International Journal of Society Reviews (INJOSER) e-ISSN: 3030-802X
Vol. 1 No. 12, 2024, pages: 1405~1414

KEEPING OUR ENVIRONMENT HEALTHY TOGETHER: SUSTAINABLE WASTE MANAGEMENT POLICIES

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Abstract

Effective and sustainable waste management is one of the most pressing environmental challenges of the modern era. Maintaining environmental health is not only essential for human health but also essential in ensuring the sustainability of natural resources. The research methods carried out on this study are literature by searching for references in accordance with the context of the research. Research findings show that global and local policies that integrate environmentally friendly technologies and innovative strategies in waste management. The use of the Internet of Things (IoT), robotics, and thermal waste processing techniques such as pyrolysis and gasification in forming efficient waste management systems. Implementation of advanced technology and community education play a vital role in improving the efficiency of waste management. The conclusions of this study show that sustainable waste management policies not only reduce the burden on the environment but also strengthen health infrastructure against the impact of climate change.

Keywords: Environmental Health, Policy, Waste Management.

Introduction

In the midst of increasing global awareness of environmental issues,ining our environmental health has become an unattainable need. One of the major issues facing different parts of the world is waste management. (Sharma et al., 2020). Waste, both organic and inorganic, continues to increase in volume and diversity as populations and industries develop. If not properly managed, waste can have a wide range of negative impacts on human health and the survival of ecosystems. (Zorpas, A. A. 2020).

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Therefore, sustainable waste management becomes a very important topic to explore, not only to provide solutions to current environmental problems, but also to secure the future of human life. Sustainable waste policy seeks to balance between economic, social, and environmental needs by minimizing negative impacts on the environment and human health, while maximizing resource efficiency.

Environmental health is an important aspect of our lives that has a direct impact on public health, ecosystems, and overall quality of life. (Agathokleous, E., & Calabrese, E. J. 2020). Good environmental management is the key to preventing diseases andining natural balance. When our environment is clean and wellined, we minimize the risk of disease spread and ensure that natural resources can be awakened for use by generations to come. (Bindraban et al., 2020). It covers everything from recycling, reducing air and water pollution, toining hygiene in our homes and around us. (Lohmann et al., 2020).

In addition, good environmental health supports ecosystem sustainability. Healthy ecosystems play an important role in keeping natural cycles running well, like the water and carbon cycles that are essential for life on Earth. Without awakened environmental health, ecosystems can be disrupted, which will ultimately threaten the existence of various species including humans. (Zhang et al., 2010). Ecosystem sustainability is also directly related to biodiversity, where species diversity in an ecosystem helps maintain natural balance and provides benefits ranging from food, medicine, to global climate stability. (Jepson et al., 2020).

Furthermore, awakened environmental health supports sustained economic growth. Tourism, agriculture, fishing, and a variety of other industries are heavily dependent on a healthy environment. A real example is natural tourism that can only be awakened if its natural environment is preserved, or agriculture that requires fertile soil and clean water for food production (Campbell-Lendrum, D., & Corvalán, C. 2007). Poor environmental conditions, on the other hand, can lead to huge economic losses due to reduced productivity, increased health costs, and damage to infrastructure. Therefore, investing in environmental health is not only an effort to preserve nature, but also a strategic step to ensure stable and sustainable economic growth. (Cousins et al., 2020).

In short, the importance of environmental health lies in its ability to maintain public health, ensure the sustainability of ecosystems, and support sustainable economic growth. Every effort we make to preserve the health of the environment is not just an investment in nature, but also in the well-being and survival of mankind in the future. (Pourchet et al., 2020). In this context, a comprehensive approach is needed to formulate, implement, and monitor policies and practices in waste management that are capable of adapting to ever-evolving challenges.

Waste issues have become one of the most pressing environmental issues around the world. (Whaley et al., 2020). The accumulation of waste, whether it be household, industrial, or medical waste, continues to rise with population growth and

industrialization. A lot of waste that is not properly managed, ends up accumulating at final landfills that do not meet the standards or are even disposed of in vain. This condition causes soil and water pollution, which can damage habitats, pollute water sources used for consumption and irrigation, and endanger human health. For example, toxic chemicals from industrial waste can penetrate into the soils and contaminate underground water sources, while burning open waste can lead to extensive air pollutation (Cortés et al., 2020).

