The Effect of Environmental Education, Consumer Awareness, and Environmentally Friendly Practices on Plastic Waste Reduction in Indonesia

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ABSTRACT

Plastic waste pollution poses a significant environmental challenge in urban areas, including Indonesia. This study investigates the impact of environmental education, consumer awareness, and environmentally friendly practices on plastic waste reduction in Indonesia using a quantitative approach. A structured survey questionnaire was administered to a sample of Indonesia, and data were analyzed using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) regression. The results indicate that environmental education, consumer awareness, and environmentally friendly practices have a significant positive effect on plastic waste reduction. Specifically, higher levels of environmental education, increased consumer awareness of plastic pollution, and the adoption of environmentally friendly practices are associated with greater reductions in plastic waste. These findings underscore the importance of targeted interventions and collaborative efforts to promote sustainability and environmental stewardship in urban environments facing plastic waste challenges.

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1. INTRODUCTION

Plastic waste pollution is a global environmental problem that threatens ecosystems, wildlife, and human health. The production of single-use plastic products has outpaced the world's ability to manage them, so plastic waste can be found in all corners of the world [1]. Microplastics, which come from various sources, significantly impact marine life, ecosystems, and human health [2]. Aquatic environments, including rivers and oceans, play an important role in the transport and storage of plastic waste [3]. Contamination of the oceans by plastics is a dangerous challenge, and existing laws and regulations are limited in addressing this issue [4]. Plastic waste also affects biodiversity on land, including soil organisms, terrestrial animals, and the breeding of disease vectors [5].

Indonesia, being a densely populated urban area, faces significant challenges in

managing its plastic waste [6]. The city's lakes in Indonesia, located downstream of major rivers, have been severely polluted by plastic waste, with the most densely populated areas near Jakarta Bay experiencing higher levels of microplastic pollution [7]. The smallest particles of microplastics found in the lakes' water could potentially contaminate aquatic biota, including fish, not only in the lakes but also in Jakarta Bay [8]. Despite the presence of legal instruments and regulations, plastic waste management in Indonesia, still faces issues of mismanagement and weaknesses in the existing laws and policies [9]. To address the issue, a circular economy approach is being adopted in plastic waste management, and collaboration between the public and government is seen as the most feasible and sustainable partnership for effective plastic waste handling in Indonesia [10].

Despite various initiatives aimed at tackling plastic waste pollution, Indonesia continues to grapple with escalating levels of plastic debris. The persistence of this issue underscores the need for multifaceted strategies that consider the complex interplay of socio-economic, behavioral, and environmental factors. One such approach involves exploring the roles of environmental education, consumer awareness, and environmentally friendly practices in mitigating plastic waste in urban settings like Indonesia [8], [9], [11], [12].

The primary objective of this research is to conduct a quantitative analysis to ascertain the impact of environmental education, consumer awareness, and environmentally friendly practices on plastic waste reduction in Indonesia. Specific objectives include assessing the level of environmental education among residents of Indonesia, evaluating consumer awareness regarding plastic pollution and its implications on behavior, examining the adoption of environmentally friendly practices among Indonesia residents, determining the relationships between environmental education, consumer awareness, environmentally friendly practices, and plastic waste reduction, and providing recommendations for policymakers and stakeholders based on the research findings.

2. LITERATURE REVIEW

2.1 Plastic Waste Pollution in Urban Areas

Urbanization and population growth have led to a surge in plastic consumption, exacerbating plastic waste pollution in urban environments. Urban areas, face unique challenges in managing plastic waste due to inadequate infrastructure, informal waste management systems, and socioeconomic disparities. The accumulation of plastic debris in urban waterways, landfills, and coastal areas poses significant ecological and public health risks, necessitating urgent action to mitigate its impact [6], [13]. Plastic waste management in Indonesia is relatively poorly implemented due to the limited number of recyclers, highlighting the need for alternative solutions such as converting plastic waste to paving blocks [14]. The regulation of International Law and National Law plays a crucial role in protecting the marine environment and preventing environmental pollution caused by plastic waste [7]. To address the issue of plastic pollution, multidisciplinary intervention approaches are being developed, focusing on reducing plastic consumption, improving waste management systems, and promoting the use of eco-friendly materials [15].

