STRATEGIC APPROACHES PROMOTING SUSTAINABLE DEVELOPMENT IN SOLID WASTE MANAGEMENT BASED ON CIRCULAR ECONOMY: A LITERATURE REVIEW

*CORRESPONDENCE

Abdul Rasool Khoso
lx20220614007@hhu.edu.cn

TYPE
Perspective

SPECIALTY SECTION

This article was submitted to the Special Issue of the International Journal of Humanities and Social Development Research

RECEIVED: 19 October, 2024
ACCEPTED: 14 November, 2024
PUBLISHED: 25 November, 2024

CITATION

Khoso. R.A., Bhutto.Sh., Akhtar.F. (2024). Strategic approaches promoting sustainable development in solid waste management based on circular economy: A Literature Review. Special Issue on "Global Strategy for sustainable development: Innovation, modelling, and alliances.International Journal of Humanities and Social Development Research. DOI:10.30546/BAKUCOP29.2024.1.5098

Abdul Rasool KHOSO*
Hohai University, Nanjing, China

Shahnaz BHUTTO
Hohai University, Nanjing, China

Farhan AKHTAR
Hohai University, Nanjing, China

Abstract

The escalating global population and swift urbanization have expressively increased the capacity of municipal solid waste (MSW) all over the world, leading to several defies counting health issues, climate change, and social discrepancies. Policymakers are obstinately exploring actual and viable solutions to discourse solid waste management (SWM). The circular economy (CE) benevolences a critical approach for organized and favorable solid waste management. This investigation highlights the indispensable elements for scheming MSW management structure prejudiced by (CE) principles. The (CE) exemplary focuses on the ideologies of (4R) Reduce, Reuse, Recycle, and Recover. The analysis underscores the significance of amenities for cataloging and waste grouping, waste treatment progressions, and the retrieval of treasured possessions from waste. It also deliberates the regulations and the oddity of policies in (SWM), referencing illustrations from developed nations. Additionally, the study deliberates the economic, social, and environmental extents of the circular economy. It provides insights to achieve sustainable development using a CE-driven system for (SWM), supporting for environmentally viable business observes, environmental impartiality, and the enrichment of social well-being. The research distinguishes inclusive commercial societies that have comprised the circular economy, determined towards sustainability. It climaxes the ingenuities by well-known worldwide administrations to lessen waste fabrication, incorporate substantial recycling and reprocess into their maneuvers and products. The research bids visions into a system that indorses societal affluence and harmony.

Keywords: Sustainable Development, Waste Recovery and Recycling, Circular Economy, Literature Review

1. Introduction

The increasing amount of solid waste accumulation poses an extremely complex challenge that needs to be addressed immediately. The World Bank estimates that at least 33% of the total of 2.01 billion tonnes of (MSW) produced annually worldwide is not managed in an environmentally responsible way (Sikder et al., 2024). According to Nevrlý and Smejkalov (2021), this negligence of natural resources increases detrimental effects on ecosystems,

The list of publications can be downloaded on the following website: https://www.ijhsdr.com/

making it necessary to explore new paths to meet material as well as energy needs while preventing resource depletion. A strong solid waste management system presents a viable way to produce energy and secondary materials without endangering the health of the ecosystem. This means making the shift to a circular economy-based strategy, in which materials are recycled in a closed-loop system to reduce the production of waste.

Comparing emerging countries to OECD countries, solid waste management is more difficult because of low recycling infrastructure, low scientific consciousness, high costs, and inadequate strategies (Budihardjo et al., 2022). Various obstacles face urban waste management worldwide, such as inadequate systems for waste separation and recycling, an inability to initially separate both wet and dry waste, and a lack of knowledge regarding the composition of solid waste system (Kumar & Agarwal, 2020). As a result, the growing amount of landfills is a serious concern because some of them take centuries to completely decompose, and leachate leaks contaminate the environment, water, and soil, putting public health at risk. If not recycled properly, everyday objects can take a long time to decompose (Devi et al., 2024). Comprehending the composition of MSW—which normally include 44% food and green waste, 17% cardboard, 12% paper and plastics, 5% glass, 4% metal, 2% wood, rubber and leather (2%), and other materials (14%)—is essential to streamlining the waste sorting process. (Sondh et al., 2022). An ineffective mixed waste separation, collection, and transportation upset the balance of the environment, highlighting the significance of waste segregation in lowering landfill volumes and reducing pollution. Each step of the process—reusing and recycling, sorting and collection of waste, recuperation of waste, and final disposal—improves the effectiveness of the system as a whole. At every level, local government and policy play a crucial role. Gasification, incineration, and pyrolysis are examples of thermochemical conversions that are practical for producing energy from waste; however, in order to maximize input quality, proper waste pre-treatment is required (Letcher, 2020). The division of waste and sorting involves the use of a variety of techniques, including eddy current separation, magnetic separation, trommel screening, and air separation, and manual sorting (Funari et al., 2023). These techniques highlight the significance of recycling and separation in order to divert materials from landfills. The United Nations synchronizes waste management objectives with sustainable development goals, acknowledging solid waste management as a critical concern (Sharma et al., 2021). It is estimated that by 2050, there will be approximately 2.4 billion tonnes of CO2 equivalents annually due to climate change. This highlights the circular economy potential management of waste driven to address sustainable development and financial stability, while protecting human rights and natural assets.

Through the efficient use of natural resources and the production of commodities, Circular Economy (CE) offers a way to reduce the burden on the environment. Its main benefit is that it promotes growth in all areas—economic, social, and environmental (Ghisellini et al., 2016). Adoption of CE is encouraged by many nations in an effort to restore the environmental and economic health of their regions (Herrador & Van, 2024). CE reduces the negative effects of extraction, emissions, and disposal while minimizing pressure on global resources by circulating resources within local economies (Chowdhury et al., 2022). Numerous stakeholders, including companies, politicians, and environmental organizations, generally hold the view that a CE-centric economy is unavoidable in the long run (Almulhim, & Al-Saidi, 2023). According to Lei et al. (2021) this model is perceived as a structured sustainable development framework that attempts to recover critical factors of sustainability.

It is essential to regularly evaluate CE practices in the social, economic, and environmental domains in order to track advancements in sustainable waste management. A strong waste management model requires the cogent growth of these three pillars. Using the 4Rs (Reduce, Reuse, Recycle, and Recover) as a framework for waste management, this study critically analyzes a number of aspects of managing municipal solid waste (MSW) in a circular economy. The collection, sorting, recycling, reuse, and recovery of valuable materials are prioritized. In order to create an effective waste management model, this study explores the harmonious growth of social, environmental, and economic dimensions, whereas prior research has mostly concentrated on the environmental aspect. One important component of a circular economy (CE) is material recovery from waste, which includes obtaining valuable resources like electricity, fuel, oil, fertilizer, animal bedding, and valuable metals. Leading companies and organizations that have embraced the principles of circular economy provide smaller organizations with inspiration to adopt more efficient waste management practices and vision.

