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BIBLIOMETRIC MAPPING ANALYSIS OF BLUE ECONOMY, SUSTAINABLE RIVER ECONOMY, AND ECO-ENZYME IN BLUE GOLD

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Abstrak
Penelitian ini menggunakan metode kajian literatur bibliometrik untuk mengelaborasi eco enzyme, ekonomi biru, dan ekosistem sungai berkelanjutan. Tujuan dari studi ini adalah memetakan penelitian tentang keterkaitan eco enzyme dengan ekosistem sungai yang bersih dan sehat bagi pertumbuhan ekonomi berkelanjutan selama periode 2019 – 2023 dengan menggunakan database Scopus. Hasil penelitian menunjukkan bahwa terjadi fluktuasi dalam jumlah publikasi, dimana akhir periode observasi menunjukkan trend kenaikan. Visualisasi jaringan mengidentifikasi terdapat empat klaster utama penelitian yaitu klaster merah, hijau, kuning, dan biru. Kluster merah berfokus pada aspek-aspek kebijakan, pemerintahan, dan pertimbangan ekosistem yang lebih luas. Kluster hijau berfokus pada manfaat langsung dari pembangunan berkelanjutan. Kluster kuning berfokus pada aspek-aspek global dan kebijakan pembangunan berkelanjutan. Sedangkan Kluster biru berfokus pada basis pengetahuan atau literatur yang terkait dengan sustainable blue economy. Temuan ini memberikan wawasan berharga bagi pemerintah dan masyarakat dalam pengelolaan limbah untuk tercapainya Blue Gold Economy.
Kata kunci: Ekonomi Biru, Eco-enzyme, Ekosistem Sungai, Blue Gold, Bibliometrik

Abstract
This study uses a bibliometric literature review method to elaborate on eco enzymes, blue economy, and sustainable river ecosystems. The purpose of this study is to map research on the relationship between eco enzymes and clean and healthy river ecosystems for sustainable economic growth during the period 2019 – 2023 using the Scopus database. The results showed that there was a fluctuation in the number of publications, where the end of the observation period showed an upward trend. The network visualization identified four main research clusters: red, green, yellow, and blue. The red cluster focuses on aspects of policy, governance, and broader ecosystem considerations. The green cluster focuses on the immediate benefits of sustainable development. The yellow cluster focuses on global aspects and sustainable development policies. Meanwhile, the blue cluster focuses on the knowledge base or literature related to the sustainable blue economy. This finding provides valuable insights for the government and the community in waste management to achieve the Blue Gold Economy.
Keywords: Blue Economy, Eco-enzyme, River Ecosystem, Blue Gold, Bibliometric.

Introduction

The increasingly complex global environmental challenges have driven innovative efforts in natural resource management, including the management of river ecosystems. One approach gaining attention is the concept of "Economic Blue Gold," which refers to the economic and ecological value of sustainably managed water resources. Ilma (2014) reinforces this by stating that the blue economy is a concept aimed at optimizing water resources to boost economic growth through innovative and creative activities while ensuring business sustainability and environmental preservation. The introduction of eco-enzymes, biochemical products derived from the fermentation of organic waste, is believed to enhance water quality and support the rehabilitation of aquatic ecosystems. The use of eco-enzymes has emerged as a potential solution for supporting a sustainable river economy (Bernadn et al 2017).

Research on the topic of "Mapping the Eco-Enzyme System Model to Achieve a Blue Gold Sustainable River Economy: A Bibliometric Approach" has not been previously conducted. This study's novelty lies in using a bibliometric approach to map the eco-enzyme system model within the context of a sustainable river economy. Through bibliometric analysis, the study identifies research trends, inter-topic connections, and key contributors to the development of this field. This mapping is crucial for understanding the current research landscape and identifying areas that require further attention, whether in technology development or policy implementation.

The eco-enzyme system model in this context aims to address the main challenges in sustainable river management, such as water pollution, public awareness of health, aquatic ecosystems, and the economic growth potential of rivers. By integrating eco-enzymes into river management practices, the study hopes to achieve efficiency in water quality restoration and biodiversity conservation, ultimately supporting the development of a sustainable river-based economy.

