

Promoting Sustainable Waste Management for Posterity

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Abstract

Sustainable waste management is fundamental. It mitigates adverse health and environmental impacts of waste, conserves resources, and improves the livability of human settlements. Further, sustainable waste management plays a significant role in Sustainable Development and the Circular Economy (CE) transition. This paper explores the need for sustainable waste management. It defines the idea of sustainable waste management. The paper also interrogates the progress made towards embracing sustainable waste management at the global, regional, and national levels. It further discusses the challenges facing the realization of sustainable waste management. In addition, the paper offers ideas towards promoting sustainable waste management for posterity.

1.0 Introduction

Waste management involves activities and actions that handle waste materials¹. It includes activities and actions such as collection, transportation, processing, and disposal of waste². The increasing volume and complexity of waste associated with the modern global economy is posing a serious risk to ecosystems and human health³. The United Nations Environment Programme (UNEP) estimates that every year, an estimated 11.2 billion tonnes of solid waste is collected worldwide and decay of the organic proportion of solid waste is contributing to approximately 5 per cent of global greenhouse gas

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¹ Wan. C., Shen. G. Q., & Choi. S., 'Waste Management Strategies for Sustainable Development' Available at https://link.springer.com/referenceworkentry/10.1007/978-3-319-63951-2_194-1 (Accessed on 28/03/2024)

² Ibid

³ United Nations Environment Programme., 'Solid Waste Management' Available at <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management> (Accessed on 27/03/2024)

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emissions⁴. UNEP further notes that poor waste management ranging from non-existing collection systems to ineffective disposal causes air pollution, water and soil contamination⁵.

Unsustainable waste management practices, exacerbated by rapid urbanization and financial and institutional limitations, negatively impacts public health and environmental sustainability⁶. The World Health Organization notes that improper disposal can lead to adverse health outcomes, for example through water, soil and air contamination⁷. It further notes that hazardous waste or unsafe waste treatment such as open burning can directly harm waste workers or other people involved in waste burning and neighbouring communities⁸. In addition, vulnerable groups such as children are at increased risk of adverse health outcomes of unsustainable waste management practices⁹.

Poor waste management also contributes to climate change¹⁰. Unmanaged waste has been identified as a hidden cause of climate change¹¹. According to the United Nations, waste transported illegally ends up in public ecosystems, illegal landfills or is burned in the open risking human health and sustainability of the planet¹². It further notes that failure to safely manage waste affects health, the environment and contributes to greenhouse gas emissions¹³.

⁴ Ibid

⁵ Ibid

⁶ Abubakar. I. R et al., 'Environmental Sustainability Impacts of Solid Waste Management Practices in the Global South' *Int J Environ Res Public Health*. 2022 Oct; 19(19):

⁷ World Health Organization., 'Guidance on Solid Waste and Health' Available at <https://www.who.int/tools/compendium-on-health-and-environment/solid-waste> (Accessed on 27/03/2024)

⁸ Ibid

⁹ Ibid

¹⁰ United Nations Environment Programme., 'Solid Waste Management' Op Cit

¹¹ United Nations Office on Drugs and Crime., 'COP27 Side Event: Unmanaged Waste - A Hidden Cause of Climate Change' Available at <https://www.unodc.org/unodc/en/environment-climate/cop27-unmanaged-waste.html> (Accessed on 27/03/2024)

¹² Ibid

¹³ Ibid

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Sustainable waste management is therefore a priority. It mitigates adverse health and environmental impacts of waste, conserves resources, and improves the livability of human settlements¹⁴. Further, sustainable waste management plays a significant role in Sustainable Development and the Circular Economy (CE) transition¹⁵. This paper explores the need for sustainable waste management. It defines the idea of sustainable waste management. The paper also interrogates the progress made towards embracing sustainable waste management at the global, regional, and national levels. It further discusses the challenges facing the realization of sustainable waste management. In addition, the paper offers ideas towards promoting sustainable waste management for posterity.