2. Methodology

The literature survey was conducted using a methodical approach with the goal of gathering precise and pertinent studies. Using terms like "Circular economy," "circularity," "solid waste management," "MSW management," "three pillars of circular economy," "sustainable waste management," and "exergy," among others, the process involved looking for research articles from diverse websites including, Science Direct, Springer, Google Scholar, Official websites and Research gate. The articles that came up in these searches were carefully assessed by reading the titles and abstracts. A shortlist of articles that closely matched the current study was created in order to conduct a more thorough analysis. To make the final selection in the detailed examination, the research articles' entire texts were carefully examined. Furthermore, a search was conducted through the shortlisted papers' references to find more pertinent research articles. A summary of earlier efforts in SWM that attempted to accomplish sustainability through various tactics. In order to guarantee consistency in waste management procedures, Section 2 of the review concentrates on the function highlighting the effectiveness of solid waste and subsequent organization. The concepts of the four Rs of solid waste and its management, including Reuse, Reduce, Recycle and Recover are covered in Section 3. The significance of these ideas in developing a solid waste management framework that is effective in promoting a circular economy is emphasized in this section. The society, environment and economy, the three pillars of the circular economy—are examined in Section 4 with reference to (MSW) systems. It also emphasizes the goals of influential people around the world who support incorporating a circular economy concepts into waste management procedures.

3. Results and Discussions:

Table-1 Key components and scope of earlier studies in the fields of SWM and circular economy

Study approach	Significant structures	References
SWM and applications towards Waste-to-energy	• MSW is considered to be a source of sustainable energy. • Various wastewater methods are appropriate for various types of waste. • Diverse techniques are used to manage waste: inert waste is dumped in landfills, mixed MSW is burned, organic waste is anaerobically digested, and wood, tires, and plastics are pyrolyzed.	(Kaur et al., 2023; Zhou & Zhang, 2022; Akinshilo, 2019)
Green Economy	• Economic growth, reducing poverty, and preserving the environment are the main goals of the green economy. • Emphasis is placed on the ideas of waste pyramid, industrial ecology, and CE. • A cohesive set of rules and policies for waste management can support the development of a green economy.	(Zhironkin & Cehlar, 2022; Adamowicz, 2022; Muljaningsih et al., 2022)
A system for managing waste in the circular economy.	• Its main goal is to combine solid waste management and the CE concept. • Serious problems with the environment and human health are the result of ineffective waste management. • CE strategies such as recovery, recycling, repurposing, restoring, reuse, etc., can promote economic growth.	(Smol et al., 2020; Fatima et al., 2020)
Environment and CE	• The public should be encouraged to learn about green logistics and CE. • Reducing resource usage and waste at the source should receive more attention. • The operation of a closed-loop economy is superior to that of a linear economy.	(Li et al., 2022; Sariatli, 2017; Bhattacharjee, & Cruz, 2015)
CE	• One important method for evaluating the ecological well-being of products is life cycle assessment, or LCA. • Environmental effects are contrasted with circularity indicators. • With the expansion of CE's structure, there is a great deal of room for expansion in the green industrial parks and industrial economy.	(Bossek et al., 2021;
System for managing solid waste based on the circular economy	• The application of CE in systems that handle solid waste can assist in reducing the issues associated with waste accumulation and generation. Because MSW is an amalgamation of wastes, it must be properly sorted before being sent to the treatment facility. • To fully utilize waste's potential for recycling and valuable recovery, infrastructure must be provided by effective strategies and policies. • Using contemporary assessment instruments like energy analysis, environmental sustainability in a CE can be evaluated in terms of its social, economic, and environmental aspects.	Current Study

3.1 Waste grouping and organizing stations

Reducing waste generation and implementing efficient waste collection systems are both necessary to address the challenges of waste management. In certain countries, waste collection is typically managed by private entities or local authorities; however, organizing waste collection and indulgencing it for the purpose of salvaging remains a significant for nations worldwide (RamHormozi, 2019). Complex challenges related to waste management (Nzeadibe and Adama, 2015) necessitate the establishment of transferring waste properly for addressing the growing waste predicament. Existing management of solid waste facilities frequently lack the resources needed to function efficiently, with inefficiencies in the use of resources like labor and vehicles (Salazar-Adams, 2021).

Waste is collected using a variety of techniques, such as vehicle-based collection with notification signals, central waste collection points, from initial collection to final disposal. Urban and rural waste collection rates differ, with higher rates generally seen in high-income nations relative to low-income nations because of disparities in infrastructure, waste management effectiveness, and waste education. Waste collection rates are also influenced by an area's level of development within a nation; in general, urban areas have higher rates than rural ones because waste collection is frequently seen as an urban amenity (Kaza et al., 2018). Many nations have privatized waste management systems, frequently with government subsidies, to address the complexity of waste collection and administration. By involving private agencies, this has increased efficiency and service quality. Additionally, privatization can lessen the burden on local and state government agencies. As facilities for transient storage where municipal solid waste (MSW) is gathered before being sent to recycling or waste-to-energy facilities, waste transfer stations are essential to waste management. Unloading from trash trucks, inspecting, removing hazardous materials, compressing, and transferring to larger vehicles are important duties at waste transfer stations (Lebank, 2020). In order to reduce transportation expenses as the time for shifting as well as the amount of waste increase, waste transfer stations are ideally located close to recycling and treatment facilities (Yousefloo & Babazadeh, 2020). Modern technological innovations like the Internet of Things (IoT) have the potential to greatly improve solid waste management systems' efficiency. As shown in Moscow (Maiurova et al., 2022), digitalization of waste disposal networks can maximize resource utilization and enhance overall system performance. Effective waste management requires waste sorting. A range of methods including hand picking, air density separation, metal extraction, and electrostatic techniques are employed to manage various waste materials. In order to prepare waste for additional processing and recycling, these separating techniques are necessary as shown in figure.

Figure-1 Waste progresses through stages of collection, segregation, and sorting, ultimately arriving at a suitable waste treatment facility, following a structured pathway outlined in waste management protocols.

Source: (Sondh et al., 2024)

3.2 Manual Sorting

Large objects like rocks, wood, and oversized clothes must be separated from other waste materials during the sorting process at the source. This technique uses simple tools like big tables or belt conveyors and is usually performed by workers using their hands.

A popular method for sorting municipal solid waste is handpicking, which works especially well for getting rid of things like plastic made from PVC and e-waste. Concrete, wood, glass, and rocks are frequently found in construction and demolition waste (Lawson, 2020). Although manual sorting requires a lot of time and labor, it is an efficient way to separate waste and recover valuable materials. This method, which mainly uses human resources, is common in nations where cheap labor is easily accessible. After the waste has been emptied, it must be spread out and disposed of (with precautions taken), with visible waste being manually separated for reuse, collected and stored, and any leftover debris must be disposed of (Liang et al., 2024).

3.3 Air density separator

Fans or blowers are used in this garbage division process to speed up the procedure. By producing an upward airflow, the fan helps separate materials according to their differing densities. The force of the airflow and the way the materials are introduced into the air column, determine how effective this method is. Another important consideration is moisture content, since water can make some materials clump and fall, which can interfere with the sorting process ("Solid Waste Management," 2022). Techniques for separating air further can be divided within zigzag and wind shifter types of separators. These techniques efficiently separate metals and more substantial wastes from materials with lightweight including plastic bottles and various categories of plastic.