This study aims to map the development of the eco-enzyme concept in scientific literature and identify its potential contributions to achieving water resource-based sustainable economic goals, often referred to as "Blue Gold." Through a bibliometric approach, this article will provide a comprehensive overview of the evolution and dynamics of research related to eco-enzymes and their relevance in supporting a sustainable river economy.

Blue Gold

Water is one of the most valuable resources for all living beings and their functionality. The awareness of water's importance as a valuable resource has gradually been recognized, leading to its transformation into an economic commodity. This trend peaked at the Dublin Conference, which concluded that water should be considered a private or economic commodity in all its uses (Gorre-Dale, 1992). Consequently, water resources (rivers and oceans) have gradually become contaminated by industrial pollution and human activities, affecting not only human health but also hindering sustainable social development (Xu et al., 2022a). The importance of water management has led to the emergence of the Blue Gold concept, which aims to optimize water resource conservation while acknowledging their economic potential for social development.

The Blue Gold concept is generally understood as referring to water resources, particularly freshwater, which are extremely valuable. The term reflects the understanding that water is a highly valuable commodity, comparable to gold. Water resources have the potential to provide economic value across various sectors such as agriculture, industry, energy, and

consumption. This awareness has driven companies to exploit water resources, often benefiting only specific groups (Jusuf, 2015). The Blue Gold concept promotes innovative measures that ensure the equitable distribution of water resources nationally and encourage sustainable water use and freshwater ecosystem conservation (Barlow & Clarke, 2017).

Blue Economy

The Blue Economy is a discipline aimed at transitioning resources from scarcity to abundance while addressing various issues contributing to environmental problems (Kathijotes, 2013). Economic activities that focus on marine dependency are often connected to other economic sectors such as tourism, maritime transport, energy, and fisheries. The growth of the Blue Economy aims to support sustainable development in maritime and marine sectors, recognizing that oceans and seas drive the global economy and have significant potential to foster growth and innovation (Vázquez et al, 2021). In other words, the Blue Economy is a macroeconomic concept involving various elements such as global and national governance, economic development, environmental conservation, and international diplomacy.

The core principle of the Blue Economy is to achieve sustainable prosperity at the national or regional level by ensuring the well-being of all communities and environmental preservation, particularly of marine ecosystems (Bari, 2017). Implementing this principle presents numerous challenges that involve all stakeholders, including private industry sectors, research institutions, civil society organizations, and governments, demanding a holistic and synergistic approach. To address these challenges, the European Union proposed the "Growth Blue" strategy in 2012, which includes three key aspects:

1. Utilizing the high potential of maritime sectors to drive economic growth and create jobs;
2. Providing a comprehensive framework through the development of knowledge, regulations, and security; and Encouraging regional cooperation to ensure sustainable marine resource management (Wenhai et al, 2019). This strategy highlights the importance of international collaboration in achieving Blue Economy goals and inspires other countries to develop similar policies.

Balancing socio-economic activities with marine ecosystem conservation requires strategies that include the efficient use of marine resources, protection of marine biodiversity, and the implementation of economic practices that do not harm ecosystems. This approach also emphasizes cooperation among governments, the private sector, and communities to contribute to broader social welfare without compromising environmental sustainability. Thus, the economic benefits are not concentrated on a few parties but can be enjoyed by all layers of society.

Sustainable River Economy (SRE)

Sustainable economy is an approach to development that emphasizes a balance between economic growth and environmental preservation. When applied in the context of rivers, the sustainable river economy refers to the integration of economic and ecological considerations in managing river resources so that economic benefits can be maximized without damaging river ecosystems and the surrounding environment (Wang et al., 2024). This approach involves the river basin ecosystem, as the wise use of abundant water resources, strategic waterways, and environmental and ecological capacities can optimize the economic value of rivers. Strategies toward a sustainable river economy through basin integration can significantly

enhance ecological efficiency by aligning regional economic growth with minimizing river resource exploitation, environmental pollution, and biodiversity loss (Wang et al., 2024).

