Devosia: Community Outreach Journal of Indonesian Movement
Vol 1 No 1 January 2026, Hal 13-22
ISSN: XXXX-XXXX (Print) ISSN: XXXX-XXXX (Electronic)
Open Access: https://researchfrontiers.id/devosia/index

Environmental Conservation and Sustainability: Waste Management, Renewable Energy Awareness, and Environmental Protection Programs.

Alya Nabila Adistia[1*], Anjela Karunia Amalia[2], Ahmad Rizaldy Fanbudy[3], Annisa Vada Febriani[4], Diana Widhi Rachmawati[5]
[1] UIN Walisongo Semarang, Indonesia
[2] IPB University, Indonesia
[3]STAIN Mandailing Natal, Indonesia
[4] Universitas Ahmad Dahlan, Indonesia
[5] Universitas PGRI Palembang, Indonesia
email: alyaadistia@gmail.com[1]

Article Info :
Received:
25-11-2025
Revised:
10-01-2026
Accepted:
22-01-2026

Abstract

Environmental degradation, climate change, and increasing resource pressure have intensified the need for integrated environmental conservation and sustainability strategies. This study examines environmental conservation practices by focusing on waste management, renewable energy awareness, and environmental protection programs within coastal environmental contexts. A qualitative descriptive approach was employed using field observation, document analysis, and literature-based evaluation to capture ecological conditions, environmental pressures, and sustainability initiatives. The findings indicate that effective waste management plays a critical role in reducing pollution, supporting ecosystem stability, and mitigating environmental risks in sensitive coastal areas. Renewable energy awareness is identified as a key social and institutional driver that influences behavioral change, technological acceptance, and sustainability-oriented decision-making. Environmental protection programs function as structural instruments that align conservation goals with regulatory frameworks and long-term resource management. The study highlights that sustainability outcomes are strengthened when operational practices, awareness-based initiatives, and policy instruments are integrated within a coherent environmental governance framework. This research contributes to sustainability literature by emphasizing the complementary roles of waste management, renewable energy awareness, and environmental protection programs in achieving long-term environmental resilience.

Keywords : *Environmental Conservation; Sustainability, Waste Management, Renewable Energy Awareness, Environmental Protection Programs.*

©2022 Authors.. This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License.
(https://creativecommons.org/licenses/by-nc/4.0/)

INTRODUCTION

Environmental conservation and sustainability have emerged as critical global priorities as environmental degradation, climate change, and resource depletion increasingly threaten ecological balance and human well-being. Rapid industrialization, urban expansion, and consumption-driven lifestyles have intensified waste generation and environmental pollution, placing significant pressure on natural ecosystems. Effective waste management strategies have therefore become a central component of sustainable development agendas worldwide. Studies emphasize that sustainable waste practices are not only technical solutions but also social and institutional processes that require systemic integration (Pandiyarajan et al., 2022; Külekçi & Güvendi, 2023).

Waste management plays a strategic role in promoting sustainability by reducing environmental burdens while encouraging resource efficiency. The application of the reduce, reuse, and recycle principles has been widely recognized as a foundational approach to minimizing waste and supporting circular economic systems. Successful waste management initiatives demonstrate that structured recycling programs can enhance environmental outcomes when supported by community participation and governance mechanisms. Empirical evidence from diverse sectors highlights the contribution of sustainable waste practices to cleaner environments and long-term ecological resilience (Pandiyarajan et al., 2022; Perkumienė et al., 2023).

Environmental sustainability is closely linked to education and public awareness, which shape individual and collective attitudes toward environmental responsibility. Environmental education has

been identified as a key driver in fostering pro-environmental behavior and supporting sustainable development goals across generations. Awareness programs that integrate ecological values into formal and informal education systems strengthen societal capacity to address environmental challenges. Research confirms that knowledge-based interventions significantly influence sustainable practices related to waste management and environmental protection (Yadav et al., 2022; Djirong et al., 2024).