3.4 Trommel screening

This screening, sometimes referred to spinning visuals, are physical transmission devices that are frequently used for material separation in the solid waste treatment sector (Mousavi et al., 2024). These screens are made out of a cylindrical drum with a surface covered in a web-like structure made of meshes in different sizes. The mesh of the trommel enables the separation of particular waste sizes as it rotates, creating a heap, for example, of manure. Waste that exceeds the mesh's allowable size is stopped at the trommel's back end (Chen et al., 2010). For a trommel to operate smoothly, effectively, and safely, human resources are needed. Both wet and dry garbage can be processed by these devices. Objects are raised with lifting bars on an inclined drum and then dropped to descend further. To help with separation, elevating bars also give the objects a shake. Trommel screens are used in the municipal solid waste (MSW) industry to classify particles into fixed sizes. Trommels improve the quality of other solid waste derived from fuel by eliminating inorganic materials such as ash and water from grouped light solvents (Goli et al., 2021). Three major sets of materials are usually obtained from the MSW after it has been inspected at the sorting plant: (i) Refuse Derived Fuels (RDFs), which consist of combustible materials; (ii) large-sized materials, such as stones, metals, electronic material, etc.; and (iii) inert or delicate materials.

3.5 Metal Separation

A large percentage of mixed waste is composed of plastics, paper, elements, e-waste, and food particles in sorting stations. For a number of reasons, metal separation is an essential stage in waste separation facilities (Elisha, 2020). To begin with, it helps separate premium materials. Second, the effective running of later operations like crushing, visual sorting, and RDF production depends on the removal of metals. Current separation and magnetic separation are two methods for metal separation that are frequently used (Sniatala et al., 2023). While eddy current separation creates repulsive forces in non-ferrous metals, which cause them to be ejected from the waste stream, magnetic separation uses magnets to attract and separate ferrous metals from the waste stream. By effectively removing metallic materials from mixed waste, these methods facilitate subsequent procedures and increase the effectiveness of waste management as a whole (Xavier et al., 2023).

3.6 Magnetic Separation

This method allows the removal of gathered metal by using an electromagnet to activate or deactivate. It is noteworthy that this technique is not applicable to all metal separations (Ding et al., 2021). The device is made up of a permanent electromagnet mounted on a rotating drum that draws magnetic tools from the belt conveyor. Besides that, non-iron metallic are not affected by magnetic fields and have no ferrous content. Copper, aluminum, and stainless steel are a few examples of materials that have little to no magnetism. A further drawback is that non-magnetic materials containing minute magnetic particles will not be captured (Fitzgerald, 2013). Larger magnetic objects may also unintentionally collect undesirable materials like paper, plastic, and food scraps. In mixed recycling streams, where materials are gathered and separated prior to processing, this problem is especially prevalent.

3.7 Eddy Separation

Eddy current separation is a widely employed technique for the separation of non-magnetic materials, like aluminum, present in electronic waste. In order to differentiate non-ferrous metals according to their conductivity, this method uses electromagnetic induction. This method involves using a conveyor belt to transport a mixture of non-magnetic materials in a predetermined size range to the eddy current separator (Smith et al., 2019). This method is effective because it delivers material fast and guarantees uniform distribution in a single layer. After that, the material travels to the main pulley separating substances zone, where non-metals are driven away from the host substance (Anastassakis, 2018). Rejected non-ferrous metals are routed through carefully positioned splitters to collection belts or bins. According to Huang et al. (2021), the speed at which average plastic, aluminum, and copper rudiments separate from desiccated biodegradable is greatly impacted by fine-tuning the rotor rapidity, provender amount, and girdle speed. Non-metallic materials fall freely into non-ferrous areas, while brass ingredients are drawn to the strong magnetic power created inside the separator.

3.8 Separation by electrostatics

Electronic waste, or e-waste, is the term for disposed of or abandoned electronic items, including laptops, TVs, cell phones, batteries, and more. The generation of e-waste has increased noticeably in recent years, but efficient disposal techniques are still difficult to come by because of the intricacy of electronic waste components. Numerous hazardous metals, like lead, polybromine, cadmium, the element lithium, mercury, and retardants, are found in e-waste. These metals can cause serious health problems, including damage to the different parts of the body like, liver, kidneys, heart and brain. Although, E-waste can further be divided into semiconductors, conductors, and insulators. Effective recycling of these components appears to be possible with electrostatic separation (Tilmatine et al., 2009). With this method, conducting and insulation substances found in e-waste are effectively recycled. Disassembly, disposal, and final treatment are usually steps in the e-waste disposal process. The first step in separating valuable and hazardous components is disassembly (Oke, & Potgieter, (2024). Materials are broken down to liberate them from substances and separate them in subsequent processing. Materials that have distinct charges are attracted to or repelled from each other according to the electrostatic charges principle, which underlies electrostatic separation. In separators, conductive elements fascinate contradictory indicted matters, like metal drums, and separate them from through the use of attractive forces (Aksa et al., 2013). Printed circuit boards (PCBs) are essential parts of e-waste because, according to Waste from Electrical and Electronic Equipment (WEEE), they contain a considerable amount of valuable metals (Hamerski et al., 2019). PCB electrostatic separation turns out to be a successful method for recovering value products (Jha et al., 2024).

3.9 Balers and compactors

Space constraints resulting from accumulating waste are a common challenge faced by waste management organizations. Thankfully, developments in technology provide some relief from this problem. Users can use balers and compactors, among other tools, to minimize the amount of space that waste takes up. Press channels, pressing chambers, tying devices, and power units are the four main parts of a baler. The procedure is filling a hopper with waste, which the baler then compresses into bales, or bundles. The amount of waste is greatly decreased by these bales, which helps with recycling and makes waste easier to handle. Balers are used in many different industries, such as manufacturing, recycling plants, retail stores, and institutions. Round and square waste balers are the two most popular varieties (Shang et al., 2021). The effectiveness of handling, aggregation, transportation, and storage procedures all depend heavily on bale density (Shah and Darr, 2016). In a similar vein, compactors are essential for reducing waste volume and, consequently, the amount of space needed in landfills. Compactors not only minimize volume but also provide the benefit of reducing fire hazards, smells, and rodent infestation.

4. Policies for Waste Management, Reuse, Recycle

Within a nation or region, peace is fostered by an environmentally friendly municipal solid waste (MSW) management system. By applying the principles of reduce, reuse, and recycle, adopting a circular economy-based strategy for handling municipal solid waste presents a chance to lower natural resource consumption and protect the ecosystem (Li et al., 2021). According to Cunha (2024) this is in line with the Sustainable Development Goals (SDGs) of the United Nations, including " "Ensure Sustainable Production and Utilization Patterns" (SDG-12) and "Take immediate action to mitigate the effects of climate change" (SDG-13). Creating a framework of laws and policies is essential to creating a waste management system that works. Using circular economy techniques is the main way to achieve sustainability in MSW management. Recycling—often referred to as "misplaced resources"—contributes significantly to sustainable waste disposal by lowering waste effluence, restoring usable resources, and conserving energy (Sondh et al, 2024).