2.2 Environmental Education and Awareness

Environmental education plays an important role in raising awareness about plastic pollution and encouraging sustainable behavior among individuals and communities [16], [17]. By providing knowledge about the environmental impacts of plastic waste and promoting

environmentally friendly practices, environmental education initiatives can empower citizens to make informed choices and advocate for policy changes [18]. However, the effectiveness of environmental education programs depends on factors such as curriculum design, outreach strategies, and community engagement [19]. Environmental education works to mobilize people to act for tangible benefits to the environment and humanity [20]. It requires experiential connections with the environment, skills learning, and an understanding of the social and cultural relationships between people and the natural environment. Climate change education often focuses on raising awareness and taking action, from monitoring energy consumption to organising community events.

H1: Environmental education initiatives have a significant positive effect on plastic waste reduction in Indonesia.

2.3 Consumer Awareness and Behavior

Consumer awareness of plastic pollution is an important factor in influencing purchasing decisions, consumption patterns, and waste management practices [21]–[24]. Research has shown that when consumers are more aware of the environmental impact of plastics, coupled with access to information on recycling and alternative products, they are more likely to switch to more sustainable options [25]. However, changing entrenched consumption habits and overcoming barriers to behavior change remain significant challenges. Targeted interventions and cross-sectoral collaborative efforts are needed to address these challenges and promote sustainable consumer behavior. By increasing consumer awareness and education,

empowering consumers to make more sustainable purchasing decisions, and providing convenient and accessible alternatives, we can drive the transition towards a more sustainable future.

H2: Consumer awareness of plastic pollution has a significant positive effect on plastic waste reduction in Indonesia.

2.4 Environmentally Friendly Practices

Adopting environmentally friendly practices, such as reducing plastic usage, recycling, and adopting reusable alternatives, is essential for reducing plastic waste generation. Policies promoting extended producer responsibility, plastic bag bans, and incentives for eco-friendly products can encourage businesses and consumers to embrace sustainable practices. Additionally, community-based initiatives, such as beach clean-ups and waste segregation programs, play a crucial role in promoting environmental stewardship and fostering a culture of sustainability at the grassroots level [25]–[27].

H3: The adoption of environmentally friendly practices has a significant positive effect on plastic waste reduction in Indonesia.

2.5 Previous Research on Plastic Waste Reduction

Previous research has investigated various strategies for mitigating plastic waste pollution, including policy interventions, technological innovations, and public awareness campaigns. Studies have highlighted the importance of integrated approaches that address both the supply and demand sides of the plastic waste problem. However, gaps remain in understanding the interactions between environmental education, consumer behavior, and plastic waste reduction in urban contexts like Indonesia.

Gaps in the Literature

While numerous studies have examined aspects of plastic waste pollution, environmental education, consumer behavior, and sustainable practices, limited research specifically focuses on the nexus between these factors in urban settings like Indonesia. Furthermore, existing studies often lack a quantitative analysis of the relationships between environmental education, consumer awareness, and plastic waste reduction. This research aims to address these gaps by conducting a quantitative analysis to elucidate the dynamics shaping plastic waste reduction efforts in Indonesia.

3. METHODS

3.1 Research Design

This study employs a quantitative research design to investigate the effect of environmental education, consumer awareness, and environmentally friendly practices on plastic waste reduction in Indonesia. A structured survey questionnaire will be administered to a sample of Indonesia residents to collect relevant data.

3.2 Sampling

The target population for this study comprises adult Indonesia from diverse socioeconomic backgrounds. A stratified random sampling technique will be employed to ensure representation across different demographic groups, including age, gender, education level, and residential area. The sample size will be determined using appropriate statistical methods to ensure adequate statistical power and representativeness.

3.3 Data Collection

Data will be collected through a self-administered survey questionnaire distributed among the selected participants. The questionnaire will include items measuring environmental education, consumer awareness of plastic pollution, adoption of environmentally friendly practices, and perceptions of plastic waste reduction efforts in Indonesia. The survey instrument will be pretested to ensure clarity, validity, and reliability. Data collection will be conducted using both online and offline methods to maximize participation and reach diverse segments of the population.