Eco-Enzyme

Water pollution is a severe and complex issue with widespread and varied impacts, primarily caused by human activities. This phenomenon is evident in developing countries, where impoverished communities lacking access to clean water often seek alternative sources such as wells and springs to meet their needs (Nair et al., 2022). As a solution, eco-enzyme solutions can be used to reduce liquid waste and be applied in water management (Sisri & Surtikanti, 2022). Eco-enzyme is a fermented product from natural materials that benefits the environment, agriculture, and households (Srinandarahmawati & Yaswinda, 2021; Hasanah, 2021). In addition to its social uses, eco-enzyme can convert waste into valuable products that support economic activities.

In the era of global industrialization, environmental pollution has become a critical issue as the world's population growth increases food production, particularly of fruits, vegetables, and cereals, to meet human needs. Industrialization and innovation are considered to have burdened nature by releasing toxic wastes such as heavy metals, metalloids, and organic contaminants that have serious environmental impacts. However, by utilizing the potential of organic waste to be converted into eco-enzyme, at least the amount of organic waste can be reduced, and water pollution issues can be more effectively addressed (Hemalatha & Visantini, 2020).

Methodology

This research employs a quantitative exploratory approach through bibliometric analysis. Bibliometric analysis is a widely recognized and rigorous method used to explore and analyze large volumes of scientific data. Through this approach, it is possible to identify publications based on authors, leading journals, and the development of a particular field, thereby highlighting emerging areas within it (Donthu et al., 2021; Durán Sánchez et al., 2014). The data for this study is sourced from the Scopus database, with several preliminary steps undertaken to obtain data visualization using VOSviewer. The following are the steps involved in analyzing the research topic:

Selection of Criteria and Sources

The selection of criteria is conducted to construct the topic into keywords that will be used in the Scopus database. Scopus is chosen as it contains a collection of reputable journals with validated quality of content, ensuring that the study provides comprehensive information. The search is conducted in English to obtain the largest possible number of studies, limited to the years 2019-2023.

Table 1. Flow of Literature Search Based on Scopus Database

No	Search Keyword	Document Quantity
1	Query (English search terms) = "Blue Gold" OR "Blue Economy" AND "sustainable"	828
2	Query (English search terms) = "Blue Gold" OR "Blue Economy" AND "sustainable" OR "river economy"OR"Eco enzyme"	828
3	Environmental Science	431
4	Publication Year: 2019 to 2023	331
5	Language: English	329
6	Journal	269
7	Article	211

Data processing

Scopus database is used to curate studies according to the specified criteria, resulting in the identification of 211 articles. These articles are then extracted in RIS format and visualized using VOSviewer. Scopus also provides data analysis features that allow for the examination of trends in publication productivity by country, author, and the development of studies over time. This holistic view of the criteria mapping assists the researcher in drawing comprehensive conclusions.

Data visualization

VOSviewer is a tool used for visualizing data, particularly in the context of bibliometric analysis. The data visualization involves mapping the complex relationships between keywords such as "blue gold," "blue economy," "sustainable river economy," and "eco enzyme." This visualization aids researchers in understanding the structure and dynamics of collaboration across these study contexts.

Results and Discussion

Mapping Interconnected of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold by Trend