Alongside waste management, renewable energy awareness represents a crucial dimension of environmental sustainability. Transitioning from fossil fuels to renewable energy sources is essential for reducing greenhouse gas emissions and mitigating global warming. Investment in renewable energy development has demonstrated positive impacts on both environmental performance and economic sustainability. Scholarly findings highlight that renewable energy adoption is strongly influenced by public awareness, green financing, and institutional support mechanisms (Sharma et al., 2022; Qing et al., 2024).

Renewable energy initiatives are also deeply connected to natural resource management and environmental protection policies. Sustainable management of natural resources contributes to environmental stability while supporting economic activities such as agriculture and industry. Research indicates that balanced approaches to resource extraction, conservation, and reforestation are essential for achieving long-term sustainability outcomes. Integrated environmental protection strategies have been shown to strengthen resilience against climate change and resource depletion (Lu & Wang, 2023; Yang & Solangi, 2024).

Technological innovation plays an increasingly important role in advancing environmental conservation and sustainability efforts. Environmentally friendly technologies support cleaner production processes, reduce emissions, and enhance energy efficiency across industrial sectors. The development of green technologies has been identified as a strategic pathway for countries seeking sustainable economic growth without compromising environmental integrity. Studies demonstrate that technological advancement aligned with sustainability principles accelerates progress toward environmental protection goals (Ramadhan et al., 2024; Gunduz Songur et al., 2023).

Environmental conservation initiatives are also closely associated with sustainable tourism and service industries, where environmental protection must be balanced with economic development. Regulatory frameworks and environmental policies influence how industries adopt sustainable predominance in waste management and energy usage. Evidence from tourism and hospitality sectors shows that environmental programs contribute to both ecosystem preservation and long-term economic viability. Legal and institutional arrangements have been identified as critical factors in ensuring effective implementation of environmental protection strategies (Khater et al., 2025; Perkumienė et al., 2023).

Based on these considerations, environmental conservation and sustainability require an integrated approach that encompasses waste management, renewable energy awareness, and environmental protection programs. Interdisciplinary strategies combining education, technology, policy, and financial instruments are essential to address contemporary environmental challenges. Existing studies underline that sustainability outcomes are most effective when environmental initiatives are supported by public awareness and institutional commitment. This research therefore positions waste management practices, renewable energy awareness, and environmental protection programs as interconnected pillars for achieving sustainable environmental development at the global level (Hayat et al., 2023; Sahoo et al., 2023).

METHODS

This study employed a qualitative descriptive approach to examine environmental conservation and sustainability practices focusing on waste management, renewable energy awareness, and environmental protection programs in coastal settings. Data were collected through field observation, document analysis, and literature-based evaluation to capture environmental conditions, ecological characteristics, and sustainability practices within the study area. Observational data emphasized coastal environmental features, including shoreline conditions, vegetation coverage, and environmental pressures related to flooding and ecosystem dynamics, providing contextual support for environmental protection analysis. Secondary data were obtained from peer-reviewed journals, official environmental reports, and sustainability policy documents to strengthen analytical interpretation. The collected data were analyzed using thematic analysis to identify patterns related to environmental management

strategies, public awareness, and conservation outcomes. This methodological framework enabled an integrated understanding of how environmental conditions and sustainability initiatives interact within coastal environments.

RESULTS AND DISCUSSION (Capital, bold , Times new romance 11 pt)

Waste Management Practices as a Foundation of Environmental Conservation

Waste management has become a fundamental pillar of environmental conservation due to its direct relationship with ecosystem health, resource efficiency, and long-term sustainability outcomes. Increasing volumes of municipal, industrial, and coastal waste have intensified environmental pressures, particularly in vulnerable ecosystems such as coastal zones and shoreline settlements. Empirical studies demonstrate that unmanaged waste accelerates land degradation, marine pollution, and ecosystem imbalance, ultimately threatening human livelihoods and biodiversity (Pandiyarajan et al., 2022; Külekçi & Güvendi, 2023). Within sustainability frameworks, waste management is therefore positioned not merely as a technical operation but as a systemic environmental intervention.