4.1 Policies regarding Waste Management

A robust policy framework put in place by individuals and local authorities is essential to an effective SWM structure driven by the circular economy. This structure places a strong emphasis on infrastructure development, law enforcement, awareness raising, and institution setup. Serving waste management states like Germany, which implemented policies advocating waste reduction and recovery, can teach developing and underdeveloped nations a lot (Wilson, 2023). As demonstrated by Latin American nations that emphasize public sector engagement, public involvement is essential for efficient waste management (Félix-López et al., 2023). Under these arrangements, the government acts as if it were a business, seeking to maximize profits at the expense of preserving the environment and the welfare of the populace. Due to energy scarcity, European nations have reduced the amount of waste sent to treatment plants by using waste as a source of energy. Waste recovery is Portugal's top priority, as evidenced by Decree Law No. 178/2006 (Dinis et al., 2023). Finland prioritizes resource-wise urban development to lessen its impact on the environment, while Germany has focused on sources of clean energy since the 1990s under its "Energiewende" policy. Finland's HINKU initiative seeks to improve both social and environmental health by reducing emissions by 80% by 2030 (Hirvilammi et al., 2023). Technological developments are essential to solid waste management because they make sustainable and affordable solutions possible. Achieving sustainable development goals requires policies to keep up with technological advancements.

4.2 Waste reuse and Recycle

Sorting and segregating waste is an essential step in categorizing waste according to how it will be treated in the end. A number of factors, including its potential for reuse, waste can be sent to a landfill, treatment facility, or recycling plant after it has been sorted. Prioritizing recycling and waste reuse is crucial for resource conservation and environmental protection on a global scale (Cudjoe et al., 2021). By lowering the demand for virgin resources in the production of commodities, reusing items like metals, plastics, and paper helps protect natural resources and improve environmental health (Tang et al., 2020). According to Nevrlý and Smejkalov (2021), achieving "zero-waste" can be facilitated by optimizing recycling rates, and continuous research and innovation endeavors to introduce circularity into the economy. Concrete blocks can be made from a variety of recycled solid waste components, including recovered concrete, crushed brick, and waste glass (Luhar et al., 2019). A nation's income level and the extent of its recycling practices are frequently correlated (Moroke et al., 2019). Compared to middle-class and lower-class countries, high-income countries usually have more developed waste management systems, which results in higher recycling rates (Ferronato et al., 2019). On the other hand, inefficient collection systems, weak waste management programs, and low levels of public awareness impede recycling initiatives in middle-class and lower-income nations (Munir et al., 2021). Because of laws that restrict landfill disposal, allow private companies to participate in waste collection, and impose fines on non-recycled waste, Germany, Austria, South Korea, Wales, and Switzerland have some of the highest recycling rates in the world (Gray, 2017). Waste must be collected, sorted, recycled, treated, and disposed of as part of an efficient municipal solid waste (MSW) management system (Cohen et al., 2021). Every step is important, and if any are inefficient, the system as a whole could be compromised. Natural resource exploitation is a common pressure on developing nations to meet waste management requirements and raise living standards. In order to address these issues and put suitable waste management strategies into practice, effective policymaking and governance are essential (Bui et al., 2022). To meet waste management targets and advance sustainability, recycling units must be integrated into waste management systems. In order to have the desired effect on waste management systems, public-private partnerships are essential (Cheng et al., 2023).

4.3 Waste dealing ability and Recovery

The efficient functioning of a circular economy (CE) depends on reducing waste capacity and disposing of waste properly. In the past, landfilling was the most common way to dispose of waste, which resulted in the buildup of massive waste mountains in many urban areas and serious health and environmental risks (Liu and Liu, 2021). Growing environmental consciousness has led to the development of a variety of waste disposal techniques, which can be broadly categorized into two categories: thermo-chemical methods (which include incineration, gasification, and pyrolysis) and biochemical methods (which include anaerobic digestion and composting) (Li et al., 2016). Decomposing organic matter, especially food waste, makes up the majority of the Organic Part of MSW (OFMSW), which accounts for 40–70% of all MSW generated worldwide (Ali et al., 2017). Even though biochemical methods are good at reducing waste volume, they can take a long time—25 to 40 days—to treat waste, mostly organic material. On the other hand, they simplify waste management by providing flexibility in the periodic addition of raw materials (Nanda and Berruti, 2021). In contrast, thermo-chemical procedures entail a significant amount of heat, energy and can route waste at temperatures between 350 and 1500 °C more quickly than biochemical techniques. These procedures have the potential to reduce waste volume by 75–90%, but they frequently cause environmental problems by releasing pollutants like dioxins, furans, NOx, SOx, and PAHs (Munir et al., 2021; Kumar and Samadder, 2017). By changing the operating conditions and process parameters, efforts are being made to reduce these emissions (Upadhyay et al., 2019). Due to the oxygen-starved environment needed, pyrolysis provides a solution to emissions like NOx, SOx, PAHs, and dioxins; however, it also produces contaminants like toxic metals and nitrogen (Sipra et al., 2018; Hasan et al., 2021). In order to maximize waste management while reducing environmental impact, research projects investigate a variety of waste handling procedures, such as pyrolysis, gasification, composting and anaerobic digestion, (Sondh et al., 2024). Waste disposal techniques can be improved and made more ecologically friendly and efficient through continuous innovation and improvement, which will aid in the shift to a sustainable and circular economy.

Figure-2. An illustration comparing the technical characteristics of different waste treatment techniques, including composting, anaerobic digestion, gasification, incineration, pyrolysis, and landfills.

Source: (Sondh et al., 2024).

5. Municipal Solid Waste Management focused on a Circular Economy.

According to Mhatre et al. (2021), in order to promote sustainability objectives in a country, circular economy (CE) models and policies ought to be incorporated into MSW management teams. The Fernandes et al., (2023), defined sustainability in 1987 as meeting current needs without jeopardizing upcoming cohorts' ability to encounter individual. The foundation for attaining sustainability in MSW management systems is the CE framework, which is based on three main pillars: environmental health (Environmental Aspects), social upliftment (Social Aspects), and economic development (Techno-Economic Aspects) (Gadaleta et al., 2022). The realization of sustainability necessitates the strong support of all three pillars. To create a dependable and effective framework, policymakers must work together in concert. Sustainable development initiatives within a country or region can be supported by a workable framework that places a high priority on a robust environment, society, and economy. As Fig. 4 shows, each of these elements adds unique characteristics to the CE.