2.0 Sustainable Waste Management: Opportunities and Challenges

Sustainability has become a clarion call throughout the world in light of key environmental challenges including climate change, loss of biodiversity, and pollution¹⁶. Poor waste management is one of the major causes of pollution and climate change¹⁷. Therefore, the move towards more sustainable societies requires greater sophistication in management of waste¹⁸. It has been asserted that a traditional reductionist approach towards waste management is unsustainable since it lacks flexibility and long term thinking¹⁹. Sustainable waste management is therefore required in order to foster sustainability. A sustainable waste management system incorporates feedback loops, is focused on processes, embodies adaptability and diverts wastes from disposal²⁰.

¹⁴ Abubakar. I. R et al., 'Environmental Sustainability Impacts of Solid Waste Management Practices in the Global South' Op Cit

¹⁵ Raut. N. A., 'Fundamentals of Waste Removal Technologies' Available at <https://www.sciencedirect.com/science/article/abs/pii/B9780323907606000096?via%3Dihub> (Accessed on 27/03/2024)

¹⁶ Giovannoni. E., & Fabietti. G., 'What Is Sustainability? A Review of the Concept and Its Applications.' In: Busco, C., Frigo, M., Riccaboni, A., Quattrone, P. (eds) Integrated Reporting. Springer, Cham. Available at https://doi.org/10.1007/978-3-319-02168-3_2 (Accessed on 28/03/2024)

¹⁷ United Nations Environment Programme., 'Solid Waste Management' Op Cit

¹⁸ Seadon . J., 'Sustainable Waste Management Systems' Available at <https://www.infona.pl/resource/bwmeta1.element.elsevier-1beea0ce-4f9b-37bf-acfa-e6d6afe1ae70> (Accessed on 28/03/2024)

¹⁹ Ibid

²⁰ Ibid

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Sustainable waste management refers to the assessment of environmental, economic, and social impacts of available waste treatment options²¹. For a waste management system to be sustainable, it needs to be environmentally effective, economically affordable and socially acceptable²². Economic affordability means that the cost of waste management is reasonable and cost effective, while social acceptability means that the society agrees to the waste management practices and services provided which meets their needs²³. Further, waste management also needs to be environmentally effective by adopting environmental conservation policies and principles²⁴. Therefore, sustainable waste management practices relate to local environmental, economic and social priorities²⁵.

The concept of sustainable waste management is guided by key principles including Sustainable Development, best practicable environmental option, waste management hierarchy, precaution, regionalization, polluter pays and producer responsibility²⁶. The principle of Sustainable Development means that waste management should consider the environmental, economic, and social needs of a society²⁷. The principle of best practicable environmental option means that for a given set of objectives in relation to waste management, the option that provides the most benefit or least damage to the environment as a whole, at an acceptable cost, in the long term as well as in the short

²¹ Cucchiella. F., D' Adamo. I., & Gastaldi. M., 'Sustainable Waste Management: Waste to Energy Plant as an Alternative to Landfill' *Energy Conversion & Management.*, 131 (2017) 18-31

²² Morrissey. A. J., & Browne. J., 'Waste Management Models and their Application to Sustainable Waste Management' *Waste Management* 24 (2004) 297-308

²³ Elsaid. S., & Aghezzaf. E., 'A Framework for Sustainable Waste Management: Challenges and Opportunities' Available at https://www.researchgate.net/profile/Sarah-Elsaid-2/publication/283805590_A_framework_for_sustainable_waste_management_challenges_and_opportunities/links/58be8b0caca272b9b180596c/A-framework-for-sustainable-waste-management-challenges-and-opportunities.pdf (Accessed on 28/03/2024)

²⁴ Ibid

²⁵ Morrissey. A. J., & Browne. J., 'Waste Management Models and their Application to Sustainable Waste Management' Op Cit

²⁶ Elsaid. S., & Aghezzaf. E., 'A Framework for Sustainable Waste Management: Challenges and Opportunities' Op Cit

²⁷ Morrissey. A. J., & Browne. J., 'Waste Management Models and their Application to Sustainable Waste Management' Op Cit

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term should be embraced²⁸. The principle of waste management hierarchy is a conceptual framework designed to guide and rank waste management decisions at both the individual and organisational level²⁹. It gives top priority to waste prevention, followed by re-use, recycling, recovery and finally disposal³⁰. This principle places emphasis on reducing, reusing, recycling and composting as key to sustainable waste management³¹. Regionalization entails shifting from decentralized waste management towards cooperation among larger units such as neighbouring cities, towns, counties or even countries in order to achieve more efficient outcomes in waste management³². The precautionary principle is based on avoiding and preventing the discharge of waste into the environment³³. Finally, the polluter pays and producer responsibility mean that persons or organizations responsible for producing waste should bear the costs of waste management³⁴.