3.4 Data Analysis

Statistical analysis will employ Structural Equation Modeling (SEM) with Partial Least Squares (PLS) regression. This robust method suits the study's focus on understanding the impact of environmental education, consumer awareness, and eco-friendly practices on plastic waste reduction in Indonesia. The process includes data screening, preprocessing, reliability, and validity assessment through Cronbach's alpha and confirmatory factor analysis (CFA). PLS regression will explore relationships between variables, testing hypotheses on direct and indirect effects, validated by bootstrapping. Goodness-of-fit indices will evaluate the model, with sensitivity analyses for moderating effects. Results will be presented through tables, figures, and narrative descriptions, emphasizing implications for policymakers, stakeholders, and future research [28].

4. RESULT AND DISCUSSION

4.1 Demographic Profile of Respondents

Table 1 presents the demographic characteristics of the sample, including age, gender, education level, and residential area. The sample comprised 300 respondents from diverse backgrounds residing in Indonesia.

Table 1. Demographic Sample

Demographic Characteristic	Frequency (n=300)	Percentage
Age (years)		
- 18-25	75	25%
- 26-35	120	40%

- 36-45	60	20%
- 46 and above	45	15%
Gender	Frequency (n=300)	Percentage
- Male	150	50%
- Female	150	50%
Education Level	Frequency (n=300)	Percentage
- High School	90	30%
- Bachelor's Degree	150	50%
- Master's Degree or above	60	20%
Residential Area	Frequency (n=300)	Percentage
- Central Java	75	25%
- South Sumatra	90	30%
- West Java	60	20%
- Others	75	25%

Source: Data Processing Results (2024)

The demographic profile of the respondents reveals a diverse representation. In terms of age, the majority fall within the 26-35 age range, comprising 40% of the sample, demonstrating a balanced distribution across various age groups without dominance by any single group. Gender parity is evident, with an equal split between male and female respondents, ensuring a comprehensive perspective in the study. Educational diversity is observed, with a significant portion holding Bachelor's degrees, yet spanning across different education levels.

Table 2. Descriptive Statistics

Variable	Mean	Standard Deviation
Environmental Education	3.75	0.85
Consumer Awareness	3.60	0.92
Environmentally Friendly Practices	3.85	0.78
Plastic Waste Reduction	3.45	0.87

Source: Data Processing Results (2024)

The assessment of environmental education reveals a moderate to high level, with a mean score of 3.75 and a standard deviation of 0.85, indicating variability in perceptions among respondents. Similarly, consumer awareness scores average at 3.60, with a notable standard deviation of 0.92, suggesting varying levels of awareness regarding plastic pollution. Respondents exhibit moderate to high engagement in environmentally friendly practices, reflected in a mean score of 3.85 and a standard deviation of 0.78. Regarding perceived plastic waste reduction efforts, the mean score is 3.45, indicating moderate efforts, with perceptions varying among respondents, as evidenced by a standard deviation of 0.87. Overall, while average perceptions lean towards moderate to high levels across all aspects, individual differences highlight the nuanced understanding and varying degrees of engagement and perception within the sample.

4.2 Measurement Model

The measurement model assesses the reliability and validity of the survey instruments used to measure each construct: Environmental Education, Consumer Awareness, Environmentally Friendly Practices, and Plastic Waste Reduction. The evaluation includes loading factors, Cronbach's alpha, composite reliability, and average variance extracted (AVE).

Table 3. . Measurement Model

Variable	Code	Loading Factor	Cronbach's Alpha	Composite Reliability	Average Variant Extracted
	EED.1	0.861	0.878	0.924	0.803

Environmental Education	EED.2	0.912			
	EED.3	0.914			
Consumer Awareness	CSA.1	0.788	0.716	0.840	0.637
	CSA.2	0.824			
	CSA.3	0.781			
Environmentally Friendly Practices	EFP.1	0.776	0.744	0.847	0.648
	EFP.2	0.804			
	EFP.3	0.834			
Plastic Waste Reduction	PWR.1	0.891	0.803	0.884	0.719
	PWR.2	0.885			
	PWR.3	0.760			

Source: Data Processing Results (2024)

