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Water and Sustainable Development: Implementation and Impact of Eco-Enzyme Flushing Program in Green Universities

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ABSTRACT

Water is one of the essential needs for all living things, and it is crucial to maintain its quality, especially in water bodies near campuses. These water bodies are often utilized by people around the campus and may connect with other water sources. However, due to the high water consumption on campus by students, faculty members, and local communities, the water quality around campus needs to be considered. Meanwhile, eco-enzyme is an affordable product that can help sustain and improve water quality. Therefore, this study examines the implementation and impacts of an eco-enzyme flushing program in Indonesian green universities. Qualitative methods were employed in this study by analyzing experts' speeches from a YouTube video of the eco-enzyme festival attended by 22 universities simultaneously through thematic coding. The program's implementation involves cooperation between campuses and the surrounding communities, believing it can improve water quality, a heightened sense of environmental responsibility, and collaboration between various institutions to achieve sustainable development. Experts from green universities argue that this program's benefits extend to the environment and functional products, primarily for agriculture. One tangible benefit of this program is that the lake around the university has better water quality for use by the local community. Moreover, this program offers a long-term solution in line with principles of environmental preservation, social equity, and economic viability.

1. INTRODUCTION

Water lies at the heart of sustainable development and is paramount for socio-economic progress, thriving ecosystems, and human survival [1, 2]. It serves as a critical factor in reducing the global disease burden and enhancing communities' health, well-being, and productivity. Moreover, water plays a central role in generating and safeguarding a multitude of benefits and services for humanity [3]. Additionally, water is significant in adapting to climate change, acting as a vital link between the climate system, human society, and the environment [4].

As a finite and irreplaceable resource, water is essential for human welfare and can only be renewed through effective management practices [5]. Currently, over 1.7 billion people reside in river basins where water usage surpasses natural recharge, leading to a depletion trend. It is projected that by 2025, two-thirds of the world's population will inhabit countries experiencing water stress [6]. While water poses significant challenges to Sustainable Development Goals (SDGs), efficient and equitable management has the potential to play a pivotal role in bolstering the resilience of social, economic, and environmental systems amidst rapid and unpredictable changes [7, 8].

One area where sustainable water management practices can be implemented is in educational institutions, such as universities [9, 10]. These institutions have a significant water consumption rate due to the large number of students, faculty, and staff, as well as the diverse range of facilities and activities on campus. What is more, many campuses in Indonesia have water reservoirs that serve multiple purposes, such as nurturing aquatic ecosystems, facilitating outdoor activities for students, and preventing flooding [11-15]. Intriguingly, these water bodies are often utilized by the surrounding communities as well. Hence, the significance of water in the campus environment cannot be overstated, as it plays a crucial role in preserving the sustainability of ecosystems and meeting the water requirements of the local community.

The use of eco-enzyme flushing programs is an innovative and environmentally friendly approach to addressing water scarcity and promoting sustainable water in educational institutions. Eco-enzymes are natural and biodegradable substances that can potentially improve the efficiency of wastewater treatment systems and reduce water consumption

[16, 17]. Several researchers confirmed that the application of eco-enzyme flushing could be considered as an antimicrobial compound [18], purification of contaminated water [19], foul odor and organic impurities removal [20], disinfectant [21], accelerate the growth of particular plants [22], and pollutant erasure [23]. By introducing eco-enzyme flushing programs in universities, significant water savings can be achieved while maintaining or enhancing sanitation and hygiene standards on campus.

In a green university setting, where sustainability is a core principle [24], the implementation of an eco-enzyme flushing program becomes even more relevant. According to UI Green Metric [25], water is one of the indicators that reflects the interconnectedness of environmental sustainability because water is a finite and essential resource, and its conservation and efficient use are critical considerations in sustainable development. By adopting an eco-enzyme flushing program, a green university can demonstrate its dedication to sustainable water management and serve as a model for other educational institutions seeking to implement similar initiatives. The collaboration program among green universities for flushing eco-enzymes is a commitment of educational institutions to improve environmental quality [26]. Additionally, the implementation of the program can effectively clean and remove dirt, stains, and odors with minimal water usage, improving water quality for the community around the university.