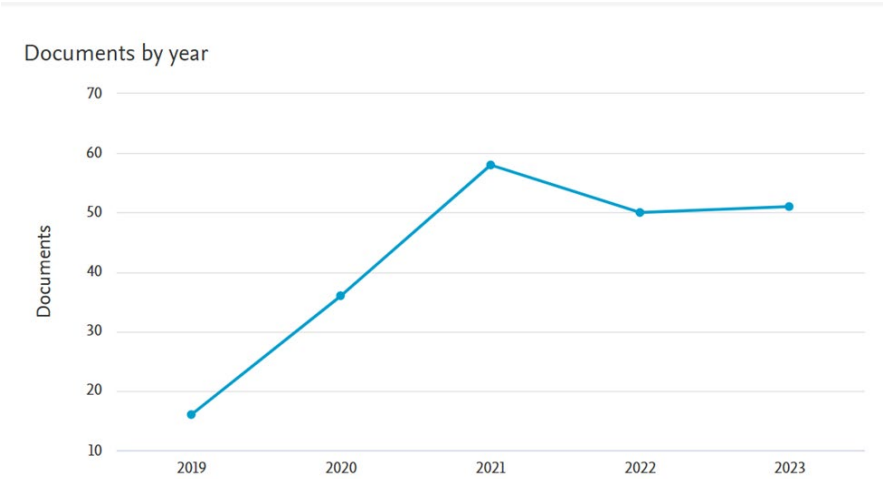

Figure 1. Evolution in The Number of Publications

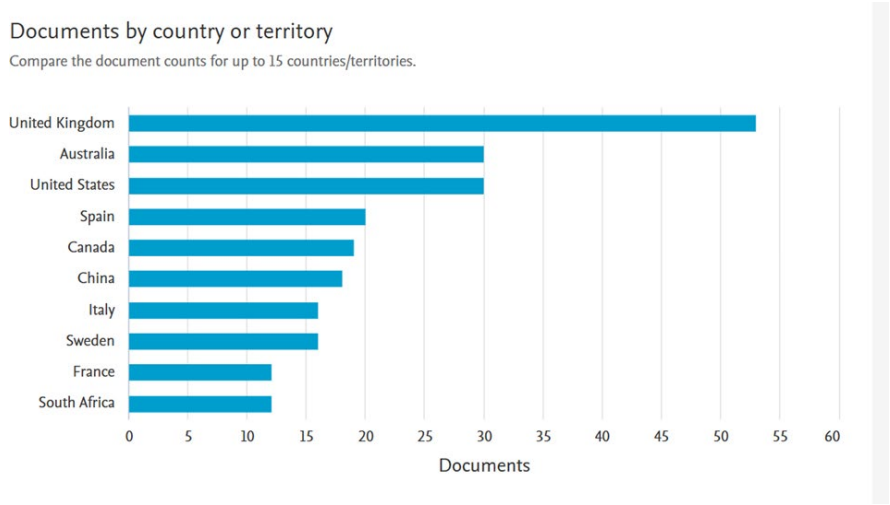

Figure 2. Document Chart by Country Region

Mapping Interconnected of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold by Author

Research findings indicate that use of the keywords "Blue Gold" OR "Blue Economy" AND "Sustainable" reveals a significant overlap in the number of documents when compared to the use of the keywords "Blue Gold" OR "Blue Economy" AND "Sustainable" OR "River Economy" OR "Eco-Enzyme", amounting to a total of 828 articles. Further analysis of the data shows that 2021 was the year with the highest number of journal publications on blue gold or blue economy, with 58 documents published. According to the trend illustrated in Figure 1, the period from 2019 to 2023 has seen a steady increase, indicating that topics related to environmental science are increasingly being recognized as urgent issues that require thorough investigation alongside proposed solutions.

Mapping Interconnected of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold by Country

According to the data analysis results, as shown in Figure 2, the country with the highest number of journal publications is the United Kingdom, with a total of 56 documents. The data on literature production by country can be further grouped on a larger scale by continent, namely Europe, Australia, America, Asia, and Africa. Developed countries tend to

be more productive in producing literature reviews based on the specified criteria..