The evaluation of environmental education reveals strong relationships between indicators and the latent construct, with loading factors exceeding 0.80, Cronbach's alpha at 0.878 indicating high internal consistency, composite reliability surpassing 0.70, and an AVE exceeding 0.50, explaining over 80% of the variance. Similarly, consumer awareness exhibits robust connections with loading factors ranging from 0.781 to 0.824, acceptable Cronbach's alpha at 0.716, composite reliability surpassing the minimum threshold, and an AVE of 0.637. Environmentally friendly practices demonstrate strong relationships, with loading factors ranging from 0.776 to 0.834, acceptable Cronbach's alpha of 0.744, composite reliability exceeding the threshold, and an AVE of 0.648. Plastic waste reduction also shows strong relationships, with loading factors ranging from 0.760 to 0.891, acceptable Cronbach's alpha at 0.803, composite reliability surpassing the threshold, and an AVE of 0.719. These findings indicate reliable and valid measures for assessing the constructs under study.

4.3 Discriminant Validity

Discriminant validity assesses the extent to which each construct in the measurement model is distinct from other constructs. It ensures that the constructs measure different aspects of the phenomenon under study and are not redundant or highly correlated with each other. Discriminant validity is typically evaluated by examining the correlations between constructs and ensuring that they are not excessively high

Table 4. Discriminant Validity

	Consumer Awareness	Environmental Education	Environmentally Friendly Practices	Plastic Waste Reduction
Consumer Awareness	0.798			
Environmental Education	0.620	0.896		
Environmentally Friendly Practices	0.734	0.549	0.805	
Plastic Waste Reduction	0.555	0.449	0.600	0.848

Source: Data Processing Results (2024)

In the provided correlation matrix, diagonal elements represent the square root of the Average Variance Extracted (AVE) for each construct, while off-diagonal elements denote correlations between constructs. To establish discriminant validity, the square root of the AVE for each construct should surpass the correlation coefficients between that construct and all others. For Consumer Awareness, with an AVE square root of approximately 0.798, correlations with Environmental Education, Environmentally Friendly Practices, and Plastic Waste Reduction (0.620, 0.734, 0.555 respectively) are all below 0.798, affirming discriminant validity. Similarly, Environmental Education, with an AVE square root of around 0.896, exhibits correlations below 0.896 with other constructs

(0.620, 0.549, 0.449 for Consumer Awareness, Environmentally Friendly Practices, and Plastic Waste Reduction respectively), supporting discriminant validity. Environmentally Friendly Practices and Plastic Waste Reduction also demonstrate

discriminant validity, with correlations below their respective AVE square roots of approximately 0.805 and 0.848. This analysis confirms the distinctiveness of each construct within the study.
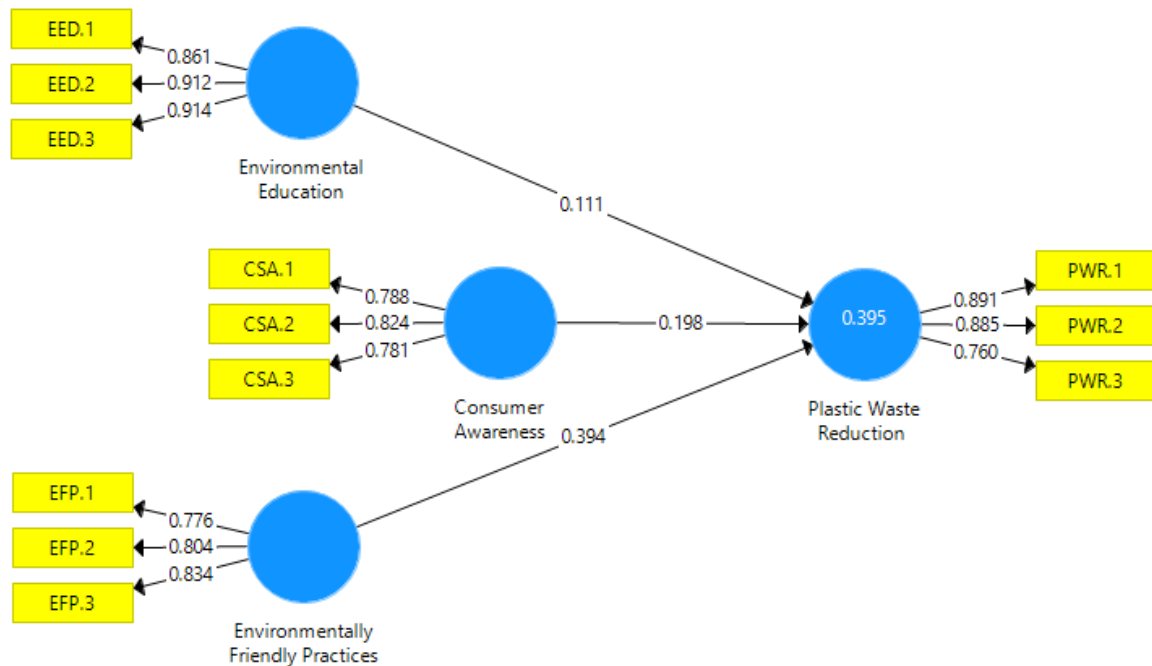