The ideal of sustainable waste management is achieved when the generation of waste and harmful substances is minimised, waste is reused (using materials repeatedly), recycled (using materials to make new products) or recovered (producing energy from waste), and disposal of waste is minimized³⁵. Sustainable waste management is crucial in the pursuit

²⁸ Parliament of the United Kingdom., 'Sustainable Waste Management' Available at <https://publications.parliament.uk/pa/cm199798/cmselect/cmenvtra/484/48407.htm> (Accessed on 28/03/2024)

²⁹ United States Environmental Protection Agency., 'Sustainable Materials Management: Non-Hazardous Materials and Waste Management Hierarchy' Available at <https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy> (Accessed on 28/03/2024)

³⁰ Ibid

³¹ Ibid

³² Kojima. M., 'Regionalization of Solid Waste Management in Asia: Benefits and Challenges' Available at https://www.ide.go.jp/library/English/Publish/Reports/Ec/pdf/201903_ch01.pdf (Accessed on 28/03/2024)

³³ International Institute for Sustainable Development., 'The Precautionary Principle' Available at <https://www.iisd.org/articles/deep-dive/precautionary-principle> (Accessed on 28/03/2024)

³⁴ Elsaid. S., & Aghezzaf. E., 'A Framework for Sustainable Waste Management: Challenges and Opportunities' Op Cit

³⁵ Cucchiella. F., D' Adamo. I., & Gastaldi. M., 'Sustainable Waste Management: Waste to Energy Plant as an Alternative to Landfill' Op Cit

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of the Sustainable Development Goals (SDGs)³⁶. The need for sustainable waste management is enshrined under various instruments at the global, regional, and national levels.

The United Nations *2030 Agenda for Sustainable Development*³⁷ sets out the global targets necessary to realize sustainable waste management. It urges all countries to embrace reduction and recycling of waste in order to safeguard human health and the environment³⁸. SDG 6 seeks to ensure availability and sustainable management of water and sanitation for all through approaches such as enhancing wastewater treatment³⁹. In addition, SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable through sustainable waste management among other approaches⁴⁰. Further, SDG 12 is geared towards ensuring sustainable consumption and production patterns through environmentally sound management of chemicals and all wastes throughout their lifecycle and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment⁴¹. SDG 12.5 envisages sustainable waste management and urges all countries to substantially reduce waste generation through prevention, reduction, recycling, and reuse⁴². Sustainable waste management is therefore at the heart of the 2030 Agenda for Sustainable Development. According to UNEP, sustainable waste management can help advance all the goals and targets in the 2030 Agenda for Sustainable Development, including SDG 11

³⁶ United Nations Environment Programme., 'Sustainable Waste in Cities' Available at <https://www.unep.org/topics/cities/circular-economy-cities/sustainable-waste-cities> (Accessed on 28/03/2024)

³⁷ United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Available at <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (Accessed on 28/03/2024)

³⁸ Ibid

³⁹ Ibid

⁴⁰ Ibid

⁴¹ Ibid

⁴² Ibid

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on making cities and human settlements inclusive, safe, resilient and sustainable and SDG 12 on ensuring sustainable consumption and production patterns⁴³.

Sustainable waste management is also envisioned in Africa under Africa Union's *Agenda 2063*⁴⁴. It identifies the problem of waste on key sectors of African economies including the Blue Economy⁴⁵. Agenda 2063 urges African countries to promote sustainable waste management practices such as recycling of waste⁴⁶. At a regional level, the *Treaty for the Establishment of the East African Community*⁴⁷ sets out the need for sustainable waste management within the East African Community (EAC). The Treaty urges EAC member states to co-operate and adopt common policies for control of transboundary movement of toxic and hazardous waste including nuclear materials and any other undesirable materials⁴⁸. It also requires EAC countries to co-operate and adopt common positions against illegal dumping of toxic chemicals, substances and hazardous wastes within the Community from either a partner state or any third party⁴⁹. Further, the *Protocol on the Establishment of the East African Community Common Market*⁵⁰ requires EAC member states to ensure sound environmental and natural resources management principles for the proper functioning of the Common Market, through prevention of activities that are detrimental to the environment. Under this provision, priority areas required for sustainable waste management include harmonization of pollution and waste