The application of structured waste management systems contributes significantly to environmental protection by reducing pollution loads and promoting material recovery. The principles of reduce, reuse, and recycle have been widely adopted as strategic mechanisms to support circular economy objectives in both urban and coastal contexts. Research shows that regions implementing integrated waste management policies experience measurable reductions in landfill dependency and environmental contamination (Puntillo, 2023; Perkumienė et al., 2023). These outcomes highlight the environmental and economic value of waste governance embedded within sustainability planning.

Coastal environments require particular attention in waste management practices due to their ecological sensitivity and exposure to anthropogenic activities. Improper waste disposal in coastal settlements often exacerbates flooding risks, shoreline erosion, and marine ecosystem degradation. Observational evidence from coastal regions indicates that accumulated solid waste obstructs natural drainage systems and weakens the protective function of mangrove vegetation (Lu & Wang, 2023).

Figure 1. Coastal Flooding Impact on Residential Areas Surrounded by Mangrove Vegetation

The relationship between waste accumulation and coastal vulnerability underscores the importance of integrated environmental protection strategies. Mangrove ecosystems function as natural barriers against coastal flooding while simultaneously acting as carbon sinks and biodiversity habitats. Studies confirm that waste pollution significantly reduces mangrove resilience, diminishing their ecological and protective capacity (Yang & Solangi, 2024). Effective waste management therefore contributes not only to cleanliness but also to climate adaptation and disaster risk reduction. Empirical data from regional and international studies further illustrate the environmental impact of structured waste management systems. The following table summarizes findings from selected studies and official reports regarding waste management outcomes and environmental indicators.

Table 1. Environmental Outcomes of Waste Management Practices

Study / Report	Location / Scope	Key Waste Management Indicator	Environmental Outcome
Pandiyarajan et al. (2022)	Multi-regional	3R implementation rate	Reduced landfill waste and pollution
Külekçi & Güvendi (2023)	Urban municipality	Recycling participation	Improved environmental quality
Perkumienė et al. (2023)	Tourism regions	Waste segregation efficiency	Cleaner coastal environments
Puntillo (2023)	Circular economy sector	Resource recovery rate	Lower environmental footprint

Source: Compiled from peer-reviewed studies and official sustainability reports.

The data indicate that waste management effectiveness correlates strongly with improved environmental indicators across multiple sectors. Regions with higher recycling participation and waste segregation efficiency demonstrate reduced pollution levels and enhanced ecosystem stability. These findings align with broader sustainability research emphasizing waste governance as a driver of environmental resilience (Sahoo et al., 2023). The consistency of outcomes across geographical contexts reinforces the global relevance of waste management strategies.

Waste management also intersects with environmental education and community engagement, shaping behavioral change toward sustainable practices. Awareness programs embedded within waste governance frameworks have been shown to increase compliance, participation, and long-term environmental commitment (Yadav et al., 2022; Djirong et al., 2024). When communities understand the ecological consequences of waste mismanagement, participation in recycling and waste reduction initiatives increases substantially. This social dimension strengthens the effectiveness of technical waste solutions.

Technological innovation further enhances waste management performance by enabling efficient processing, monitoring, and material recovery. Advanced waste treatment systems, including waste-to-energy and recycling technologies, reduce environmental burdens while supporting sustainable resource use (Seif et al., 2023; Ramadhan et al., 2024). These technologies align waste management with renewable energy objectives, creating synergistic sustainability benefits. The integration of technology transforms waste from an environmental liability into a potential resource.

In coastal regions, waste management practices must be aligned with shoreline ecosystem dynamics to ensure environmental protection. Shoreline systems are highly responsive to pollution inputs, sediment disruption, and waste accumulation. Environmental assessments reveal that cleaner coastal zones exhibit stronger ecosystem functions and improved resilience to climatic stressors (Lu & Wang, 2023). Policy and regulatory frameworks play a decisive role in sustaining effective waste management systems. Environmental regulations, institutional accountability, and financial incentives influence the adoption and enforcement of waste management practices. Studies on sustainable tourism and coastal governance highlight that regulatory alignment significantly improves waste control outcomes while balancing economic development (Khater et al., 2025). Strong governance structures therefore remain central to environmental conservation efforts.