The environmental impact of improper waste management is not limited only to pollution. Waste also contributes significantly to global climate change through greenhouse gas emissions, such as methane, resulting from the decomposition of organic waste at landfills. (Vanapalli et al., 2021). Besides, plastic waste that ends up in the oceans has created huge problems for marine life, disrupting ecosystems and entering the food chain, ultimately affecting human health. Microplastic pollution has spread widely to the deepest waters and polar regions, suggesting that the impact of plastic waste is global and urgent to address. Without effective and sustainable waste management measures, these problems will continue to worsen and threaten the general health and survival of the planet. (Azevedo et al., 2021).

Sustainable waste management is an integrated approach that aims to minimize the negative impact of waste on the environment, the economy, and society, while optimizing its benefits. This concept involves reducing waste generation at its source, improving resource efficiency, and promoting reuse, recycling, and energy recovery from unavoidable waste. (Hantoko et al., 2021). Sustainable waste management emphasizes the 3R principle (Reduce, Reuse, Recycle) as the core of its practice, where reduction in resource use and emphasis on the circular economy are key. It not only focuses on waste management once created, but also on designing products and processes to minimize the amount of waste. (Sharma et al., 2021).

Implementing sustainable waste management requires close collaboration between governments, industry, communities, and individuals. Governments need to develop and implement policies that support sustainable waste management efforts, including incentives for companies whose production practices are environmentally friendly. (Yousefi et al., 2021). Industry is expected to implement clean production principles, which not only pay attention to resource efficiency but also ensure that the resulting products are easy to recycle or reuse. Meanwhile, consumers have an important role to play in closing the cycle by choosing sustainable products and participating in recycling programmes. Through collaboration among all parties and the application of environmentally friendly technologies, waste management can become more sustainable, reduce environmental footprint, and support the well-being of present and future generations. (Van Fan et al., 2021).

The study aims to identify effective waste management policies and provide recommendations for their sustainable implementation to support environmental

health. Furthermore, the research also aims to raise public awareness of the importance of their roles inining environmental health through responsible waste management practices.

Awareness of the importance of sustainable waste management has increased, but there are still many challenges to overcome. Through this research, it is expected to be found an effective and sustainable solution that not only tackles the problem of waste technically but also takes into account the social and economic aspects of society.

Research Method

A literary research method is an approach in research that focuses on the collection, review, and analysis of relevant scientific publications, such as journals, books, and other articles, in order to gain an in-depth understanding of a research topic or issue. (Reay, 2014; Graue, 2015). It is an important initial step in many types of research and is often used to establish a theoretical framework, form hypotheses, or identify research gaps that exist in the literature. In literature research, researchers use a variety of methods to collect relevant data, including efficient keyword searches in catalogues, indexes, and academic search engines. (Sgier, 2012; Noble & Smith, 2014).

The literature research process includes the identification of relevant sources, the evaluation of the quality and usefulness of such materials, and the synthesis of information to build the argumentation or conceptual framework of research. Literary research allows researchers to determine the context of their research, avoid duplication of work, and determine the most appropriate methodology based on previous work in the same field (Grbich, 2012; Bazeley, 2013).

Result and Discussion

Waste Management

Waste is residual material produced by human activities and industrial processes, which is no longer desirable or useful in its original context. In general, waste can consist of solid, liquid, or gas, and can be hazardous or harmless depending on its nature and composition. (Sharma et al., 2020). Proper waste management is crucial to protecting human health,ining environmental hygiene, and preventing pollution. Waste can come from a variety of sources, including household, agricultural, commercial, industrial, and medical activities, with each type having different characteristics and management methods to minimize negative impacts on the environment and public health. (Zorpas, A. A. 2020).