According to Pearson et al.'s framework for sustainable decision-making in urban water management, three key components of social learning support this process: knowledge transfer for transformation, monitoring and evaluation of the decision-making process, and stakeholder engagement [27]. This framework aligns well with the implementation of the eco-enzyme flushing program, mainly because universities are typically situated within cities, and the water bodies owned by campuses can significantly impact the local community. Moreover, the three pillars of sustainability: environmental preservation, social equity, and economic viability, serve as the foundation for the successful execution of the festival [28].

Therefore, this research aims to investigate the implementation and impact of an eco-enzyme flushing program in green universities. Specifically, universities in Indonesia that have water bodies that are useful for the surrounding community are affiliated with UI Green Metric and are relatively located in big cities. It examines the attitudes and perceptions of experts from various universities towards the program, as well as any challenges or barriers encountered during its implementation. The findings can promote the program in order to provide tangible contributions to water sustainability, informing policy decisions, guiding future implementations, and contributing to the broader knowledge of sustainable water management and environmental practices in the context of higher education.

2. METHODS

This study employs a qualitative approach to explore and analyze the research topic [29]. Specifically, qualitative content analysis was conducted to analyze and interpret verbal information provided by the experts in a YouTube video, gaining insights and understanding related to the research objectives. The focus would be on capturing the nuances, perspectives, and rich descriptions the experts convey through their speeches. The speeches were extracted from YouTube videos as a primary source of data. YouTube videos are valuable qualitative data sources, providing rich and diverse perspectives from recognized experts in the field [30]. Moreover, in the context of this research, the selected YouTube videos are likened to discussions between experts on eco-enzyme festivals, where their speeches can be used as primary data.

The selected YouTube video is a recording of the eco-enzyme flushing program at Indonesian green universities simultaneously on June 5, 2023 (the video can be accessed in the Appendix section). In the process, the campus vice-chancellor or environmental experts gave remarks about the program implementation. The videos featuring opening remarks, speeches, or presentations by experts with extensive knowledge and experience in the subject matter were included. Their expertise mainly revolves around aquatic science, public health, economy, waste management and processing, environmental engineering, and biology.

The data analysis followed the Miles and Huberman model [29], which involved data collection, reduction, presentation, and verification. The data collected from the experts' speeches were condensed into manageable units, and patterns and themes were identified. The schematic process of expert speech coding is carried out thematically based on several classifications that include definitions, benefits of eco-enzymes based on specific objects, or manufacturing processes, generally related to environmental sustainability. To ensure that different coders interpret and code the content in a similar manner, two researchers conducted the coding independently, ensuring consistent and accurate coding. Once all the data related to the eco-enzyme flushing program were organized into patterns, meaningful conclusions were drawn from the information obtained.

In order to ensure the credibility and validity of the data, campuses that participate in the eco-enzyme flushing program initiated by UI Green Metric have undergone a reasonably strict selection process [25]. The UI Green Metric is a widely recognized and reputable framework specifically designed to assess and evaluate the sustainability performance of universities worldwide [31]. This framework can help increase the validity of the findings because the universities involved are affiliated with the UI Green Metric which has a philosophy of three pillars of sustainability: environmental, social, and economic, aligning with the objectives of the festival. Water is also one of the considerable indicators in the metric. Consequently, by incorporating the UI Green Metric indicator, a direct connection can be established between the data obtained from experts' speeches on YouTube videos and the established criteria for evaluating eco-enzyme flushing programs in green universities.

Moreover, three researchers participated in this analysis to avoid potential bias in the experts' speech analysis. The outcomes were reached through objective, impartial, and consensual discussions. Regarding ethical considerations, this study adheres to ethical guidelines, ensuring the privacy and confidentiality of the experts. The YouTube videos used as the primary data source were adequately cited and credited in the Appendix section. All necessary permissions and copyrights were respected, acknowledged, and obtained through direct contact with the video owner, namely UI Green Metric.