Waste management functions as a foundational element of environmental conservation and sustainability. Its influence extends beyond waste reduction to ecosystem protection, climate adaptation, and resource efficiency. Empirical evidence consistently demonstrates that effective waste management strengthens environmental resilience across terrestrial and coastal systems (Pandiyarajan et al., 2022; Puntillo, 2023). This sub-section establishes waste management as a critical entry point for broader sustainability strategies, setting the basis for discussions on renewable energy awareness and environmental protection programs in subsequent sections.

Renewable Energy Awareness as a Social and Institutional Driver of Environmental Sustainability

Renewable energy awareness has emerged as a critical social dimension of environmental sustainability, particularly in regions experiencing ecological vulnerability and resource pressure. Awareness shapes how communities, institutions, and policymakers perceive the urgency of transitioning from fossil-based energy systems to cleaner alternatives. Studies emphasize that energy transitions are not solely technological processes but are deeply influenced by knowledge dissemination, social acceptance, and behavioral change (Sharma et al., 2022; Mostaghimi & Rasoulinezhad, 2022). In sustainability discourse, renewable energy awareness functions as a catalyst that bridges environmental objectives with societal engagement.

Public understanding of renewable energy technologies significantly affects adoption rates and long-term sustainability outcomes. Research demonstrates that communities with higher levels of renewable energy literacy tend to support clean energy policies and demonstrate greater willingness to adopt renewable technologies (Izam et al., 2022; Qing et al., 2024). Awareness initiatives improve perceptions of feasibility, reliability, and economic benefits associated with renewable energy systems. These social factors reduce resistance to energy transitions and enhance institutional legitimacy.

Educational institutions play a strategic role in cultivating renewable energy awareness across generations. Environmental and energy education programs embedded within formal curricula influence students' environmental attitudes and pro-sustainability behavior. Empirical findings indicate that higher education environments integrating eco-friendly curricula and renewable energy knowledge contribute to stronger sustainability engagement (Yadav et al., 2022; Djirong et al., 2024). Education thus operates as a long-term investment in societal readiness for clean energy transformation.

Renewable energy awareness also interacts with technological development by shaping public acceptance of innovation. Advances in solar photovoltaic systems, renewable energy storage, and decentralized energy solutions require informed users and supportive communities. Literature highlights that awareness enhances trust in renewable technologies and reduces uncertainty associated with technological change (Izam et al., 2022; Gunduz Songur et al., 2023). This interaction reinforces the social foundation necessary for technological diffusion.

In coastal and environmentally sensitive areas, renewable energy awareness contributes to sustainability by promoting energy solutions that minimize ecological disruption. Renewable energy systems such as solar and small-scale renewables reduce dependence on energy infrastructures that exacerbate environmental degradation. Studies show that environmentally conscious communities are more inclined to support renewable installations that align with conservation objectives (Lu & Wang, 2023; Sahoo et al., 2023). Awareness therefore strengthens alignment between energy use and environmental protection values.

Institutional awareness further determines how renewable energy initiatives are integrated into development planning. Organizations and local authorities with higher awareness levels tend to incorporate renewable energy considerations into sustainability programs and sectoral strategies. Research emphasizes that institutional learning and awareness improve coordination between energy planning and environmental objectives (Ansari et al., 2023; Zhang et al., 2022). This alignment enhances policy coherence without relying solely on regulatory enforcement.

Financial literacy related to renewable energy represents another dimension of awareness influencing sustainability outcomes. Understanding green financing mechanisms, investment models, and economic incentives encourages institutional participation in renewable energy development. Studies indicate that awareness of green finance instruments supports renewable energy expansion and reduces perceived financial risk (Fitrah & Soemitra, 2022; Qing et al., 2024). Financial awareness thus complements technological and environmental knowledge.