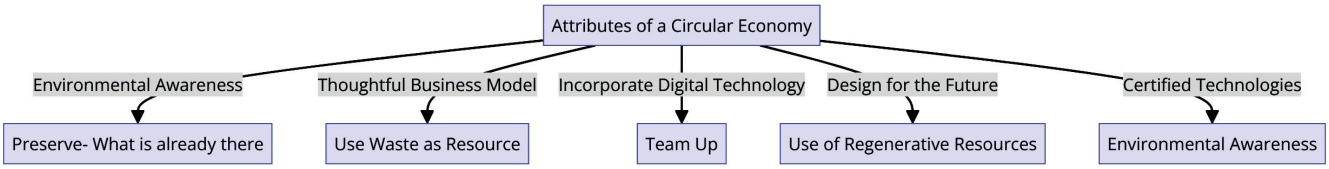

Figure-3. Attribute of a circular economy supporting SWM system involving economic, social and Environmental aspects

Source: Authors own idea

5.1 Economical aspect

Key components in demonstrating a business's sustainability efforts are the sharing and handling of product specifics, the possibilities for reuse, and the recycling procedures. Effective methods for sustainability are essential for the long-term health of a business, claim Leising et al. (2018). Nishitani et al. (2022), suggested, Material Flow Cost Accounting (MFCA) as a way to improve material efficiency and lessen the detrimental effects of resource exploiting by lowering production costs. According to Lassi (2020), growth in the economy is sustainable if it maintains or increases social welfare compared to its current levels in the future. This highlights the significance of resource ecological preservation and recycling in business models. Waste-to-Energy (WtE) facilities, which exclusively use non-recyclable waste to optimize the advantages of the (CE) paradigm, have a substantial impact on economic dynamics. According to the World Banking Group (Kaza et al., 2018), thermal incineration—a technique with a significant commercial presence worldwide—processes about 11% of municipal solid waste (MSW). Subsidies from the government for garbage removal, electricity and heat sales, and slag revenue support WtE incineration plants, which have high initial investment requirements but offer stable, substantial profits and low operating costs (Xin-gang et al., 2016). Numerous elements, including plant size, waste type, lifecycle, and operational availability, affect a WtE facility's development cost (Santosos et al., 2019). These prices vary across countries, which reflects disparities in resource availability and technological preparedness. Wu (2018) observes that WtE developments in China are significantly more expensive than those in the U.S. and Europe. Variations are also observed in Ethiopia, Vietnam, and Sri Lanka (Daily, 2017; Wu, 2018). With significant revenue from the generation of electricity in places like China (70–85%), WtE plants typically see an exciting ascend on investments (RoI) of 18–25%.

Economically, the (CE) is propelled by a dedication to environmentally sustainable company strategies and standards. This strategy places a focus on creating fresh supplies from utilized content and effectively managing the resources that are already available. Business ethics, which concentrate on proper behavior and procedures to ensure wider success, play a critical role in steering decisions towards economic recurrence.

5.2 Social aspect

By focusing on engagement with the community, equal opportunity, and improved public health, the circular economy encompasses essential social dimensions that improve solid waste management. In addition to reducing waste, initiatives that support recycling and repurposing materials also open up job opportunities, especially in areas with low incomes where jobs in waste gathering and processing can boost the local economy (Morais et al., 2022). By encouraging a culture of environmental responsibility and improving community involvement in sustainable practices, educational initiatives play a crucial role (Repp et al., 2021). Additionally, implementing circular economy waste management techniques can result in less pollution, cleaner cities, and improved community health (Dinca et al., 2022). Residents, companies, and governments must work together to implement this strategy, which will strengthen community ties and increase everyone's commitment to sustainability.

5.3 Environmental aspects

The circular economy (CE) framework incorporates ecological factors into solid waste management by encouraging material reduction, reuse, and recycling, resulting in reduced production of trash and worsening of the environment (De melo et al., 2022). In this paradigm, waste is viewed as an asset that can be constantly recycled back into production processes, rather than an end product (Kurniawan et al., 2021). This approach reduces dependability on virgin commodities, greenhouse gas emissions, and energy consumption, all of which contribute to a reduction in industrial activities' overall environmental footprint. The CE seeks to strike a balance between economic development and environmental sustainability by focusing on ecosystem restoration and regeneration through adheres to such as material recuperation and the secure return of biological substances to the environment (Vence et al., 2021). Furthermore, it promotes preservation of biodiversity and decreases pressure on landfills, which aligns with worldwide sustainability goals aimed at mitigating climate change and improving environmental health.

5.4 Key inputs of Circular Economy for Sustainable development

A circular economy (CE) can achieve success when implemented across various societal levels. Large-scale industries and well-known brands can facilitate this shift by serving as exemplary models for those transitioning from a linear to a circular economy.

The diagram illustrates a conceptual model for a Circular Economy (CE), which is intertwined with sustainable development principles and the management of solid waste. Central to this model is the CE's objective to enhance resource efficiency and reduce waste by adopting regenerative practices that promote the reuse, repair, refurbishment, and recycling of products and materials.

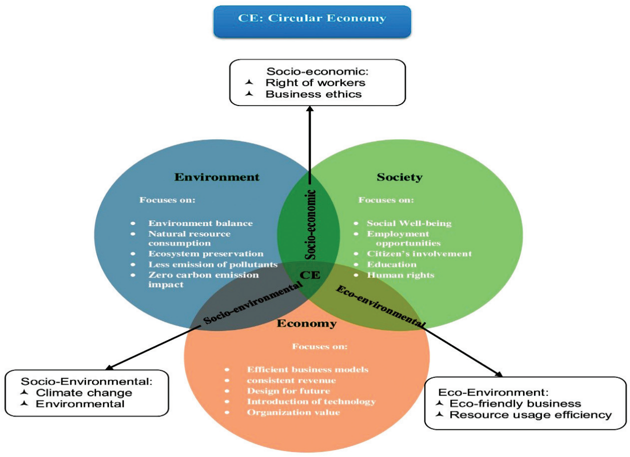

Figure.4: The three fundamental pillars of the circular economy encompass social, environmental, and economic dimensions

Source: Authors own idea

The model outlines how CE interacts with socio-economic, eco-environmental, and socio-environmental aspects. In the realm of sustainable development, the economic dimension is centered on adopting efficient business models and technologies that foster a closed-loop system, crucial for decreasing solid waste quantities and enhancing their management. The social dimension highlights the generation of job opportunities and overall well-being, which involves creating positions in the waste management industry and fostering education about recycling and reuse. From an environmental standpoint, CE advocates for the preservation of natural resources and strives to achieve zero carbon emissions, in line with practices that reduce environmental pollution. The socio-environmental perspective considers wider issues such as climate change and environmental justice, promoting a fair distribution of the environmental advantages and challenges associated with waste management. Collectively, the diagram conveys how the circular economy framework is inherently connected to achieving sustainable development goals, especially in optimizing the management of solid waste to realize economic, social, and environmental gains.

5.5 Practical outcomes of this analysis

The existing solid waste management framework is currently inadequate for addressing the prevalent challenges in waste processing. Efforts to overhaul this system have been ongoing for more than ten years. Various solutions have been proposed by scientists and relevant authorities. A Circular Economy (CE) approach to solid waste management holds significant promise for addressing issues related to climate change, energy consumption, prolonged use of materials, and social welfare. Supported by robust strategies and efficient policies, this system could facilitate smoother operations. Transitioning from a linear to a closed-loop economic model enhances the potential for economic growth with stability as a key aspect. Moreover, reusing materials within this system can alleviate environmental stress. Implementing a CE approach in solid waste management could enforce a zero-waste policy, thereby fostering sustainability within the waste management sector.