3. RESULTS AND DISCUSSION

3.1 Eco-enzyme flushing program in green universities

Eco-enzyme Festival 2023 is held to commemorate World Environment Day. This event aims to motivate universities to take concrete actions to protect the environment, raise awareness about the importance of sustainability, and foster an environment-conscious culture within the academic community. This event was supported and enthusiastically attended by 22 universities across Indonesia, intending to create a green environment. The participating universities were:

1. Universitas Negeri Surabaya (UNESA)
2. Universitas Negeri Malang (UM)
3. Universitas Sumatera Utara (USU)
4. Universitas YARSI (YARSI)
5. UIN Sulthan Thaha Saifuddin Jambi (UINSTS)
6. Universitas Esa Unggul (UEU)
7. Universitas Padjadjaran (UNPAD)
8. UIN Syarif Hidayatullah Jakarta (UINSHJ)
9. UIN Raden Fatah Palembang (UINRFP)
10. Universitas Syiah Kuala (UNSYIAH)
11. Universitas Kuningan (UNIKU)
12. Universitas Bengkulu (UNIB)
13. Universitas Teknologi Muhammadiyah Jakarta (UTMJ)
14. Universitas Negeri Padang (UNP)
15. Institut Teknologi Sepuluh Nopember (ITS)
16. Universitas Maritim Raja Ali Haji (UMRAH)
17. Universitas Andalas (UNAND)
18. Universitas Gunadarma (UG)
19. Universitas Sebelas Maret (UNS)
20. Universitas Trisakti (UT)
21. Universitas Budi Luhur (UBL)
22. Institut Teknologi Sumatera (ITERA)

These universities poured Eco-Enzyme liquid into the water streams around their respective campuses at the same time.

Prior to the festival's commencement on March 3, 2023, the chairman of UI GreenMetric initiated and encouraged green universities to organize an eco-enzyme pouring program in commemoration of World Environment Day. Subsequently, the eco-enzyme organizing team drafted and signed a decision letter. Once all participating universities reached an agreement regarding the meeting activities to discuss the program and host, each university started preparing all necessary materials, including eco-enzyme production, venue selection, and speeches. On May 30, 2023, a dress rehearsal was conducted to monitor preparations and finalize the technical implementation of the festival. Finally, on June 5, 2023, the festival was successfully hosted by UNESA. The preparation flowchart can be seen in Figure 1.

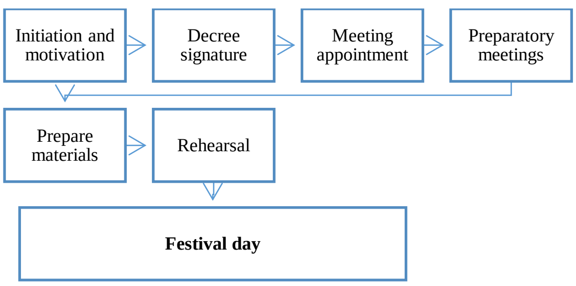

Figure 1. Eco-enzyme flushing program preparation

In more detail, the festival opened with opening remarks from the rector of UNESA, the chairman of UI GreenMetric, and representatives from the Indonesian Ministry of Environment and Forestry. After that, the pouring of eco-enzyme was started by UINSTS on the campus lake involving faculty members and students, as depicted in Figure 2. While UINSHJ continued pouring eco-enzyme liquid into water bodies on the campus by faculty members, UMRAH poured the liquid into a river near the university in collaboration with several elementary school students.

Figure 2. Pouring process at UINSTS

Once UNS poured on the campus lake by campus leaders together with the mountaineering and nature lovers club, UNPAD also took part in this event by pouring the liquid into the Arboretum Lake. Subsequently, UEU conducts pouring in campus lakes and plants. UNESA, UT, USU, and UNSYIAH continue the flushing process, which is also on the campus lake. Similarly, UNIB, UNAND, ITS, and UM decant the liquid into the campus pond. Slightly different from before, while UNIKU participated by pouring eco-enzyme directly by leaders, faculty members, and students into Citamba Rivers in Kuningan Regency, UTMJ took action to win the liquid into Ciliwung Reiver in Manggarai, as seen in Figure 3. Also, UNP, UINRFP, YARSI, and UBL pour the liquid into canals and streams around campus. UG continued their participation in the festival by pouring the liquid at Gunadarma Technopark, Cianjur Regency. Eventually, ITERA participates by planting vegetation and watering it with liquid eco-enzymes.

Figure 3. Pouring process in Ciliwung River by UTMJ

It is believed that the program can improve water quality due to the fact that the enzymes in the liquid break down organic matter, reducing pollutants and odors in the water. This process can help restore the natural balance of aquatic ecosystems, leading to healthier and cleaner water resources [32]. In line with research [33], academic research development is prioritized in human consumption, mainly water. Then, by enhancing water quality, the program supports the overall health of ecosystems [34]. Clean and well-maintained water bodies provide aquatic plants and animals with a suitable habitat. Restoring ecosystem health can contribute to biodiversity conservation and the preservation of sensitive species [35].