The types of waste can be categorized according to a variety of criteria, such as physical properties, chemical composition, and potential hazards. Physically, waste is divided into solid, liquid, and gas. Solid waste includes household garbage, agricultural waste, and solid industrial waste (Agathokleous, E., & Calabrese, E. J. 2020). Liquid waste, also known as wastewater waste, includes wastewater from households,

industries, and other liquid residues that need to be handled to avoid contamination of water sources. While gas waste includes emissions from the combustion of fossil fuels, industrial processes and vehicles, which require management to reduce air pollution. (Bindraban et al., 2020).

Dangerous waste includes toxic chemicals, radioactive materials, medical waste, and other materials that can pose serious risks to human health and the environment if not properly handled. While non-hazardous waste generally includes household waste and organic materials that are more easily disaggregated and have lower risks. Both types of waste require different management strategies and methods to ensure that the negative impact on the environment and human health can be minimized. (Lohmann et al., 2020).

Sustainable waste management is a process designed to minimize the negative impact of waste disposal on the environment, human health, and the economy, taking into account sustainability principles. (Zhang et al., 2010). One of the key principles in sustainable waste management is the waste management hierarchy, which formulates management strategies based on priorities: waste prevention, waste minimization, recycling and reuse, energy recovery, and ultimately, disposal. (Jepson et al., 2020). This principle encourages the reduction of waste at its source, promotes resource efficiency through recycling and reuse, and advocates the conversion of waste into energy as an alternative disposal at the final disposal site. This principle seeks to shift the waste cycle from a linear to a closed cycle, where resources are used and recycled sustainably (Campbell-Lendrum, D., & Corvalán, C. 2007).

The second principle focuses on Extended Producer Responsibility (EPR), which encourages product manufacturers to be responsible for the entire life cycle of their products, including the final stage or disposal (Cousins et al., 2020). This concept encourages companies to design products considering resource efficiency, recyclability, and waste reduction. In addition, the 'Polluter Pays' principle emphasizes that the entity that produces the waste is financially responsible for the environmental impact of the waste. (Pourchet et al., 2020). By implementing these principles, sustainable waste management not only reduces the burden on final landfills and the environment but also supports the transition to a more sustainable and low-carbon economy. Implementation of these principles requires collaboration between government, industry, and society to create an effective and efficient waste management system. (Whaley et al., 2020).

Waste Management Policy

At the global level, waste management policies are developed through cooperation between countries and international organizations, with the aim of addressing the environmental problems caused by waste and to promote sustainable waste management. (Malek et al., 2023). One of the important policy instruments is the

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, which was agreed in 1989. The convention aims to reduce the movement of hazardous wastes between countries, and in particular to prevent the transfer of such waste to developing countries. The Basel Convention encourages countries to manage their hazardous waste domestically and improve recycling practices and sustainable waste management. It also sets strict rules for the export and import of hazardous waste, ensuring that countries have adequate infrastructure and capacity to handle such waste safely. (Guo et al., 2021).

On the other hand, the United Nations Environment Programme (UNEP) plays a key role in coordinating international efforts for waste management. UNEP works to promote integrated and sustainable waste management through initiatives such as the Global Campaign on Sustainable Waste Management and various technical collaboration and building capacity programmes. Other international organizations such as the World Bank are also involved in funding waste management projects in developing countries, focusing on improving infrastructure, introducing new technologies, and building capacity. (Yusoff, S. 2018). Through this international collaboration, there has been increased global awareness and action on the importance of waste management, demonstrating a shared commitment to addressing global environmental challenges and advancing sustainable waste management for a greener and healthier future. (Shekdar, A. V. 2009).

At the national level, waste management policies are often developed and implemented by governments with a regulatory framework designed to ensure that waste is managed responsibly and sustainably. These policies may include detailed laws and regulations on waste reduction, hazardous waste management, recycling, and safe disposal of waste. (Finnveden et al., 2013). For example, governments can set ambitious recycling targets, require companies to adopt extended producer responsibility (EPR), and impose taxes or tariffs on certain waste disposal to encourage more effective waste reduction and management practices. Through a combination of strict regulation, incentives, and education, national-level policies aim to responsible waste management and reduce its impact on the environment and public health. (Sakai et al., 2017).