6. Conclusion and Policy recommendation:

Adopting a circular economy model in solid waste management is essential for sustaining progress in the context of increasing waste dilemmas. This study underscores the importance of integrating economic, social, and environmental approaches to improve the efficiency and effectiveness of waste management systems. Embracing circular economy principles such as reduction, reuse, recycling, and recovery allows local governments to lessen environmental degradation and conserve resources. The research advocates for strong policy frameworks and innovative technologies to support the implementation of these principles. In essence, a circular economy-based approach in SWM not only aids in achieving sustainable development but also creates a resilient infrastructure capable of addressing future environmental predicaments and meeting community demands.

Author Contributions

Abdul Rasool Khoso conceived the research idea, designed the study protocol, and supervised data collection and analysis.

Funding

This research has no funding.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The authors confirm being the sole contributor of this work and have approved it for publication.

Peer-review

Externally peer-reviewed.

Acknowledgments

The Guest Editors would like to acknowledge all the authors of the manuscripts and the blind reviewers of those articles who helped making this Special Issue a stronger contribution to policy.

Conflict of interest

No potential conflict of interest was reported by the author (s)

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References and notes:

Adamowicz, M. (2022). Green deal, green growth and green economy as a means of support for attaining the sustainable development goals. *Sustainability*, *14*(10), 5901. **https://doi.org/10.3390/su14105901**

Akinshilo, A. (2019). Energy potential from municipal solid waste (MSW) for a developing metropolis. *Journal of Thermal Engineering*, *5*(6), 196-204. https://doi.org/10.18186/thermal.654322.

Aksa, W., Medles, K., Rezoug, M., Boukhoulda, M.F., Bilici, M., Dascalescu, L., (2013). Two stage electrostatic separator for the recycling of plastics from waste electrical and electronic equipment. J. Electrost. 71, 681–688. https://doi.org/10.1016/j.elstat.2013.03.009.

Ali, A., Mahar, R.B., Soomro, R.A., Sherazi, S.T.H., (2017). Fe3O4 nanoparticles facilitated anaerobic digestion of organic fraction of municipal solid waste for enhancement of methane production. Energy Sources, Part A Recover. Util. Environ. Eff. 39, 1815–1822. https://doi.org/10.1080/15567036.2017.1384866.

Almulhim, A. I., & Al-Saidi, M. (2023). Circular economy and the resource nexus: Realignment and progress towards sustainable development in Saudi Arabia. *Environmental Development*, *46*, 100851. https://doi.org/10.1016/j.envdev.2023.100851.

Anastassakis, G. N. (2018). Solid Waste Separation and Processing: Principles and Equipment. *Handbook of Environmental Engineering*, 627-671.

Bhattacharjee, S., & Cruz, J. (2015). Economic sustainability of closed loop supply chains: A holistic model for decision and policy analysis. *Decision Support Systems*, 77, 67-86. https://doi.org/10.1016/j.dss.2015.05.011.

Bossek, D., Goermer, M., Bach, V., Lehmann, A., & Finkbeiner, M. (2021). Life-LCA: the first case study of the life cycle impacts of a human being. *The International Journal of Life Cycle Assessment*, *26*(9), 1847-1866. https://doi.org/10.1007/s11367-021-01924-y.

Budihardjo, M.A., Ardiansyah, S.Y., Ramadan, B.S., 2022. Community-driven material recovery facility (CdMRF) for sustainable economic incentives of waste management: evidence from Semarang City, Indonesia. Habitat Int. 119, 102488. https://doi.org/10.1016/j.habitatint.2021.102488.

Bui, Tat-Dat, Tseng, Jiun-Wei, Ming-Lang Tseng, M.K.L., (2022). Opportunities and challenges for solid waste reuse and recycling in emerging economies: a hybrid analysis, Resources, Conservation and Recycling. Resour. Conserv. Recycl. 177. https://doi.org/10.1016/j.resconrec.2021.105968.

Cheng, S., Yu, Y., Meng, F., Chen, J., Chen, Y., Liu, G., & Fan, W. (2023). Potential benefits of public–private partnerships to improve the efficiency of urban wastewater treatment. *NPJ Clean Water*, *6*(1), 13. https://doi.org/10.1038/s41545-023-00232-2.

Chen, Y.S., Hsiau, S.S., Lee, H.Y., Chyou, Y.P., Hsu, C.J., (2010). Size separation of particulates in a trommel screen system. Chem. Eng. Process. Process Intensif. 49, 1214–1221. https://doi.org/10.1016/j.cep.2010.09.003.

Chowdhury, N. R., Paul, S. K., Sarker, T., & Shi, Y. (2023). Implementing smart waste management system for a sustainable circular economy in the textile industry. *International Journal of Production Economics*, *262*, 108876. https://doi.org/10.1016/j.ijpe.2023.108876

Cohen, C., Halfon, E., Schwartz, M.,)2021). Trust between municipality and residents: a game-theory model for municipal solid-waste recycling efficiency. Waste Manag. 127, 30–36. https://doi.org/10.1016/j.wasman.2021.04.018.

Cudjoe, D., Wang, H., Zhu, B., (2021). Assessment of the potential energy and environmental benefits of solid waste recycling in China. J. Environ. Manag. 295, 113072. https://doi.org/10.1016/j.jenvman.2021.113072.

Daily, (2017). Two Waste-To-Energy Plants to Get off the Ground Today. [WWW Document]. URL. https://www.ft.lk/article/634380/Two-waste-to-energy-plants-toget-off-the-ground-today. 9.19.22.

Cunha, D. R., Pereira, N. N., de Santana Porte, M., & Campos, C. R. (2024). Sustainability practices for SDGs: a study of Brazilian ports. *Environment, Development and Sustainability*, *26*(4), 9923-9944. https://link.springer.com/article/10.1007/s10668-023-03126-y.

De Melo, T. A., de Oliveira, M. A., de Sousa, S. R., Vieira, R. K., & Amaral, T. S. (2022). Circular economy public policies: A systematic literature review. *Procedia Computer Science*, *204*, 652-662.

Devi, P., Dey, S. R., Sharma, K., Kumar, P., & Singh, J. (2024). Waste Management as an Opportunity for the Inclusion of Vulnerable Groups. In *Waste Management in the Circular Economy* (pp. 207-230). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-42426-7_11.

Dincă, G., Milan, A. A., Andronic, M. L., Pasztori, A. M., & Dincă, D. (2022). Does circular economy contribute to smart cities' sustainable development?. *International journal of environmental research and public health*, *19*(13), 7627.

Ding, Y., Zhao, Jun, Liu, J.W., Zhou, J., Cheng, L., Zhao, Jia, Shao, Z., Iris, Ç., Pan, B., Li, X., Hu, Z.T., (2021). A review of China's municipal solid waste (MSW) and comparison with international regions: management and technologies in treatment and resource utilization. J. Clean. Prod. 293. https://doi.org/10.1016/ j.jclepro.2021.126144.