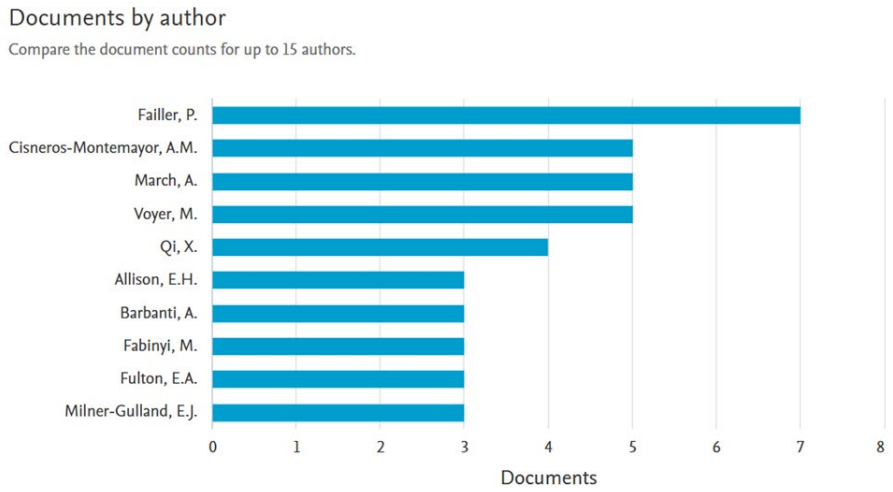

Figure 3. The Most Productive Authors

A robust body of literature is often the result of skilled researchers who are able to comprehensively articulate realities, thereby providing readers with knowledge or information that can be used to understand a particular phenomenon. According to the graph in Figure 3, researcher Faller, P is the most productive author over the past five years in writing on the topic of environmental science. This is followed by other authors who share a strong commitment to exploring the same topic, with the least productive among them having published a minimum of three studies.

Visualization Criteria

After selecting the variables of document publication year, country, and author, we analyzed the output generated from the Scopus database using the VOSviewer application to identify dominant keywords. This application aids in visualizing the bibliometric map, resulting in three different types of visualizations: network visualization, overlay visualization, and density visualization.

Network Virtualization

The visualization results from the data analysis reveal four general clusters, each containing keywords found in the 211 articles. The largest nodes indicate the intensity of keyword occurrence across the entire set of articles, providing insight into the main research focuses of the scholars involved. These four clusters summarize the topics currently being discussed and researched.

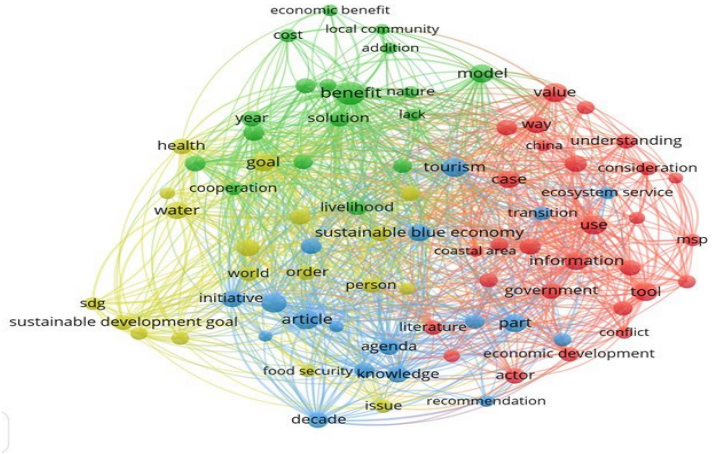

Figure 4. Network Visualization of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold

- **Cluster 1 (Red)**: The largest nodes indicate that the main topics under discussion include the utilization of ecosystem services. The red cluster focuses on aspects of policy, governance, and broader ecosystem considerations. The keywords seen include value, understanding, ecosystem service, government, and economic development.
- **Cluster 2 (Green)**: The largest nodes indicate that the main topics under discussion include the benefits of implementing a sustainable blue economy. The green cluster focuses on the immediate benefits of sustainable development. Prominent keywords include economic benefit, health, water, sustainable development goal, and solution. The use of eco enzymes is often linked to environmental health and water treatment.
- **Cluster 3 (Yellow)**: The largest nodes indicate that the main topics under discussion include the Sustainable Development Goals (SDGs). The yellow cluster focuses on global aspects and sustainable development policies. Some of the keywords that stand out in this yellow cluster include sustainable development goal (SDG), world order, initiative, article, agenda, food security knowledge.
- **Cluster 4 (Blue)**: The largest nodes indicate that the main topics under discussion include knowledge related to the sustainable blue economy. The keywords that appear are literature, food security knowledge.