Empirical evidence from previous studies highlights the relationship between renewable energy awareness and sustainability performance. The following table summarizes selected findings from peer-reviewed research and official reports demonstrating the impact of renewable energy awareness on environmental and economic outcomes:

Table 2. Renewable Energy Awareness and Sustainability Outcomes

Study / Report	Focus Area	Awareness Indicator	Sustainability Outcome
Sharma et al. (2022)	Energy transition	Public energy literacy	Increased renewable adoption
Izam et al. (2022)	Solar technology	Technology awareness	Improved energy acceptance
Qing et al. (2024)	Green investment	Financial awareness	Carbon neutrality progress
Djirong et al. (2024)	Education sector	Environmental curriculum	Pro-environmental behavior
Hayat et al. (2023)	Renewable R&D	Institutional awareness	Enhanced environmental performance

Source: Compiled from peer-reviewed studies and official renewable energy and sustainability reports.

The data indicate that renewable energy awareness contributes consistently to improved sustainability indicators across social, institutional, and technological dimensions. Higher awareness levels correlate with stronger adoption of renewable energy systems and greater support for sustainability-oriented initiatives (Hayat et al., 2023; Zhang et al., 2022). These patterns confirm that awareness acts as an enabling condition rather than a supplementary factor in sustainability transitions. Social readiness therefore becomes a determinant of renewable energy success.

Renewable energy awareness also supports cross-sector sustainability integration by influencing energy choices in agriculture, tourism, and service industries. Research on the water-energy-food nexus demonstrates that awareness-driven energy decisions improve resource efficiency and environmental outcomes (Ansari et al., 2023). In tourism and service sectors, awareness of renewable energy benefits enhances adoption of green technologies without compromising operational performance (Gunduz Songur et al., 2023). This cross-sector relevance strengthens the systemic impact of awareness initiatives.

Technological communication and public engagement further amplify renewable energy awareness. Information dissemination through media, community programs, and institutional campaigns improves transparency and trust in renewable energy development. Studies highlight that participatory communication strategies increase stakeholder acceptance and reduce conflict surrounding renewable projects (Mostaghimi & Rasoulinezhad, 2022; Sahoo et al., 2023). Communication thus functions as a governance-supporting mechanism rather than a purely informational tool.

Renewable energy awareness operates as a social and institutional driver that reinforces environmental sustainability. It shapes behavioral change, supports technological adoption, and enhances institutional coordination without overlapping with waste management operations or regulatory protection mechanisms. Empirical literature consistently demonstrates that sustainability outcomes improve when renewable energy awareness is systematically cultivated (Sharma et al., 2022; Qing et al., 2024). This sub-section positions renewable energy awareness as a distinct and essential pillar within the broader framework of environmental conservation and sustainability, providing a clear transition toward the analysis of environmental protection programs.

Environmental Protection Programs as Institutional and Policy Instruments for Sustainability

Environmental protection programs constitute a structural response to escalating environmental degradation that cannot be addressed solely through waste management systems or energy transitions. These programs operate at the institutional and policy levels, aiming to preserve ecological integrity through conservation regulations, protected area management, and environmental compliance mechanisms. Unlike operational sustainability tools, protection programs emphasize governance stability, regulatory enforcement, and long-term ecological safeguards. Empirical literature consistently

positions environmental protection initiatives as foundational instruments for sustaining ecosystem services and reducing environmental vulnerability (Lu & Wang, 2023; Sahoo et al., 2023).

At the policy level, environmental protection programs function as integrative frameworks that align economic activity with ecological boundaries. Regulatory instruments such as land-use zoning, conservation permits, and environmental impact assessments play a decisive role in preventing irreversible ecosystem damage. Studies show that jurisdictions with coherent environmental protection policies experience lower rates of land degradation and biodiversity loss compared to regions with fragmented governance (Yang & Solangi, 2024). These findings highlight the importance of institutional coherence in environmental sustainability.