Dinis, M. A. P., Vidal, D. G., & Begum, H. (2023). Future Interdisciplinary Waste Ecological Challenges: A Critical Analysis of the Portuguese Case. In Handbook of Sustainability Science in the Future: Policies, Technologies and Education by 2050 (pp. 965-983). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-04560-8_39.

Elisha, O. D. (2020). Moving beyond take-make-dispose to take-make-use for sustainable economy. *Int. J. Sci. Res. Educ*, *13*(3), 497-516.

Fatimah, Y. A., Govindan, K., Murniningsih, R., & Setiawan, A. (2020). Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia. *Journal of cleaner production*, 269, 122263. https://doi.org/10.1016/j.jclepro.2020.122263.

Félix-López, M., Ormaza-Murillo, M., Álvarez-Santana, C., & Banchon, C. (2023). Exploring the Impact of Reclaimed Water on Latin America's Development. Journal of Ecological Engineering, 24(10). https://doi.org/10.12911/22998993/169962.

Fernandes, A., Figueiredo, M., Chaves, H., Neves, J., & Vicente, H. (2023). Assessment of water consumers literacy. In *Emerging Technologies for Water Supply, Conservation and Management* (pp. 1-27). Cham: Springer International Publishing. https://link.springer.com/chapter/10.1007/978-3-031-35279-9_1.

Ferronato, N., Ragazzi, M., Gorritty Portillo, M.A., Guisbert Lizarazu, E.G., Viotti, P., Torretta, V., (2019). How to improve recycling rate in developing big cities: an integrated approach for assessing municipal solid waste collection and treatment scenarios. Environ. Dev. 29, 94–110. https://doi.org/10.1016/ j.envdev.2019.01.002.

Fitzgerald, G.C., (2013). Pre-processing and Treatment of Municipal Solid Waste (MSW) Prior to Incineration, Waste to Energy Conversion Technology. Woodhead Publishing Limited. https://doi.org/10.1533/9780857096364.2.55.

Funari, M. F., Silva, L. C., Mousavian, E., & Lourenço, P. B. (2023). Real-time structural stability of domes through limit analysis: application to St. Peter's Dome. *International journal of architectural heritage*, *17*(6), 915-937. https://doi.org/10.1080/15583058.2021.1992539.

Gadaleta, G., De Gisi, S., Todaro, F., Campanaro, V., Teodosiu, C., Notarnicola, M., (2022). Sustainability assessment of municipal solid waste separate collection and treatment systems in a large metropolitan area. Sustain. Prod. Consum. 29, 328–340. https://doi.org/10.1016/j.spc.2021.10.023.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner production*, *114*, 11-32. https://doi.org/10.1016/j.jclepro.2015.09.007.

Goli, V.S.N.S., Singh, D.N., Baser, T., (2021). A critical review on thermal treatment technologies of combustible fractions from mechanical biological treatment plants. J. Environ. Chem. Eng. 9, 105643. https://doi.org/10.1016/j.jece.2021.105643.

Gray, A, (2017). Circular economy [WWW Document]. URL. World Econ. Forum. https://www.weforum.org/agenda/2017/12/germany-recycles-more-than-anyother-country/. 3.2

Hamerski, F., Krummenauer, A., Bernardes, A.M., Veit, H.M., (2019). Improved settings of a corona-electrostatic separator for copper concentration from waste printed circuit boards. J. Environ. Chem. Eng. 7, 102896. https://doi.org/10.1016/j.jece.2019.102896.

Hasan, M.M., Rasul, M.G., Khan, M.M.K., Ashwath, N., Jahirul, M.I., (2021). Energy recovery from municipal solid waste using pyrolysis technology: a review on current status and developments. Renew. Sustain. Energy Rev. 145, 111073. https://doi.org/10.1016/j.rser.2021.111073.

Herrador, M., & Van, M. L. (2024). Circular economy strategies in the ASEAN region: A comparative study. *Science of The Total Environment*, *908*, 168280. https://doi.org/10.1016/j.scitotenv.2023.168280.

Hirvilammi, T., Peltomaa, J., Pihlajamaa, M., & Tiilikainen, S. (2023). Towards an eco-welfare state: Enabling factors for transformative eco-social initiatives. European Journal of Social Security, 25(4), 445-463. https://doi.org/10.1177/13882627231195724.

Huang, Z., Zhu, J., Wu, X., Qiu, R., Xu, Z., Ruan, J., (2021). Eddy current separation can be used in separation of non-ferrous particles from crushed waste printed circuit boards. J. Clean. Prod. 312, 127755. https://doi.org/10.1016/j.jclepro.2021.127755

Jha, R., Agrawal, M., Jena, A., Mishra, G., Verma, H. R., Meshram, A., & Singh, K. K. (2024). A review on existing pre-treatment techniques of waste printed circuit boards. *Canadian Metallurgical Quarterly*, 1-17. https://doi.org/10.1080/00084433.2024.2310348.

Kaur, A., Bharti, R., & Sharma, R. (2023). Municipal solid waste as a source of energy. *Materials Today: Proceedings*, *81*, 904-915.

Kaza, S., Yao, L., Bhada-Tata, P., Woerden, F. Van, (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. World Bank Publications. https:// doi.org/10.1596/978-1-4648-1329-0.

Kumar, A., & Agrawal, A. (2020). Recent trends in solid waste management status, challenges, and potential for the future Indian cities–A review. Current Research in Environmental Sustainability, 2, 100011. https://doi.org/10.1016/j.crsust.2020.100011

Kumar, A., Samadder, S.R., (2017). A review on technological options of waste to energy for effective management of municipal solid waste. Waste Management. 69, 407–422. https://doi.org/10.1016/j.wasman.2017.08.046.

Kurniawan, T.A., Lo, W., Singh, D., Othman, M.H.D., Avtar, R., Hwang, G.H., Albadarin, A.B., Kern, A.O., Shirazian, S., (2021). A societal transition of MSW management in Xiamen (China) toward a circular economy through integrated waste recycling and technological digitization. Environ. Pollut. 277. https://doi.org/10.1016/ j.envpol.2021.116741.

Lassi, A., (2020). Economic growth and circular economy? [WWW Document]. URL. Reduces. https://projects2014-2020.interregeurope.eu//reduces/news/newsarticle/10730/economic-growth-and-circular-economy/. 9.19.22.

Lawson, E., (2020). Best Practices for Construction Waste Management. [WWW Document]. URL. https://www.recycling-magazine.com/2020/03/30/best-practices-forconstruction-waste-management/. 3.22.2.

Lebank, R., (2020). What is a waste transfer station? [WWW Document]. URL. Dotdash Meredith. https://www.thebalancesmb.com/what-is-a-waste-transfer-station2877735. 3.15.2

Lei, H., Li, L., Yang, W., Bian, Y., Li, C.Q., (2021). An analytical review on application of life cycle assessment in circular economy for built environment. J. Build. Eng. 44. https://doi.org/10.1016/j.jobe.2021.103374.

Leising, E., Quist, J., Bocken, N., (2018). Circular Economy in the building sector: three cases and a collaboration tool. J. Clean. Prod. 176, 976–989. https://doi.org/ 10.1016/j.jclepro.2017.12.010.