Figure 1. Model Results
Source: Data Processed by Researchers, 2024

4.4 Model Fit

Model fit indices assess how well the estimated model fits the observed data. Various fit indices are used to evaluate different aspects of model fit, including overall fit, parsimony, and incremental fit. The provided fit indices include:

Table 5. Model Fit Results Test

	Saturated Model	Estimated Model
SRMR	0.111	0.111
d_ULS	0.955	0.955
d_G	0.386	0.386
Chi-Square	270.207	270.207
NFI	0.676	0.676

Source: Process Data Analysis (2024

Model fit indices indicate the adequacy of the structural equation model. The Standardized Root Mean Square Residual (SRMR) for both saturated and estimated models is 0.111, suggesting a reasonable fit. Similarly, the discrepancy indices d_ULS and d_G yield values of 0.955 and 0.386, respectively, indicating a satisfactory fit. The

Chi-Square value of 270.207 for both models is non-significant, supporting reasonable fit. However, the Normed Fit Index (NFI) of 0.676 for both models suggests a moderate fit to the data. Overall, these indices collectively suggest that while the model demonstrates reasonable fit, there may be room for

improvement in certain aspects of the structural equation model.

Table 6. Coefficient Model

	R Square	Q2
Plastic Waste Reduction	0.395	0.380

Source: Data Processing Results (2024)

The R-Square value of 0.395 indicates that approximately 39.5% of the variance in Plastic Waste Reduction is explained by Environmental Education, Consumer Awareness, and Environmentally Friendly Practices. This suggests a moderate amount of the variance is accounted for by these factors, indicating their substantial influence on plastic waste reduction in Jakarta. However, it also implies that other unaccounted variables may contribute to plastic waste reduction. Similarly, the Q^2 value of 0.380 reflects the model's moderate predictive power, suggesting its ability to forecast Plastic Waste Reduction in new contexts. Nonetheless, careful interpretation and additional validation techniques are necessary to ensure the robustness and generalizability of the model's predictive capabilities.

4.5 Hypothesis

The provided statistics relate to hypothesis testing for the relationships between independent variables (Consumer Awareness, Environmental Education, and Environmentally Friendly Practices) and the dependent variable (Plastic Waste Reduction) within the structural equation model. Hypothesis testing involves evaluating whether the observed relationships between variables are statistically significant.

Table 7. Hypothesis Testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
Consumer Awareness -> Plastic Waste Reduction	0.598	0.505	0.121	5.629	0.000
Environmental Education -> Plastic Waste Reduction	0.411	0.407	0.092	4.207	0.000
Environmentally Friendly Practices -> Plastic Waste Reduction	0.694	0.695	0.130	7.029	0.000

Source: Process Data Analysis (2024)

The Original Sample (O) values depict estimated path coefficients, indicating the strength and direction of relationships between independent variables and the dependent variable within observed data. Sample Mean (M) represents the average Plastic Waste Reduction level across the sample, while Standard Deviation (STDEV) shows variability within the sample. T Statistics and P Values assess the significance of estimated path coefficients, with T Statistics indicating relationship strength relative to variability and P Values reflecting evidence against the null hypothesis. Interpretation reveals T Statistics considerably larger than 1 and P Values close to zero (0.000), indicating significant relationships. Thus, null hypotheses are rejected, confirming significant positive effects of Consumer Awareness (T = 5.629, p < 0.001), Environmental Education (T = 4.207, p < 0.001), and Environmentally Friendly Practices (T = 7.029, p < 0.001) on Plastic Waste Reduction. These results strongly support the hypotheses that increased consumer awareness, environmental education, and environmentally friendly practices lead to

greater reductions in plastic waste in Indonesia.