Furthermore, the program serves as an educational tool to raise awareness about the importance of water and environmental sustainability. Through their involvement in the program, university students, faculty members, and elementary school students gain firsthand experience in implementing eco-friendly practices. This exposure cultivates a sense of environmental responsibility and encourages a mindset of sustainable living [36].

The participation of multiple universities in the eco-enzyme flushing program fosters collaboration and networking among educational institutions. Sharing experiences, best practices, and research findings allows universities to collectively work towards common goals of water and environmental sustainability [37]. Universities can learn from one another and work together to create a more sustainable future and water through this collaborative approach. This collaboration can lead to the development of innovative solutions and the sharing of resources and expertise.

Apart from water and environment, these findings are consistent with Bender's study [38], stating that collaboration among universities can help implement SDG 17 (Partnership for the Goals). This is because SDG 17 focuses on the importance of building strong partnerships to achieve sustainable development. The collaborative activities among green universities in the eco-enzyme pouring program represent a tangible example of partnership for sustainable development. The program's engagement with leaders of universities, UI GreenMetric, and representatives from the Indonesian Ministry of Environment and Forestry further exemplifies the collaborative approach and the involvement of different stakeholders. By working together on environmental or water initiatives, universities are committed to addressing shared sustainability challenges.

Furthermore, many universities have a broader community beyond their campuses, while engaging with local communities is crucial for achieving sustainable development. By implementing the program, universities interact with local communities and raise awareness about environmental issues, demonstrating their commitment to SDG 17's principles of community engagement.

3.2 Experts' speech

In fact, not all experts representing each campus give specific speeches about eco-enzymes. Some of them only broadcast the pouring process or introduce their own campuses. As a result, only 8 out of 22 universities analyzed the speech. To begin with, the speech opened with the host of the eco-enzyme flushing program (UNESA). The expert from the campus explained the definition of eco-enzyme and its benefits for the environment.

"*Eco enzyme is an enzyme produced by active microbes from the fermentation of organic waste, including fruit and vegetable skins with a mixture of water and molasses. Eco enzymes also have many benefits for the environment, namely to improve the quality of the water and air environment*" **- UNESA**

Similarly, UT and UNS began the speech by providing definitions and benefits of pouring eco-enzymes in water bodies:

"*Eco enzyme is a multipurpose liquid among which can be used as liquid fertilizer, disinfectant, natural pesticide, bar soap, toilet cleaner, and face mask*" - **UT**

"*Eco enzyme is made from fermented fruit and vegetable waste, when eco enzyme is poured into the lake there are several positive things obtained including producing water purification processes, suppressing pollutants, and growing microorganisms as fish feed in the lake*" **- UNS**

Based on the transcriptions of the experts speech above, it can be observed that eco-enzyme is a versatile liquid with various applications. According to UNEAS and UT scientists, it can be utilized as a liquid fertilizer, disinfectant, natural pesticide, bar soap, toilet cleaner, and facial mask. This indicates that the eco enzyme has multiple benefits and can be employed in various aspects of daily life and environmental care. Moreover, as mentioned by UNS experts, the eco-enzyme is produced through the fermentation of fruit and vegetable waste. When poured into a lake, it has several positive effects, including water purification, pollution reduction, and the promotion of microorganisms as fish feed in the lake. This highlights the eco enzyme's potential to contribute to environmental conservation and enhance the ecological balance in aquatic ecosystems.

The argument is reinforced by Wen et al. [39] stated that eco-enzymes are fermentation products from daily kitchen waste such as fruits and vegetables. Eco-enzymes have many benefits, namely, their antibacterial and antifungal activities can release residual deposits on water pipes to prevent clogging, and can absorb pollutants from cigarette smoke and motor vehicle exhaust [40]. Additionally, Hemalatha and Visantini [17] also explained that eco-enzymes are able to process waste-containing metals, including pollutants found in water. The results show that the Biological Oxygen Demand (BOD) decreased after using eco-enzymes, from 80.0 mg/L to 22.3 mg/L.