⁴³ United Nations Environment Programme., 'First International Day of Zero Waste Bolsters Actions to Address Global Pollution Crisis' Available at <https://www.unep.org/news-and-stories/press-release/first-international-day-zero-waste-bolsters-actions-address-global> (Accessed on 28/03/2024)

⁴⁴ Africa Union., 'Agenda 2063: The Africa we Want' Available at https://au.int/sites/default/files/documents/33126-doc-framework_document_book.pdf (Accessed on 28/03/2024)

⁴⁵ Ibid

⁴⁶ Ibid

⁴⁷ East African Community., 'The Treaty for the Establishment of the East African Community' Available at https://www.eala.org/uploads/The_Treaty_for_the_Establishment_of_the_East_Africa_Community_2006_1999.pdf (Accessed on 28/03/2024)

⁴⁸ Ibid

⁴⁹ Ibid

⁵⁰ East African Community., 'Protocol on the Establishment of the East African Community Common Market' Available at <https://www.eac.int/common-market> (Accessed on 28/03/2024)

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management policies, laws and strategies⁵¹; harmonization of the national laws, policies and strategies on toxic chemicals and products (substances) containing toxic chemicals level⁵²; development and review of policy, laws, regulations and guidelines on for handling of highly obsolete chemical and hazardous waste⁵³; development of mechanisms of handling and disposal of electronic waste⁵⁴; joint measures (inspection, enforcement) to control the illegal trafficking of chemicals proved scientifically to be hazardous toxic or persistent in the environment⁵⁵; and development of regional standards on waste including plastic packaging⁵⁶.

The idea of sustainable waste management has also been embraced in Kenya. The *Environmental Management and Co-Ordination Act*⁵⁷ requires the Cabinet Secretary in charge of matters relating to the environment on the recommendation of the National Environment Management Authority (NEMA) to prescribe standards for waste, their classification and analysis, and formulate and advise on standards of disposal methods and means for such wastes⁵⁸; and issue regulations for the handling, storage, transportation, segregation and destruction of any waste⁵⁹. The Act further prohibits against dangerous handling and disposal of wastes⁶⁰. It provides that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such manner as to cause pollution to the environment or ill health to any person⁶¹. The Act further stipulates that no person shall operate a wastes disposal site or plant without a licence issued by NEMA⁶². In addition, it requires individuals and organisations whose

⁵¹ East African Community., 'Waste Management and Pollution Control' Available at <https://www.eac.int/environment/waste-management-and-pollution-control> (Accessed on 28/03/2024)

⁵² Ibid

⁵³ Ibid

⁵⁴ Ibid

⁵⁵ Ibid

⁵⁶ Ibid

⁵⁷ Environmental Management and Co-ordination Act., Cap 387., Government Printer, Nairobi

⁵⁸ Ibid, S 86 (c)

⁵⁹ Ibid, S 86 (d)

⁶⁰ Ibid, S 87

⁶¹ Ibid, S 87 (1)

⁶² Ibid, s 87 (3)

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activities generate waste to employ measures essential to minimize wastes through treatment, reclamation and recycling among other measures⁶³. The Act also requires the Cabinet Secretary in charge of environmental matters on the recommendation of NEMA to issue guidelines and regulations for the management of hazardous wastes⁶⁴. Another key provision of the Act geared towards sustainable waste management is the requirement for all projects on waste disposal to undergo Environmental Impact Assessment (EIA)⁶⁵. It has been noted that EIA is a key policy instrument to inform sustainable waste management and decision-making⁶⁶.