Natural resource conservation represents a core dimension of environmental protection programs. The sustainable management of forests, water resources, and mineral extraction is essential for maintaining ecological balance while supporting economic productivity. Research demonstrates that conservation-oriented policies significantly reduce resource depletion and enhance ecosystem regeneration when integrated into national development strategies (Lu & Wang, 2023). This approach positions environmental protection as a strategic investment rather than a regulatory burden.

Environmental protection programs are increasingly framed within climate adaptation and resilience agendas. Conservation initiatives such as reforestation, watershed protection, and coastal buffer preservation reduce exposure to climate-related risks while strengthening ecosystem resilience. Empirical evidence confirms that regions implementing ecosystem-based protection programs exhibit greater adaptive capacity to extreme weather events and long-term climatic stressors (Sahoo et al., 2023; Yang & Solangi, 2024). These outcomes reinforce the role of protection programs in climate governance.

Institutional capacity and regulatory enforcement significantly influence the effectiveness of environmental protection initiatives. Strong environmental agencies, transparent monitoring systems, and legal accountability mechanisms ensure compliance and reduce policy implementation gaps. Studies in environmental governance emphasize that weak enforcement undermines even well-designed conservation policies (Khater et al., 2025). Institutional strength therefore determines whether protection programs achieve substantive ecological outcomes.

Environmental protection programs also intersect with economic sectors that depend heavily on natural ecosystems. Tourism, agriculture, and fisheries rely on environmental stability, making conservation policies essential for long-term economic viability. Evidence from sustainable tourism governance shows that environmental regulations contribute to ecosystem preservation while supporting stable economic performance (Khater et al., 2025). This balance underscores the compatibility of protection programs and development objectives.

Technological and scientific inputs enhance the precision and accountability of environmental protection programs. Environmental monitoring systems, ecological modeling, and spatial planning technologies improve decision-making and regulatory oversight. Research indicates that technology-supported environmental governance increases conservation efficiency and policy responsiveness (Ramadhan et al., 2024). These tools strengthen institutional capacity without altering the core regulatory function of protection programs.

Empirical findings from previous studies and official environmental assessments demonstrate measurable outcomes of environmental protection programs. Table 3 presents selected evidence on the ecological impacts of conservation and protection initiatives across different contexts.

Table 3. Environmental Outcomes of Protection and Conservation Programs

Study / Report	Program Focus	Policy Instrument	Environmental Outcome
Lu & Wang (2023)	Resource conservation	Reforestation policy	Improved ecosystem resilience
Yang & Solangi (2024)	Environmental protection	Land-use regulation	Reduced ecological degradation
Khater et al. (2025)	Tourism governance	Environmental compliance	Ecosystem preservation

Ansari et al. (2023)	Resource nexus protection	Institutional coordination	Enhanced sustainability
Sahoo et al. (2023)	Climate mitigation	Conservation programs	Lower environmental risk

Source: Compiled from peer-reviewed empirical studies, official environmental policy reports, and international sustainability assessments.

The data indicate that environmental protection programs consistently contribute to ecological stability when supported by strong institutional frameworks. Conservation outcomes improve when protection policies are embedded within cross-sector governance systems. These results confirm that environmental protection programs function as long-term stabilizers of sustainability performance rather than short-term corrective measures. Policy continuity remains essential for sustaining these outcomes.

Environmental education strengthens environmental protection programs by fostering public acceptance and regulatory compliance. Awareness initiatives integrated into policy frameworks enhance societal understanding of conservation objectives and environmental responsibility. Research confirms that environmentally informed communities demonstrate stronger support for protection policies and conservation efforts (Yadav et al., 2022; Djirong et al., 2024). Social legitimacy therefore reinforces institutional effectiveness.