Several other campuses gave speeches containing the benefits of eco-enzymes:

"*Eco enzyme can replace fertilizer as a nutrient for plants, eco enzyme is able to help the flowering process in plants but not for the growth of leaves so that its use alternates between fertilizer and eco enzyme*" - **UNIB**

"*The by-product of eco enzime is pitera mushroom which can be used as a basic ingredient for beauty products*" **- UG**

"*Eco enzymes can be used as biodisinfectants, cleaning floors, as biocatalysts for soil nutrient absorption by plant roots, fermentors that improve the quality of animal feed*" - **USU**

"*Eco enzyme can be used as an air purifier, able to accelerate the decomposition of organic waste, bind contamination to water bodies, and improve water quality*"- **UINRFP**

They underscore the wide-ranging applications and advantages of eco-enzymes. From agricultural use to beauty product by-products and environmental benefits, eco enzyme proves to be a versatile and promising solution for sustainable practices in multiple sectors. Its potential to replace or complement traditional chemical products makes it a valuable asset in promoting eco-friendly approaches and contributing to sustainable development.

The expert opinion from UNIB is consistent with previous empirical research that eco-enzyme has high antimicrobial activity, inhibiting microbial growth, and can be used as a biopesticide [18]. Eco enzyme solution, when mixed with water, will react and can be used as a cleaning liquid ranging from dishes, floors, clothes, and toilets, to hair washes and bath soap [40].

Furthermore, corroborating expert opinions from UG, eco enzymes in the fermentation process produce pitera mushrooms, making eco enzymes with the addition of *Aspergillus oryzae* produce pitera mushrooms during fermentation on day 5 for the addition of 25 gr [41]. Eco-enzyme without the addition of external microbes, pitera mushrooms only appear after fermentation lasts for two weeks. Pitera mushroom is a good fungus resulting from the fermentation process of making eco enzyme solutions, eco enzymes that produce pitera mushrooms during the fermentation process will be more expensive because the organic acids contained are more so that the pH value is also lower [42].

Ultimately, USU expert's opinions show that eco enzymes are also beneficial for plant growth and development. When used to water plants, a mixture with water will provide better fruit, flower, or harvest yields and can also be used to repel insects [40]. The use of eco enzymes also helps speed up seedling time in plants [16].

In line with expert opinions from UINRFP, products produced from eco-enzymes are liquids containing bacteria and enzymes breaking down organic matter in the environment and helping reduce pollution [16]. This liquid in the environmental field has been commonly used in liquid waste treatment, lake water purification, air quality improvement, and soil quality [43]. In addition, it is also reinforced by research conducted by Kumar et al. [44] stated that eco enzyme plays a role in improving water quality in the Yamuna River, India, shown by pH measurements have increased from 6.7 to 7.2, coliform in water has also decreased, the use of eco enzyme is very feasible and economical.

Separately, UBL stated the process of making eco-enzymes and supplemented with their benefits to reduce global warming.

"*Making eco enzymes has a ratio of sugar: organic waste: water which is 1: 3: 10 for three months fermentation using a bottle that tapers up has better quality, every day the bottle cap needs to be opened because eco enzyme also produces ozone gas to help reduce global warming and clean the air*" – **UBL**

Based on the opinion, the eco enzyme processing process utilizes brown sugar, organic waste from fruit and vegetable waste, and water with a ratio of brown sugar, vegetable waste, and water 1:3:10 three months ago, eco-enzyme can be used [19]. Another result in making eco enzymes is to produce ozone, which is needed by the earth's atmosphere [40].

Generally speaking, the majority of words appearing in expert speech are eco enzyme, water, quality, waste, organic, and improve, as depicted in Figure 4. The speeches emphasize the potential of eco enzymes in improving water quality, managing waste, and enhancing organic processes. In other words, eco-enzyme is a multipurpose liquid produced from the fermentation of organic waste. It can be used as a mopping liquid, kitchen cleaner, fruit and vegetable cleaner, insect repellent, and plant fertilizer. The production of eco-enzymes is important for reducing the amount of organic waste piling up in landfills. Effective microorganisms are a mixture of beneficial microorganisms that can be used to improve soil quality, water quality, and air quality. Wastewater can be utilized to make fertilizer and reduce greenhouse gas emissions from agriculture [45].