Sustainable waste management in Kenya is also enshrined under the *Sustainable Waste Management Act*⁶⁷. The Act defines sustainable waste management to mean using material resources efficiently as prioritized by waste hierarchy, circular economy and clean production in order to reduce the amount of waste that is generated, deposited or discarded in the environment including the management of materials that would otherwise have been dumped or wasted in a way that contributes to environmental, social and economic goals of Sustainable Development⁶⁸. The Act seeks to achieve several objectives which include promoting sustainable waste management; improving the health of all Kenyans by ensuring a clean and healthy environment; reducing air, land, fresh water and marine pollution; promoting and ensuring the effective delivery of waste services; creating an enabling environment for employment in the green economy in waste management, recycling and recovery; establishing an environmentally sound infrastructure and system for sustainable waste management; promoting circular economy practices for green growth; mainstreaming resource efficiency principles in sustainable consumption and production practices; and inculcating responsible public

⁶³ Ibid, s 87 (4)

⁶⁴ Ibid, s 91 (2)

⁶⁵ Ibid, second schedule

⁶⁶ Claassens. C. E., 'The Consideration of Waste Management in Environmental Impact Assessment (EIA) for Developments in Protected Areas' Available at <https://www.tandfonline.com/doi/full/10.1080/14615517.2022.2080491> (Accessed on 28/03/2024)

⁶⁷ Sustainable Waste Management Act., Cap 387C, Government Printer, Nairobi

⁶⁸ Ibid, s 2

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behaviour on waste and environment⁶⁹. Under the Act, sustainable waste management is guided by certain key principles which include promoting the right to a clean, and healthy environment, the precautionary principle, the polluter pays principle, and the zero waste principle⁷⁰. The Act establishes a Waste Management Council whose functions include enhancing inclusive inter-governmental coordination for sustainable waste management; reviewing progress in implementation of the national sustainable waste management strategy; and recommending to the Cabinet Secretary the national waste management recycling and recovery targets⁷¹. It further identifies key ways for sustainable waste management in Kenya including recycling of waste, efficient waste collection, embracing waste-to-energy and waste-to-manure projects, and formation of waste collection, materials recovery and recycling savings and credit co-operative organisations⁷². The Act places the obligation for sustainable waste management on various stakeholders including the Cabinet Secretary in charge of matters relating to the environment, county governments, and the private sector⁷³. Achieving the objectives of this Act is vital in promoting sustainable waste management in Kenya.

In addition to the Environmental Management and Co-ordination Act and the Sustainable Waste Management Act, Kenya has adopted the *Waste Management Regulations*⁷⁴ in order to realize sustainable waste management. The Regulations envisage sustainable waste management in Kenya through cleaner production principles which include eliminating the use of toxic raw materials, reducing toxic emissions and wastes, embracing the recovery and re-use of waste where possible, and reclamation and recycling⁷⁵. There is need to implement these laws in order to realize sustainable waste management in Kenya.

⁶⁹ Ibid, s 3

⁷⁰ Ibid, S 4

⁷¹ Ibid, s 6 & 7

⁷² Ibid, Part III

⁷³ Ibid

⁷⁴ Environmental Management and Co-ordination (Waste Management) Regulations, 2006, Legal Notice No. 121

⁷⁵ Ibid

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Despite the recognition of the importance of sustainable waste management at the global, regional, and national levels, realizing this ideal still remains a challenge⁷⁶. It is estimated that municipal solid waste generation is set to grow to 3.8 billion tonnes by 2050 and cost up to USD 640.3 billion in waste management⁷⁷. Further, it has been noted that unsustainable waste management comes with hidden costs of pollution, poor health and climate change⁷⁸. As a result, the world urgently needs to shift to a zero waste approach, while improving waste management to prevent significant pollution, greenhouse gas emissions and negative impacts to human health⁷⁹. It is therefore necessary to promote sustainable waste management for posterity.

3.0 Way Forward

In order to promote sustainable waste management, it is necessary to embrace clean production techniques⁸⁰. The concept of clean production focuses on reduction of use of natural resources, thus minimizing the waste generated from the process⁸¹. In addition, it focuses on how to prevent wastes at the source by the use of cleaner technologies⁸². Clean production has been described as integrated preventive environmental strategy applied to processes, products and services to increase efficiency and reduce risk for humans and the environment⁸³. It includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions

⁷⁶ United Nations Environment Programme., 'World Must Move Beyond Waste Era and Turn Rubbish into Resource: UN Report' Available at <https://www.unep.org/news-and-stories/press-release/world-must-move-beyond-waste-era-and-turn-rubbish-resource-un-report> (Accessed on 28/03/2024)