Overlay Vissualization

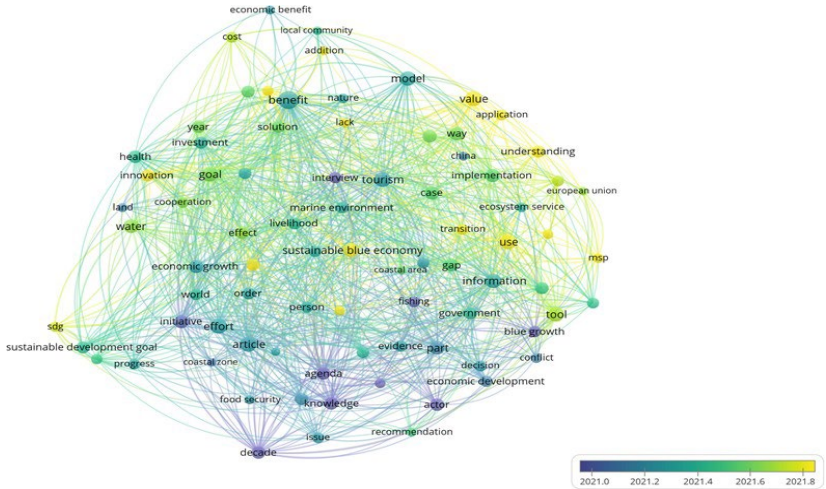

Figure 5. Overlay Visualization of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold

The analysis conducted through VOSviewer’s visualization revealed trends over time, particularly focusing on the year 2021. The visualization indicates that topics such as “tool,” “blue growth,” “economic development,” and “evidence part” appear in a more purple hue, suggesting that these are relatively newer areas of research. In contrast, topics like “sustainable blue economy,” “goal,” and “benefit” aredisplayed in a more yellow color, indicating that these areas have garnered significant attention and are considered primary focal points.

In the context of policy and the blue economy, keywords such as “economic development,” “government,” and “sustainable blue economy” are grouped within thesame cluster. This clustering highlights the interconnectedness of these topics within the broader framework of economic policy. Additionally, topics like “health” and “water” underscore the growing interest in innovation and the management of marine resources, particularly in relation to their impact on ecosystem health. To achieve a sustainable blue economy, keywords such as “MSP” (marine spatial planning), “tool,” and “implementation” have emerged as crucial topics, emphasizing the importance of planning and execution in this domain.

Density Visualization

The sustainable blue economy is an area of increasing importance that demands serious attention, as it concerns balancing economic benefits withsustainability. This focus extends beyond the marine environment to include

freshwater systems, particularly rivers, which are crucial for supporting the blue gold economy and achieving sustainability.

The keyword clusters identified in the visualization reflect a focus on policy development, innovation, and implementation to support these objectives. The presence of terms such as gap and lack indicates challenges that need to be addressed and offers opportunities for further exploration, particularly in practical implementation and transitioning to a more robust blue economy system.