Figure 4. Word cloud of experts' speech

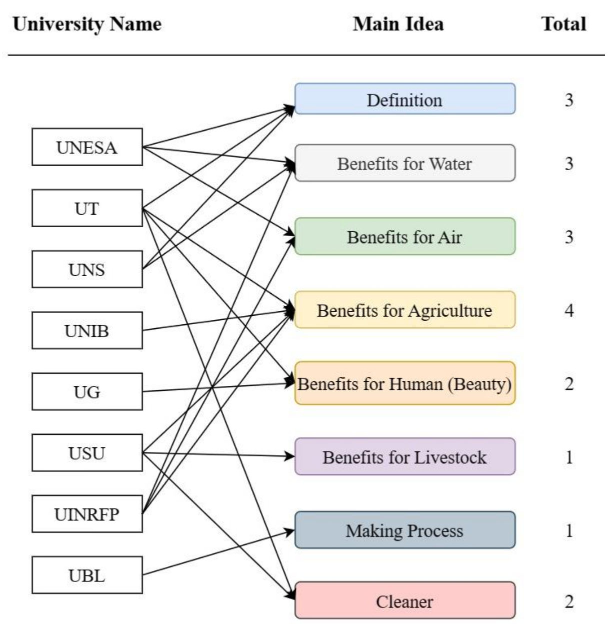

Figure 5. Topic discussed by experts

In terms of the main idea, as witnessed in Figure 5, the coding results provide a comprehensive overview of the main themes and topics discussed in the speeches related to eco-enzymes, highlighting their diverse applications and benefits in various fields. Although the experts mainly emphasized the benefits of the program for agriculture, many of them mentioned the benefits for air, water, people, and even livestock. Some experts also noted the definition of eco-enzyme, possibly their first experience in making this product. Thus, the implementation of this program provides many benefits for sustainable development, not only for the environment, but also for the community.

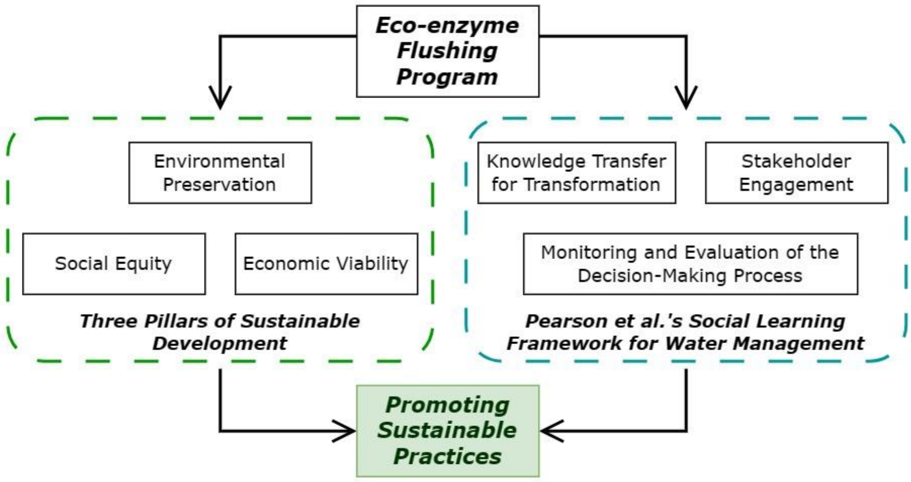

Figure 6. Relationship between the eco-enzyme flushing program with the three pillars of sustainability [28] and the social learning framework for sustainable decision-making in urban water management [27]

3.3 Water and sustainable development perspective

The program presents a significant perspective on water and sustainable development. As a vital resource for life and development, water requires responsible management to ensure its availability for future generations [2]. Sustainable development emphasizes the need to meet present needs without compromising the ability of future generations to meet their own needs [28]. In this context, the eco-enzyme flushing program offers a sustainable solution that aligns with the principles of environmental preservation, social equity, and economic viability, as seen in Figure 6, resulting in the promotion of sustainable practices.

Regarding environmental preservation, water quality is crucial for maintaining healthy ecosystems. The eco-enzyme flushing program contributes to environmental preservation by enhancing water quality in lakes, rivers, and other water bodies. This intervention led to observable improvements in water quality. Our study indicates that eco-enzymes, instead of chemical-based alternatives, play a crucial role in breaking down organic waste, reducing pollutants, and enhancing water clarity. This is supported by numerous studies in environmental science, which have shown that eco-enzymes aid in the degradation of organic matter, reducing chemical and biological oxygen demand and ultimately improving water quality [20, 23], maintaining the natural integrity of water resources. For instance, Varshini and Gayathri [46] discovered that eco-enzyme able to reduce parameter BOD, COD, TDS, Nitrate, Nitrite, and Ammonium in the water effectively.