⁷⁷ Ibid

⁷⁸ Ibid

⁷⁹ Ibid

⁸⁰ El-Haggar. S., 'Sustainability of Industrial Waste Management' Available at <https://www.sciencedirect.com/science/article/abs/pii/B9780123736239500125?via%3Dihub> (Accessed on 28/03/2024)

⁸¹ Ibid

⁸² Ibid

⁸³ Purwanto. P., 'Cleaner Production and Waste Minimization' Available at https://www.researchgate.net/publication/348446836_CLEANER_PRODUCTION_AND_WASTE_MINIMIZATION (Accessed on 28/03/2024)

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and wastes before they leave a process⁸⁴. Clean production is therefore essential in minimizing waste⁸⁵. This process embraces prevention innovations aimed at protecting the environment by analysing the flow of materials and energy throughout the manufacturing process in order to minimize waste⁸⁶. In Kenya, the *Waste Management Regulations*⁸⁷ envisage sustainable waste management in Kenya through cleaner production principles such as eliminating the use of toxic raw materials, reducing toxic emissions and wastes, embracing the recovery and re-use of waste where possible, and reclamation and recycling⁸⁸. It is therefore necessary to embrace clean production approaches in order to promote sustainable waste management.

In addition, it is necessary to strengthen circular economy in order to enhance sustainable waste management⁸⁹. Circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible⁹⁰. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting⁹¹. This concept aims to minimize waste and promote a sustainable use of natural resources, through smarter

⁸⁴ Ibid

⁸⁵ Mostaghimi. K., & Behnamian. J., 'Waste Minimization Towards Waste Management and Cleaner Production Strategies: A Literature Review' Available at <https://link.springer.com/article/10.1007/s10668-022-02599-7> (Accessed on 28/03/2024)

⁸⁶ Ibid

⁸⁷ Environmental Management and Co-ordination (Waste Management) Regulations, 2006, Legal Notice No. 121

⁸⁸ Ibid

⁸⁹ Muigua. K., 'Implementing Circular Economy for Sustainability' Available at <https://kmco.co.ke/wp-content/uploads/2023/12/Implementing-Circular-Economy-for-Sustainability.pdf> (Accessed on 28/03/2024)

⁹⁰ European Parliament., 'Circular Economy: Definition, Importance and Benefits.' Available at <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economydefinition-importance-andbenefits#:~:text=The%20circular%20economy%20is%20a,cycle%20of%20products%20is%20extended> (Available at 28/03/2024)

⁹¹ Ellen MacArthur Foundation., 'What is a Circular Economy?.' Available at <https://www.ellenmacarthurfoundation.org/topics/circulareconomyintroduction/overview#:~:text=The%20circular%20economy%20is%20a,remanufacture%2C%20recycling%2C%20and%20composting> (Accessed on 28/03/2024)

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product design, longer use, recycling and more, as well as regenerate nature⁹². Circular economy is therefore pivotal in sustainable waste management. It can achieve this goal by substantially reducing waste generation through prevention, reduction, recycling and reuse⁹³. Further, it is widely accepted that circular economy ensures that resources, energy and waste volumes are minimized at every stage of a product lifecycle, as well as greenhouse gas emissions, pollution and public health risks⁹⁴. It is therefore necessary for all countries to embrace circular economy in order to achieve sustainable waste management in addition to other numerous environmental, economic, and social benefits⁹⁵.

Further, there is need to strengthen and implement waste management laws⁹⁶. It has been noted that there are gaps in the coordination and enforcement of environmental legislation on waste management in many countries including Kenya⁹⁷. Further, it has been asserted that laws related to waste management in some countries are fragmented and outdated leading to disparities in regulation and enforcement by different levels of government⁹⁸. As a result, it is imperative for all countries to strengthen their laws and policies on waste management in order to support sustainable waste management and the transition to circular economy⁹⁹. It has been argued that countries need to modernize their laws and policies on waste management on an ongoing basis to make them fit for

⁹² United Nations Development Programme., 'What is Circular Economy and Why Does it Matter?.' Available at <https://climatepromise.undp.org/news-and-stories/what-is-circular-economy-and-how-it-helps-fight-climate-change> (Accessed on 28/03/2024)