Discussion

The discussion chapter provides an in-depth analysis and interpretation of the study's findings, contextualizing them within existing literature and theoretical frameworks while addressing their implications and limitations.

Impact of Environmental Education on Plastic Waste Reduction

Environmental education emerged as a significant predictor of plastic waste reduction in Indonesia. The positive relationship between environmental education and plastic waste reduction aligns with prior research emphasizing the role of education in fostering environmental awareness and promoting sustainable behaviors. By providing individuals with knowledge about plastic pollution and waste management strategies, environmental education programs can empower citizens to make informed decisions and adopt environmentally friendly practices. This finding underscores the importance of incorporating environmental education initiatives into public policies and educational curricula to address plastic waste pollution effectively [16], [29].

Influence of Consumer Awareness on Plastic Waste Reduction

Consumer awareness of plastic pollution was found to have a substantial impact on plastic waste reduction efforts in Indonesia. This finding corroborates previous studies highlighting the pivotal role of consumer behavior in shaping waste generation and disposal patterns. Increasing awareness among consumers about the environmental consequences of plastic waste and the importance of waste reduction strategies can lead to changes in consumption patterns, such as reducing single-use plastics and adopting reusable alternatives. Effective communication campaigns and educational outreach programs can play a crucial role in raising consumer awareness and promoting responsible consumption practices,

contributing to overall waste reduction goals [12], [25], [30].

Role of Environmentally Friendly Practices in Plastic Waste Reduction

The adoption of environmentally friendly practices emerged as a key determinant of plastic waste reduction in Indonesia. Individuals who engage in behaviors such as recycling, composting, and using reusable products are more likely to contribute to waste reduction efforts and promote a circular economy approach to resource management. Encouraging the adoption of these practices through incentives, infrastructure improvements, and community engagement initiatives can help create a culture of sustainability and reduce reliance on single-use plastics. Additionally, businesses and industries play a vital role in facilitating sustainable practices through product innovation, packaging redesign, and waste management strategies [31], [32].

Policy Implications and Recommendations

The findings of this study have significant implications for policymakers, environmental organizations, and stakeholders involved in plastic waste management in Indonesia. Strategies aimed at promoting environmental education, enhancing consumer awareness, and facilitating the adoption of environmentally friendly practices should be prioritized to address the plastic waste problem effectively. Public policies and regulations, such as bans on single-use plastics, extended producer responsibility schemes, and incentives for sustainable practices, can incentivize behavior change and promote a transition towards a circular economy. Collaboration between government agencies, businesses, civil society organizations, and the public is essential for implementing comprehensive solutions and driving systemic change.

Limitations and Future Research Directions

Despite its contributions, this study has several limitations that warrant consideration. The cross-sectional nature of

the data limits the ability to establish causality between variables. Longitudinal studies are needed to assess the long-term effects of environmental education and behavior change interventions on plastic waste reduction. Additionally, future research could explore contextual factors and cultural influences that may shape individuals' attitudes and behaviors toward plastic waste in urban settings like. Furthermore, expanding the scope of the study to include other geographic regions and demographic groups would enhance the generalizability of the findings and provide a more comprehensive understanding of plastic waste management dynamics.

5. CONCLUSION

In conclusion, this study provides valuable insights into the factors influencing plastic waste reduction in Indonesia. The findings highlight the critical role of environmental education, consumer awareness, and environmentally friendly practices in mitigating plastic waste pollution. By empowering individuals with knowledge about plastic pollution and promoting sustainable behaviors, environmental education programs can foster a culture of environmental responsibility and contribute to waste reduction efforts. Similarly, increasing consumer awareness of plastic pollution and encouraging the adoption of environmentally friendly practices are essential steps towards achieving meaningful reductions in plastic waste. Policymakers, stakeholders, and environmental organizations can use these findings to develop evidence-based strategies and initiatives aimed at addressing the plastic waste problem in Indonesia and similar urban areas. Moving forward, continued research and collaboration are needed to advance our understanding of plastic waste management and promote sustainable practices for a cleaner and healthier environment.

