agriculture and the environment.

4.2 Discussion

The purpose of this article was to analyze, from a systematic perspective, the contribution of the authors, through their publications, to the study of the variables Wastewater, Reuse, Recovery and Production Effluents, carried out in high-impact journals indexed in Scopus and Wos databases during the period 2018-2021 by authors affiliated with Latin American institutions. In this way, it is possible to affirm that the publications indicated in the body of this document, have carried out research at different levels whose findings contribute to the generation of new knowledge regarding the variables proposed for this study, this is how great contributions are identified as contemplated in the article entitled "Treatment of real wastewater by photoelectrochemical methods: An Overview" whose objective was the use of photoelectrochemical methods as they are emerging as a promising option for oxidation processes for greater efficiency of wastewater treatment due to the synergistic effects of photochemical reactions and combined electrolysis, this in order to improve the mineralization capacity through various secondary reactions. By means of this, it is reviewed as the photoelectrochemical treatment of real wastewater such as leachate from landfills, oil mills, pharmaceutical wastewater, textiles and tanneries. The efficiency of hydrogen production in the photoelectrochemical process is further detailed. It reports on the costs and energy involved in these processes, but also summarises the applicability of photocatalytic fuel cells to reduce electrical dependence. Finally, the use of photoelectrochemical approaches as an alternative for the treatment of soil washing effluents is currently being discussed. Therefore, it is absolutely necessary to know first-hand the real needs of them in order to line strategies that pursue success within their training. Supporting the above idea, the contribution made by the development of the article entitled "Electrochemical treatment of wastewater from slaughterhouses and dairy: towards a sustainable process" whose objective is based on reviewing the application of electrochemical treatments to wastewater from the livestock sector is evidenced. In addition, a general review of value-added products and the energy valuation of these industrial wastewaters with long-term perspectives is also presented, since the industrial processing of meat and dairy production uses large amounts of fresh water, so a significant volume of wastewater is evident. The treatment of these effluents has been carried out using different technologies, from biological processes to electrochemical processes of advanced oxidation. Under the concept of circular economy, the lack of available freshwater resources has increased interest in the reuse of slaughterhouse wastewater, and even in the recovery of by-products. However, like any methodology, it is not exempt from presenting problems through its use, as shown in the article entitled "Characterization of the stratigraphic column in an extra-heavy oil field to optimize production costs, from the disposal of wastewater effluents to the evaluation of shallow aquifers for water production. Cerro Negro Zone, Venezuela" whose purpose was to describe the case study of the Cerro Negro Oil Field where, on the one hand, a static and dynamic characterization of the Jobo Member was carried out in order to define the potential areas to be used as wastewater disposal from the production of the Morichal Member. Based on the geological characterization, dynamic evaluation and analysis of the surface facilities, it was selected as the best area to have more than 35,000 B/D of water derived from the production of 330 horizontal wells drilled; as well as, to support the strategy of producing wells with high water cuts in areas of perched water and close to water contacts, where a significant volume of oil is located that until now has been bypassed. On the other hand, the characterization of the Las Piedras aquifer has allowed us to define the volume and composition of the water available to use as a source of safe and probed water during the implementation of the EOR project. As a result of the implementation of these strategies, project management is expected to have an effect on infrastructure cost savings related to the non-reconstruction/replacement of a 30 km pipeline connecting to an aquifer located outside the field, in El Campo Salto (also

located in the Orinoco Oil Belt), since the production of wastewater would be disposed of in the Jobo Member located in the Cerro Negro Field. It is expected that this study will open the possibility of considering a broader plan that could involve other extra-heavy oil fields of the Orinoco Oil Belt, in order to use the entire geological column located in the same concession area, to reduce costs, minimize environmental impact. optimize production and make extra-heavy oil projects similar to this one in Venezuela more viable.(G. Divyapriya, 2021)(Miguel A. Sandoval, 2021)(Rodriguez, y otros, 2018)

5. Conclusions

This review article concludes by highlighting the importance of knowing the updated status of the bibliography published in databases such as Scopus or Wos, referring to the study of Wastewater, Reuse, Recovery and Production Effluents during the period between 2018 and 2021, and how the implementation of good sustainable practices in the reuse of wastewater and extraction of nutrients from animal production sources are vital for address current environmental and agricultural challenges at a global level. The current advances for sustainability and efficiency in the reuse of wastewater prominent from animal production have millions of benefits to keep in mind, since these practices help to conserve the ecosystems and environments, which allows for greater efficiency in water resources which allows for a sustainable economic viability in the long term. The non-management of wastewater generated by animal production can be the trigger for bad environmental pollution practices, for this reason it is important to take into account reuse models, good sustainable practices, treatment management and reuse of wastewater help these animal production models directly minimize the negative polluting effects on the environment such as, pollution of water sources and the reduction of greenhouse effects. Sustainable wastewater reuse and nutrient recovery practices can be financially beneficial for animal producers, as these can lead to cost savings through lower water consumption, lower waste disposal costs, and the creation of value-added products from recovered nutrients. These practices also have the potential to exponentially increase consumer demand for environmentally sustainable and environmentally responsible production, which has the potential to exponentially increase markets and producer profitability. It should be noted that the success of these sustainability advances lies in the importance of the implementation of the new technologies offered by this era, since the regulatory support and interested entities. In addition, the methods and advances in sustainable practices implemented for the reuse of animal production wastewater represent a vital step towards a more environmentally responsible and economically viable agriculture as they contribute to environmental preservation, resource efficiency and the long-term sustainability of the industry.

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