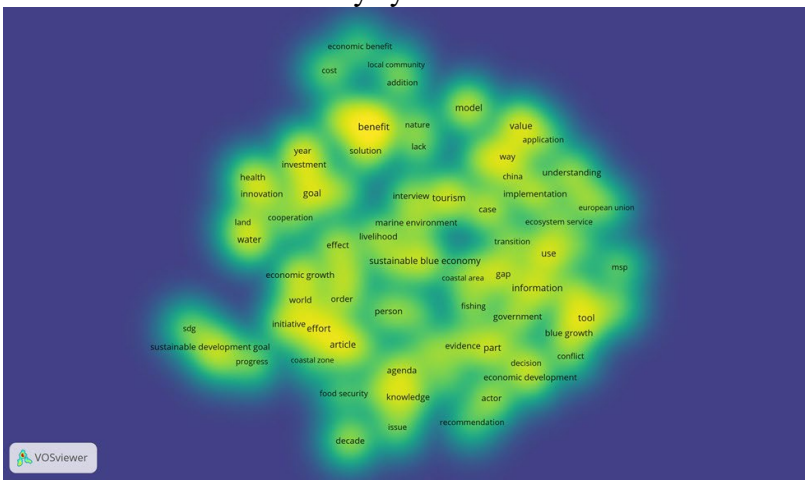

Figure 6. Density Visualization of Blue Economy, Sustainable River Economy, and Eco-Enzyme in Blue Gold

Despite its substantial potential for supporting environmental and economic sustainability, the sustainable river economy has yet to become a significant topic in research or public policy. To address this gap, eco-enzyme presents an innovative solution that significantly contributes to creating a sustainable blue-gold economy. By converting organic

waste into environmentally friendly enzymes, eco-enzyme offers a holistic approach to river management that is cleaner, healthier, and economically productive.

Study Findings

1. Lack of Focus on Sustainable River Economy:
   Research and discussion on the sustainable river economy remain limited, with few in-depth studies on how river ecosystems can be managed sustainably to support economic growth.
2. Potential of Eco-Enzyme in River Management:
   Eco-enzyme has significant potential to improve river water quality by reducing organic and chemical pollution. This improvement can support economic activities such as fisheries, tourism, and agriculture along riverbanks.
3. Contribution to the Blue Gold Economy:
   By enhancing river ecosystem quality, eco-enzyme contributes to a sustainable blue economy, where water resources are managed efficiently to support economic prosperity and environmental preservation.
4. Innovation in Organic Waste Management:
   Eco-enzyme provides an innovative solution for organic waste management by converting household and industrial waste into useful products, thereby reducing the environmental impact of such waste.
5. Opportunities for Further Research and Development:
   Given the critical role of rivers in local and regional economies, further research is needed to optimize the use of eco-enzyme in integrated and sustainable river management strategies.

Conclusion

Exploring eco-enzyme's potential through organic waste fermentation highlights its ability to improve river water quality and bolster a sustainable river economy. Despite the growing development of the "Blue Economy" concept, there remains a gap in focus on river-based economies. Eco-enzyme is identified as an innovative solution that can strengthen river-based economies and support environmental sustainability to achieve blue gold. Using a bibliometric approach, this study aims to map the literature on eco enzymes, a clean and healthy river ecosystem for sustainable economic growth from 2019 – 2023. Bibliometric analysis visualises the network of citations, author collaborations, topic trends, and research evolution.

The study results showed a fluctuation in the number of publications, and an upward trend occurred at the end of the publication period. The country with the highest contribution in this field is the United Kingdom. Network visualisation shows that literature related to eco-enzymes plays an essential role in managing river water resources to realise a Sustainable River Economy. Collaboration between stakeholders is urgently needed to achieve a Sustainable Blue Gold Economy. Further research is required to optimise eco-enzymes' use in integrated and sustainable river management strategies.

In pursuing a Blue Gold Economy, government and society must play pivotal roles in effective waste management, particularly in river ecosystems and other water resources. Governments should focus on implementing policies that promote using environmentally friendly technologies, such as eco-enzymes, in water and waste management. Strengthening industrial and domestic waste disposal regulations and providing incentives for industries and communities that contribute to water resource conservation is also crucial. Collaboration among governmental bodies, private sectors, and academic institutions is vital to ensure the sustainability of these initiatives.

Increasing awareness of the importance of water conservation and active participation in

waste management efforts, including using eco-enzymes in households, is imperative for society. Expanding educational campaigns and public outreach on waste management and ecosystem preservation can help foster behaviours that support sustainable economic practices.

Effective waste management will foster strong collaboration between governments, communities, and other stakeholders and contribute to realising a Blue Gold Economy in which water ecosystems are protected and provide sustainable economic benefits.

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