Apart from the water quality enhancement, the program also supports the sustainability of biodiversity in the universities' environment. This is directly evidenced by clearer and cleaner water bodies providing a more favorable habitat for aquatic life. Reduction in pollutant levels and increased microbial diversity, facilitated by eco-enzymes, can positively impact the ecosystem by promoting the growth of microorganisms, aquatic plants, and invertebrates, which, in turn, can support fish populations [47]. Empirical evidence showed that eco-enzyme could increase *Pangasius djambal* fish diversity and growth in peat soil ponds, even for 28 days [48].

In terms of social equity, it fosters collaboration and shared responsibility among academic institutions towards a common sustainable goal, as the program involves multiple universities across Indonesia. By actively participating in the eco-enzyme flushing program, universities demonstrate their 'green' commitment to environmental stewardship and contribute to the well-being of local communities [10]. The program's potential impact on water quality can also extend to neighboring areas, benefitting a broader population.

Lastly, sustainable development advocates for solutions that balance environmental concerns with economic viability. The eco-enzyme flushing program aligns with this principle as it utilizes natural resources efficiently, reducing the need for costly chemical alternatives [49]. The program offers an economical and sustainable approach to water treatment by repurposing organic waste into eco-enzymes. Universities and communities can implement the program without incurring significant financial burdens, making it a feasible and practical option for sustainable water resource management.

Related to the social learning framework for sustainable decision-making in urban water management [27], in the knowledge transfer for transformation aspect, the Eco-Enzyme program involves transferring knowledge about eco-enzymes and their applications among participating universities. Universities are not only using eco-enzymes as a sustainable practice but also sharing their experiences and participatory knowledge with each other [27]. This knowledge transfer is crucial to social learning, as it promotes transforming practices and behaviors. By exchanging information, universities are learning about eco-enzymes' benefits for improving water quality, waste reduction, and their environmental impact. This knowledge transfer transforms traditional approaches to managing water bodies and waste in a more eco-friendly and sustainable direction.

When it comes to monitoring and evaluating the decision-making process aspect, social learning emphasizes the importance of ongoing monitoring and evaluation of decision-making processes. In the case of the program, universities are not only implementing eco-enzyme initiatives but are also engaged in monitoring and evaluating the outcomes of these decisions. They are assessing eco-enzymes' impact on water quality, biodiversity, and the environment. This monitoring and evaluation process allows for adjustments and improvements in the program, especially for urban water management [50]. It ensures that universities can learn from both successful and unsuccessful experiences and adapt their strategies accordingly. This aspect aligns with social learning's emphasis on decision-making's iterative and adaptive nature [51].

Ultimately, in the stakeholder engagement aspect, this program involves multiple stakeholders, including the participating universities, UI Green Metric, government, faculty members, students, and local communities. The engagement of these diverse stakeholders is a fundamental component of social learning [52]. Universities collaborate with local communities and students, involving them in the eco-enzyme pouring and monitoring processes. This engagement creates a platform for sharing knowledge, experiences, and local wisdom. It fosters collective decision-making, where stakeholders contribute their insights and perspectives. This participatory approach ensures that the program considers a wide range of voices and values, contributing to social learning's inclusive nature.

By embracing the eco-enzyme flushing program, green universities set an example for other institutions and communities in the region. The program's integration into university campuses encourages students, faculty, and staff to adopt sustainable practices beyond the flushing program. This can lead to a broader culture of environmental consciousness and responsible water usage, influencing future generations of professionals and decision-makers. As the water demand continues to rise, adopting sustainable practices becomes imperative for achieving water security and supporting sustainable development [53].

3.4 Program's limitations and implications

The eco-enzyme flushing program definitely faces challenges and limitations:

1. Lack of Water-to-Eco-Enzyme Ratio: One of the challenges is the absence of consideration for the ratio of water volume in the campus environment to the quantity of eco-enzymes poured. This omission raises concerns that the positive influence generated may be confined to a micro-scale and reduced efficacy.
2. Need for Sustainability: The program has been implemented only once in Indonesia, and it is vital to ensure regular and sustainable efforts. This will help maintain the benefits of using eco-enzymes in bodies of water and the surrounding environment.
3. Limited Collaboration: The collaboration, for the most part, is confined to the academic sphere. Although there is involvement from the government, represented by the Ministry of Environment, there is room for broader collaboration, especially with local government bodies at the district or sub-district level. Expanding the program's scope in this way can amplify its positive impact.
4. Lack of Empirical Testing: There is a notable absence of empirical testing to compare water quality before and after the activity. This type of data could provide valuable insights into the program's effectiveness.