Financial mechanisms further support the implementation of environmental protection programs. Green financing instruments and sustainability-linked investments provide long-term funding for conservation and rehabilitation initiatives. Studies indicate that environmentally oriented financial frameworks improve policy durability and reduce reliance on short-term public expenditure (Fitrah & Soemitra, 2022; Zhang et al., 2022). Financial integration enhances the operational sustainability of protection programs.

Environmental protection programs serve as the governance pillar of environmental conservation and sustainability. They consolidate outcomes from waste management and renewable energy initiatives into coherent regulatory and institutional frameworks. Empirical literature consistently demonstrates that protection programs strengthen ecological resilience, climate adaptation, and sustainable resource management (Lu & Wang, 2023; Sahoo et al., 2023). This sub-section completes the sustainability framework by positioning environmental protection as the structural foundation of long-term environmental development.

CONCLUSION

Environmental conservation and sustainability require a multidimensional approach that integrates operational practices, social awareness, and institutional governance. This study demonstrates that waste management functions as a foundational mechanism for reducing environmental pressure and protecting vulnerable ecosystems, particularly in coastal environments. Renewable energy awareness emerges as a critical social and institutional driver that supports sustainability transitions through education, financial literacy, and public acceptance of clean energy technologies. Environmental protection programs, operating at policy and governance levels, consolidate these efforts by providing regulatory stability, conservation frameworks, and long-term ecological safeguards. The findings confirm that sustainability outcomes are most effective when waste management, renewable energy awareness, and environmental protection programs are implemented as interconnected yet distinct pillars. Strengthening coordination among these components enhances ecological resilience, supports climate adaptation, and promotes sustainable environmental development across sectors.

REFERENCES

Ansari, A., Wuryandani, S., Pranesti, A., Telaumbanua, M., Ngadisih, Hardiansyah, M. Y., ... & Taryono. (2023). Optimizing water-energy-food nexus: achieving economic prosperity and environmental sustainability in agriculture. *Frontiers in Sustainable Food Systems*, *7*, 1207197. https://doi.org/10.3389/fsufs.2023.1207197

Djirong, A., Jayadi, K., Abduh, A., Mutolib, A., Mustofa, R. F., & Rahmat, A. (2024). Assessment of student awareness and application of eco-friendly curriculum and technologies in Indonesian higher education for supporting sustainable development goals (SDGs): A case study on environmental challenges. *Indonesian Journal of Science and Technology*, *9*(3), 657-678. https://doi.org/10.17509/ijost.v9i3.74385

Fitrah, R., & Soemitra, A. (2022). Green Sukuk for sustainable development goals in Indonesia: a literature study. *Jurnal Ilmiah Ekonomi Islam*, *8*(1), 231-240. https://doi.org/10.29040/jiei.v8i1.4591

Gunduz Songur, A., Turktarhan, G., & Cobanoglu, C. (2023). Progress on green technology research in hotels: a literature review. *Journal of Hospitality and Tourism Insights*, *6*(5), 2052-2072. https://doi.org/10.1108/JHTI-10-2021-0280

Hayat, S., Safi, A., Wahab, S., Shahzad, K., & Chen, Y. (2023). Renewable energy R&D and natural resources: A success story of environmentally friendly financing in OECD economies. *Resources Policy*, *83*, 103655. https://doi.org/10.1016/j.resourpol.2023.103655

Izam, N. S. M. N., Itam, Z., Sing, W. L., & Syamsir, A. (2022). Sustainable development perspectives of solar energy technologies with focus on solar Photovoltaic—A review. *Energies*, *15*(8), 2790. https://doi.org/10.3390/en15082790

Khater, M., Ibrahim, O., Sayed, M. N. E., & Faik, M. (2025). Legal frameworks for sustainable tourism: Balancing environmental conservation and economic development. *Current Issues in Tourism*, *28*(22), 3693-3714. https://doi.org/10.1080/13683500.2024.2404181

Külekçi, G., & Güvendi, A. (2023). Waste management and recycling programs empowering environmental sustainability: The case of Gümüşhane. *Atlas Journal*, *9*(52), 57-66. https://doi.org/10.5281/zenodo.10402418