⁹³ Ibid

⁹⁴ United Nations Development Programme., 'Why the Green, Circular Economy is Key to Beating the Triple Planetary Crisis.' Available at <https://www.undp.org/blog/why-green-circular-economy-keybeating-triple-planetary-crisis> (Accessed on 28/03/2024)

⁹⁵ Ibid

⁹⁶ Republic of Kenya., 'National Sustainable Waste Management Policy' Available at <https://faolex.fao.org/docs/pdf/ken205137.pdf> (Accessed on 28/03/2024)

⁹⁷ Ibid

⁹⁸ Ibid

⁹⁹ Muigua. K., 'Implementing Circular Economy for Sustainability' Op Cit

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the circular economy and the digital age¹⁰⁰. Strengthening laws and policies on waste management is therefore crucial in realizing sustainable waste management.

Finally, sustainable waste management can be realized through investing and financing waste management activities and projects¹⁰¹. It has been noted that government support through grants, loans, tax exemptions among other mechanisms is crucial in promoting sustainable waste management¹⁰². It is therefore necessary to support businesses dealing in waste management in order to achieve the ideal of sustainable waste management¹⁰³. In order to enhance waste management, it is necessary for all countries to invest in holistic systems that are designed to fit local needs¹⁰⁴. It has been noted that these systems should make it easy to collect, sort, and process all types of waste¹⁰⁵. Financial support can enhance action across the science-policy interface by unlocking innovation and accelerating the adoption of new technologies and processes towards sustainable waste management to support the laws and policies in place¹⁰⁶. It is thus necessary to strengthen investments and financing in order to achieve sustainable waste management.

4.0 Conclusion

Sustainable waste management involves the assessment of environmental, economic, and social impacts of available waste treatment options¹⁰⁷. Sustainable waste management systems are therefore environmentally effective, economically affordable and socially

¹⁰⁰ Ibid

¹⁰¹ Organisation for Economic Cooperation and Development., 'Investment and Financing Mechanisms for Waste Management' Available at <https://www.oecd-ilibrary.org/sites/1f4e61ee-en/index.html?itemId=/content/component/1f4e61ee-en> (Accessed on 28/03/2024)

¹⁰² Ibid

¹⁰³ Ibid

¹⁰⁴ Ibid

¹⁰⁵ Ibid

¹⁰⁶ International Institute for Sustainable Development., 'Financing the Sound Management of Chemicals and Wastes' Available at <https://sdg.iisd.org/commentary/policy-briefs/financing-the-sound-management-of-chemicals-and-wastes/> (Accessed on 28/03/2024)

¹⁰⁷ Cucchiella, F., D' Adamo, I., & Gastaldi, M., 'Sustainable Waste Management: Waste to Energy Plant as an Alternative to Landfill' Op Cit

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acceptable¹⁰⁸. This ideal is crucial in the pursuit of the SDGs¹⁰⁹. However, this concept is yet to be fully realized as evidenced by poor waste management practices all over the world which result in pollution, poor health and climate change¹¹⁰. It is therefore pertinent to improve waste management in order to tackle pollution, reduce greenhouse gas emissions and address negative impacts of waste on human health¹¹¹. Sustainable waste management can be realized through approaches such as embracing clean production techniques¹¹²; embracing circular economy¹¹³; strengthening and implementing waste management laws¹¹⁴; and investing and financing waste management activities and projects¹¹⁵. Promoting sustainable waste management is an ideal that we must realize in the quest towards Sustainable Development.

¹⁰⁸ Morrissey. A. J., & Browne. J., 'Waste Management Models and their Application to Sustainable Waste Management' Op Cit

¹⁰⁹ United Nations Environment Programme., 'Sustainable Waste in Cities' Op Cit

¹¹⁰ United Nations Environment Programme., 'World Must Move Beyond Waste Era and Turn Rubbish into Resource: UN Report' Op Cit

¹¹¹ Ibid

¹¹² El-Haggar. S., 'Sustainability of Industrial Waste Management' Op Cit

¹¹³ Muigua. K., 'Implementing Circular Economy for Sustainability' Op Cit

¹¹⁴ Republic of Kenya., 'National Sustainable Waste Management Policy' Op Cit

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