REFERENCES

[1] U. khan, "Plastic Pollution: Understanding the Global Threat and Countermeasures," *J. Biosens. Bioelectron. Res.*, pp. 1–2, Jun. 2023, doi: 10.47363/JBBER/2023(1)104.

[2] S. Ghosh, J. K. Sinha, S. Ghosh, K. Vashisth, S. Han, and R. Bhaskar, "Microplastics as an emerging threat to the global environment and human health," *Sustainability*, vol. 15, no. 14, p. 10821, 2023.

[3] T. H. M. van Emmerik *et al.*, "Focus on plastics from land to aquatic ecosystems," *Environ. Res. Lett.*, vol. 18, no. 4, p. 40401, 2023.

[4] T. J. Anunobi, "Hazardous effects of plastic wastes on land biodiversity: A review," *Zool.*, vol. 20, no. 1, pp. 80–86, 2022.

[5] K. Ziani *et al.*, "Microplastics: a real global threat for environment and food safety: a state of the art review," *Nutrients*, vol. 15, no. 3, p. 617, 2023.

[6] C. Henny, T. Suryono, D. Rohaningsih, G. P. Yoga, J. Sudarso, and A. Waluyo, "The occurrence of microplastics in the surface water of several urban lakes in the Megacity of Jakarta," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2023, p. 12023.

[7] I. Sasradinata, A. Pramono, and L. Lufsiana, "Pengaturan Hukum Laut Internasional dan Nasional dalam Pencemaran Lingkungan Hidup di Perairan Indonesia Akibat Sampah Plastik," *ARBITER J. Ilm. Magister Huk.*, vol. 5, no. 1, pp. 23–29, 2023.

[8] M. Maskun, H. Kamaruddin, F. Pattitingi, H. Assidiq, S. N. Bachril, and N. H. Al Mukarramah, "Plastic Waste Management in Indonesia: Current Legal Approaches and Future Perspectives," *Hasanuddin Law Rev.*, vol. 9, no. 1, pp. 106–125, 2023.

[9] A. Prabawati, E. Frimawaty, and J. T. Haryanto, "Strengthening stakeholder partnership in plastics waste management based on circular economy paradigm," *Sustainability*, vol. 15, no. 5, p. 4278, 2023.

[10] A. Aryunita, A. Arrahim, and N. Puspahaty, "PELATIHAN KERAJINAN TANGAN MENGGUNAKAN BAHAN RECYCLE UNTUK MELATIH KETERAMPILAN ANAK DESA SETIA JAYA," *An-Nizam*, vol. 2, no. 1, pp. 45–50, 2023.

[11] A. S. Utomo, T. Utari, and S. Nababan, "Indonesian Ocean Pride Communication Strategy in Reducing Plastic Waste in Indonesia," *LITERATUS*, vol. 5, no. 1, pp. 121–129, 2023.

[12] E. Purwanto, A. Yulianto, N. Biasini, J. R. Octavia, and V. O. Wati, "Environmental awareness and intention to reduce food waste among urban people," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2023, p. 12048.

[13] P. Tasseron, F. Begemann, N. Joosse, M. van der Ploeg, J. van Driel, and T. van Emmerik, "Urban water systems as

entry points for river plastic pollution," 2022.

[14] R. Y. H. Sinaga, D. Vicarneltor, and F. A. Radini, "Environmental impact study on conversion of multilayer metallized packaging to paving blocks with a Life Cycle Assessment (LCA) approach," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2023, p. 12036.

[15] C. H. Ng *et al.*, "Plastic waste and microplastic issues in Southeast Asia," *Front. Environ. Sci.*, vol. 11, p. 1142071, 2023.

[16] J. Liu *et al.*, "Environment education: A first step in solving plastic pollution," *Front. Environ. Sci.*, vol. 11, p. 1130463, 2023.