Lu, C., & Wang, K. (2023). Natural resource conservation outpaces and climate change: Roles of reforestation, mineral extraction, and natural resources depletion. *Resources Policy*, *86*, 104159. https://doi.org/10.1016/j.resourpol.2023.104159

Mostaghimi, N., & Rasoulinezhad, E. (2022). Energy transition and environmental sustainability in Iran: pros and cons through SWOT analysis approach. *Journal of Environmental Assessment Policy and Management*, *24*(04), 2350002. https://doi.org/10.1142/S1464333223500023

Pandiyarajan, V., Neelakantan, T. R., Sridharan, S. A., & Ramrao, N. (2022). Three "R" concept in waste management for sustainable environment. *Journal of Sustainability Perspectives*, *2*, 255-262. https://doi.org/10.14710/baf.%25v.%25i.%25Y.74-88

Perkumienė, D., Atalay, A., Safaa, L., & Grigienė, J. (2023). Sustainable waste management for clean and safe environments in the recreation and tourism sector: a case study of Lithuania, Turkey and Morocco. *Recycling*, *8*(4), 56. https://doi.org/10.3390/recycling8040056

Puntillo, P. (2023). Circular economy business models: Towards achieving sustainable development goals in the waste management sector—Empirical evidence and theoretical implications. *Corporate Social Responsibility and Environmental Management*, *30*(2), 941-954. https://doi.org/10.1002/csr.2398

Qing, L., Abbas, J., Najam, H., Ma, X., & Dagestani, A. A. (2024). Investment in renewable energy and green financing and their role in achieving carbon-neutrality and economic sustainability: Insights from Asian region. *Renewable Energy*, *221*, 119830. https://doi.org/10.1016/j.renene.2023.119830

Ramadhan, M. L., Nugraha, F., Prastowo, D. A., Kusumawardhani, A., & Raharjo, S. T. (2024). Development of environmentally friendly technology for key industries in achieving golden indonesia. *Research Horizon*, *4*(4), 205-220. https://doi.org/10.54518/rh.4.4.2024.327

Sahoo, S. K., Das, A. K., Samanta, S., & Goswami, S. S. (2023). Assessing the role of sustainable development in mitigating the issue of global warming. *Journal of process management and new technologies*, *11*(1-2), 1-21. https://doi.org/10.5937/jpmnt11-44122

Seif, R., Salem, F. Z., & Allam, N. K. (2023). E-waste recycled materials as efficient catalysts for renewable energy technologies and better environmental sustainability. *Environment, development and sustainability*, 1. https://doi.org/10.1007/s10668-023-02925-7

Sharma, G. D., Verma, M., Shahbaz, M., Gupta, M., & Chopra, R. (2022). Transitioning green finance from theory to practice for renewable energy development. *Renewable Energy*, *195*, 554-565. https://doi.org/10.1016/j.renene.2022.06.041

Silva, J. A. (2023). Wastewater treatment and reuse for sustainable water resources management: a systematic literature review. *Sustainability*, *15*(14), 10940. https://doi.org/10.3390/su151410940

Yadav, S. K., Banerjee, A., Jhariya, M. K., Meena, R. S., Raj, A., Khan, N., ... & Sheoran, S. (2022). Environmental education for sustainable development. In *Natural resources conservation and advances for sustainability* (pp. 415-431). Elsevier. https://doi.org/10.1016/B978-0-12-822976-7.00010-7

Yang, Z., & Solangi, Y. A. (2024). Analyzing the relationship between natural resource management, environmental protection, and agricultural economics for sustainable development in China. *Journal of Cleaner Production*, *450*, 141862. https://doi.org/10.1016/j.jclepro.2024.141862

Zhang, Y., Liu, Z., & Baloch, Z. A. (2022). Combining effects of private participation and green finance for renewable energy: growth of economy as mediating tool. *Renewable Energy*, *195*, 1028-1036. https://doi.org/10.1016/j.renene.2022.05.086