Despite its weaknesses, program evaluation is essential to improve the success and benefits of future programs. The implications of this program are also substantial:

1. Higher Education's Contribution: This initiative underscores the role of higher education institutions in taking concrete actions to enhance the quality of the environment surrounding their campuses.
2. Model for Expansion: As the program represents a pioneering effort, it is hoped that future iterations will involve a more extensive array of participating institutions. This expansion can serve as a model for similar initiatives in other regions and countries, promoting eco-enzymes and knowledge sharing.
3. Global Relevance: While initially localized, this program has the potential to serve as an exemplary case for other nations. It promotes eco-enzymes and the exchange of knowledge, making it globally relevant.
4. Empirical Testing: it is necessary to conduct several parameter tests to prove that the implemented program effectively improves water quality locally and the environment globally.
5. Policymaker Policy: Although the program was initiated by academics, local governments can implement this activity, for example, by making a policy for the community to pour the eco-enzyme liquid in the river around their house once a month.

Overall, the program practically actualizes SDGs 6, 15, and 17. It encourages collaborative efforts among institutions to achieve the objectives of ensuring clean and sustainable water resources, promoting the health of terrestrial ecosystems, and facilitating partnerships for a better future.

4. CONCLUSIONS

22 green universities in Indonesia have implemented the eco-enzyme flushing program. The pouring process occurs in lakes, canals, and rivers near each campus. It is believed that this water source can provide benefits not only for campus faculty members but also for the people who live around the campus. Experts' speech mainly discusses the program's benefits for improving environmental quality, such as water and air, agriculture, animal husbandry, biodiversity, and functional products. This program is in line with the three pillars of sustainable development and the social learning framework for sustainable decision-making in urban water management.

This research signifies contributing to initiating concrete action in utilizing eco-enzymes to realize sustainable development. Definitely, this program can be a model program for local governments to recognize a better quality environment and water. Some experts' speeches also elaborated on how they simply made eco-enzymes, which the community can replicate. Although the use of eco-enzyme in this research focuses on water, pragmatically, the results of eco-enzyme provide new insights that it is also helpful for humans as beauty products, livestock, and even agriculture. So, the benefits of eco-enzymes have various variations that can depend on the needs and environmental conditions around the community.

This research implies an extension beyond the academic sphere and has practical implications for sustainable water management practices, environmental conservation, and the promotion of eco-friendly initiatives in educational institutions and beyond. Other institutions and other countries can replicate this program, or concretely, the local government can make a policy regarding the routine agenda of pouring eco-enzymes into waters by involving the community and the environmental agency in a certain period. In addition, in collaboration with academics, the government can organize socialization or workshops with the community to promote the use and benefits of eco-enzymes in various aspects, such as water, air, livestock, beauty, and agriculture, as found in this study. This is essential because in order to realize sustainable development, there needs to be real action involving many parties.

One limitation of this research is that it only uses experts' speeches on YouTube as a data source. To remedy this, conducting follow-up interviews with the experts concerned can provide a more comprehensive understanding of the research questions. Additionally, this research only evaluates the eco-enzyme flushing program's impact on water quality and environmental sustainability. Long-term studies could provide a more comprehensive understanding of the program's effectiveness and sustainability over time.

Yet, we also provided several question options for further research: How does the community respond to this program? How is the water quality improved after the eco-enzyme is experimentally applied? As a result, the research results can complement the research findings more comprehensively on social and environmental aspects. Indeed, this program involves the community, but if it is known their response to this program is that community members who are aware of the program are more likely to support and actively participate in it, spreading awareness and educating others about the importance of eco-enzymes and sustainable practices. In the second recommendation question, the program's benefits through quantitative experiments can provide new insights into the program's effectiveness in improving water quality and the environment.

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APPENDIX

The YouTube video used in this research can be accessed through the following link: https://www.youtube.com/live/-w7SswXNpJs?feature=share. The YouTube video has been properly cited in this paper in order to obtain permission.