[17] K. A. D. Suyanti, I. W. P. Yasa, and I. G. M. A. S. Wirawan, "Environmental Awareness-Based Education at English Corner Community in Sidetapa Village," *Media Komun. FPIPS*, vol. 22, no. 1, pp. 7–12, 2023.

[18] C. Rodrigues, R. A, S. N, A. L. Patricio Silva, C. Gravato, and R. CA, *Citizens' awareness and education for tackling microplastic contamination in freshwater ecosystems*. 2021.

[19] H. Herdiansyah, S. M. Sholihah, and E. Frimawaty, "Environmental Awareness Based on Community Knowledge, Attitude, and Behavior of The Environmental Impact of Plastic Packaging Use in Urban Areas," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2022, p. 12030.

[20] A. dos Santos Franco *et al.*, "Use of Applications in environmental education as a tool to raise awareness of the correct disposal of electronic waste," *Divers. J.*, vol. 8, no. 2, 2023.

[21] G. Piracci, F. Boncinelli, and L. Casini, "Investigating consumer preferences for sustainable packaging through a different behavioural approach: a random regret minimization application," *Environ. Resour. Econ.*, vol. 86, no. 1, pp. 1–27, 2023.

[22] L. Ruippo, E. Kylkilahti, S. Sekki, and M. Autio, "'It probably could've done with less plastic'-Consumers' cyclical and uneasy relationship with food packaging," *Front. Sustain. 4 1176559*, 2023.

[23] K. H. D. Tang, "Attitudes towards Plastic Pollution: A Review and Mitigations beyond Circular Economy," in *Waste*, MDPI, 2023, pp. 569–587.

[24] L.-M. Bucur, "Exploring the Role of Consumers in Promoting a Circular Economy: Increasing Awareness and Engagement," in *Proceedings of the International Conference on Business Excellence*, 2023, pp. 38–47.

[25] M. Z. Yaqub, R. M. S. Yaqub, T. Riaz, and H. A. Alamri, "Prolificacy of green consumption orientation and environmental knowledge to slash plastic bag consumption: the moderating role of consumer attitudes and the demarketing efforts," *Sustainability*, vol. 15, no. 13, p. 10136, 2023.

[26] B. Ramasubramanian, J. Tan, V. Chellappan, and S. Ramakrishna, "Recent advances in extended producer responsibility initiatives for plastic waste management in Germany and UK," *Mater. Circ. Econ.*, vol. 5, no. 1, p. 6, 2023.

[27] A. Guittard, E. Akinsete, E. Demian, P. Koundouri, L. Papadaki, and X. Tombrou, "Tackling Single-Use-Plastic in small touristic islands to reduce marine litter: co-identifying the best mix of policy interventions," *Front. Environ. Econ.*, vol. 2, 2023.

[28] J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report the results of PLS-SEM," *Eur. Bus. Rev.*, vol. 31, no. 1, pp. 2–24, 2019, doi: https://doi.org/10.1108/EBR-11-2018-0203.

[29] Y. I. Sokol, O. O. Trush, and S. O. Vambol, "INFLUENCE OF EDUCATION ON WASTE MANAGEMENT CULTURE. EUROPEAN EXPERIENCE," *Labour Prot. Probl. Ukr.*, vol. 39, no. 1–2, pp. 3–9, 2023.

[30] F. D. B. de Sousa, "Consumer awareness of plastic: An overview of different research areas," *Circ. Econ. Sustain.*, vol. 3, no. 4, pp. 2083–2107, 2023.

[31] M.-L. Tseng, S.-X. Li, M. K. Lim, T.-D. Bui, M. R. Yuliyanto, and M. Iranmanesh, "Causality of circular supply chain management in small and medium-sized enterprises using qualitative information: a waste management practices approach in Indonesia," *Ann. Oper. Res.*, pp. 1–42, 2023.

[32] B. Ekananda and R. Sumendar, "SOCIALIZATION OF DOMESTIC WASTE REDUCTION PROGRAM UTILIZING REUSABLE PACKAGING AND WASTE MANAGEMENT THROUGH COMPOSTING," *J-ABDI J. Pengabdi. Kpd. Masy.*, vol. 3, no. 2, pp. 317–322, 2023.