At the local level, waste management policies play an important role in determining how waste is processed and recycled, as well as in ensuring compliance with wider national and international regulations. (Jepson et al., 2020). Local governments, such as municipalities or city councils, often have direct responsibility for collecting, processing, and disposing of household and commercial waste. They developed policies tailored to the unique conditions and needs of the local community, such as separate waste collection schemes for organic materials, plastics, paper, and glass, as well as facilitating the safe disposal of hazardous waste such as batteries and electronics (Campbell-Lendrum, D., & Corvalán, C. 2007). In addition, local policies can include initiatives to provide citizens with information on waste reduction practices,

recycling, and composting, often through educational campaigns and community recycled centers. (Cousins et al., 2020).

The role of local governments in waste management is also crucial because they are at the forefront in facing local environmental challenges and problems, as well as having a better understanding of the capacity and needs of recycling and disposal of waste in their area. (Pourchet et al., 2020). With proactive and innovative policies, they can increase public awareness and participation in sustainable waste management, as well as ensure efficient recycling systems and the reduction of waste leading to TPA. Through effective policy implementation at the local level, not only can environmental performance be improved, but also public health and quality of life. (Whaley et al., 2020). These local initiatives also contribute to achieving broader environmental and sustainability goals at the national and global levels, showing how local action can influence greater change (Cortés et al., 2020).

Thus, waste management policies, both at the national and local levels, are key elements in creating a sustainable and effective system to reduce the negative impact of waste on the environment and public health. Through strict regulatory enforcement, innovative recycling programmes, waste reduction initiatives, and public education, waste management policies lead to the development of a circular economy, increased citizen awareness and participation, and support greater environmental goals. The combined efforts of national regulators, local policymakers, industry, and society form the foundation for efficient waste management, social responsibility, and the conservation of natural resources for future generations.

Application of new technologies in waste management

The application of new technologies in waste management has revolutionized the way waste management, reduction, and recycling are carried out, leading to more efficient and sustainable processes. One emerging technology is the use of the Internet of Things (IoT) in intelligent waste management systems. IoT sensors can be installed on trash sites and trash trucks to monitor waste levels in real time, thus allowing for more efficient optimization of garbage collection routes and transport schedules (Kusumaningtyas et al., 2018). This technology not only reduces operating costs by reducing fuel consumption and working time, but also reduces carbon emissions by minimizing unnecessary travel (Maharani, N. A., & Sari, P. N. 2016).

In the context of waste treatment, pyrolysis and waste gasification techniques are becoming increasingly popular alternatives. Both of these processes convert waste materials into energy, such as gas, oil, or reusable fuels, through an oxygen-free or limited-oxygen heating process. (Surahmat, A., & Rismayanti, R. 2022). It not only reduces the volume of waste sent to the TPA, but also produces renewable energy that can be used for other purposes. The application of this advanced thermal treatment

technology demonstrates innovation in turning waste into a resource, supporting the principle of a circular economy and reducing reliance on fossil fuels. (Arifin et al., 2023).

Finally, the use of artificial intelligence (AI) and robotics in garbage disposal has made significant progress. AI systems can identify and sort different types of material in the waste stream at higher speeds and accuracy than manual disposal, improving the efficiency of the recycling process (Kartono et al., 2021). These new technologies not only enhance the capacity and capabilities of waste management systems but also pave the way for sustainable innovation that can address global environmental challenges. (Abri et al., 2021).

Conclusion

Maintaining environmental health requires collective efforts to implement sustainable waste management policies. Through a holistic approach, which includes global and local strategies, we can improve lives and well-being sustainably through a healthy environment. Sustainable waste management policies must focus on innovation, the use of environmentally friendly technologies, and ensuring that health systems are resilient to climate change. Efficient waste management not only protects the environment but also supports climate-resilient and sustainable health systems. Applications of new technologies such as IoT, robotics, and sophisticated thermal waste treatment can reduce waste volumes and create renewable energy. Furthermore, education and public awareness of the importance of waste management is an important step towards creating positive change.

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