Letcher, T.M., (2020). Plastic Waste and Recycling: Environmental Impact, Societal Issues, Prevention, and Solutions. Academic Press. https://doi.org/10.1016/C2018-0- 01939-8.

Li, C., Aston, J.E., Lacey, J.A., Thompson, V.S., Thompson, D.N., (2016). Impact of feedstock quality and variation on biochemical and thermochemical conversion. Renew. Sustain. Energy Rev. 65, 525–536. https://doi.org/10.1016/j.rser.2016.06.063.

Li, J., Song, G., Cai, M., Bian, J., & Mohammed, B. S. (2022). Green environment and circular economy: A state-of-the-art analysis. *Sustainable Energy Technologies and Assessments*, 52, 102106. https://doi.org/10.1016/j.seta.2022.102106

Li, J., Sun, W., Song, H., Li, R., Hao, J., (2021). Toward the construction of a circular economy eco-city : an emergy-based sustainability evaluation of Rizhao city in China. Sustain. Cities Soc. 71. https://doi.org/10.1016/j.scs.2021.102956.

Liang, R., Chen, C., Ge, Y., Tao, J., Yan, B., Wang, H., ... & Chen, G. (2024). A conceptual sorting strategy of municipal solid waste towards efficient gasification. *Energy Conversion and Management*, *304*, 118209. https://doi.org/10.1016/j.enconman.2024.118209

Liu, Y., Liu, J., (2021). Mechanism and dynamic evolution of leachate collection system clogging in MSW landfills in China. Waste Manag. 120, 314–321. https://doi.org/ 10.1016/j.wasman.2020.11.057.

Luhar, S., Cheng, T.W., Nicolaides, D., Luhar, I., Panias, D., Sakkas, K., 2019. Valorisation of glass wastes for the development of geopolymer composites – durability, thermal and microstructural properties: a review. Construct. Build. Mater. 222, 673–687. https://doi.org/10.1016/j.conbuildmat.2019.06.169.

Mhatre, P., Gedam, V., Unnikrishnan, S., Verma, S., (2021). Circular economy in built environment – literature review and theory development. J. Build. Eng. 35. https:// doi.org/10.1016/j.jobe.2020.101995.

Morais, J., Corder, G., Golev, A., Lawson, L., & Ali, S. (2022). Global review of human waste-picking and its contribution to poverty alleviation and a circular economy. *Environmental Research Letters*, *17*(6), 063002.

Moroke, T., Schoeman, C., Schoeman, I., (2019). Developing a neighbourhood sustainability assessment model: an approach to sustainable urban development. Sustain. Cities Soc. 48, 101433. https://doi.org/10.1016/j.scs.2019.101433.

Mousavi, M., Kowsari, E., Gheibi, M., Cheshmeh, Z. A., Teymoorian, T., & Ramakrishna, S. (2024). Assessing Bioplastics' Economic, Commercial, Political, and Energy Potential with Circular Economy Modeling: a Sustainable Solution to Plastic Waste Management. *Materials Circular Economy*, *6*(1), 1-36. https://doi.org/10.1007/s42824-023-00098-2

Muljaningsih, S., Indrawati, N. K., & Asrofi, D. N. (2022, October). Waste management policy: a study of Malang waste bank in implementing the green economy concept. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1098, No. 1, p. 012036). IOP Publishing.

Munir, M.T., Mohaddespour, A., Nasr, A.T., Carter, S., (2021). Municipal solid waste-to-energy processing for a circular economy in New Zealand. Renew. Sustain. Energy Rev. 145, 111080. https://doi.org/10.1016/j.rser.2021.111080.

Nanda, S., Berruti, F., (2021). A technical review of bioenergy and resource recovery from municipal solid waste. J. Hazard Mater. 403, 123970. https://doi.org/ 10.1016/j.jhazmat.2020.123970.

Nevrlý, V., Smejkalov, V., (2021). Strategic decisions leading to sustainable waste management: separation , sorting and recycling possibilities a. J. Clean. Prod. 278. https://doi.org/10.1016/j.jclepro.2020.123359.

Nishitani, K., Kokubu, K., Wu, Q., Kitada, H., Guenther, E., Guenther, T., 2022. Material flow cost accounting (MFCA) for the circular economy: an empirical study of the triadic relationship between MFCA, environmental performance, and the economic performance of Japanese companies. J. Environ. Manag. 303. https://doi.org/10.1016/j.jenvman.2021.114219.

Nzeadibe, T.C., Adama, O., (2015). Ingrained inequalities? Deconstructing gendered spaces in the informal waste economy of Nigerian cities. Urban Forum 26, 113–130. https://doi.org/10.1007/s12132-014-9246-0.

Oke, E. A., & Potgieter, H. (2024). Discarded e-waste/printed circuit boards: a review of their recent methods of disassembly, sorting and environmental implications. *Journal of Material Cycles and Waste Management*, 1-17.

RamHormozi, H. (2019). *The Anatomy of Consumerism: The Story of Excess, Greed, Self-Indulgence, Wealth Accumulation, Insurmountable Waste, and Environmental Degradation*. FriesenPress.

Repp, L., Hekkert, M., & Kirchherr, J. (2021). Circular economy-induced global employment shifts in apparel value chains: Job reduction in apparel production activities, job growth in reuse and recycling activities. *Resources, conservation and recycling*, *171*, 105621.

Salazar-Adams, A., (2021). The efficiency of municipal solid waste collection in Mexico. Waste Manag. 133, 71–79. https://doi.org/10.1016/j.wasman.2021.07.008.

Santos, R.E., dos, Santos, dos, I.F.S., Barros, R.M., Bernal, A.P., Tiago Filho, G.L., Silva, F., das, G.B. da, (2019). Generating electrical energy through urban solid waste in Brazil: an economic and energy comparative analysis. J. Environ. Manag. 231, 198–206. https://doi.org/10.1016/j.jenvman.2018.10.015.

Sariatli, F. (2017). Linear economy versus circular economy: a comparative and analyzer study for optimization of economy for sustainability. *Visegrad Journal on Bioeconomy and Sustainable Development*, *6*(1), 31-34. DOI:10.1515/vjbsd-2017-0005.

Shah, A., Darr, M., 2016. A techno-economic analysis of the corn stover feedstock supply system for cellulosic biorefineries. Biofuels, Bioprod. Biorefining 6, 246–256. https://doi.org/10.1002/bbb.1657.

Shang, Y., Meng, Z., Cong, Y., Dong, J., Luo, C., Song, Z., (2021). Development of a control system with remote monitoring function for round baler. Comput. Electron. Agric. 182, 106044. https://doi.org/10.1016/j.compag.2021.106044.

Sharma, H., Raja, K., Samal, B., Cheela, V.R.S., Dubey, B.K., Bhattacharya, J., (2021). Science of the Total Environment Circular economy approach in solid waste management system to achieve UN-SDGs : solutions for post-COVID recovery. Sci. Total Environ. 800, 149605. https://doi.org/10.1016/j.scitotenv.2021.149605.

Sikder, S., Toha, M., & Mostafizur Rahman, M. (2024). An Overview on Municipal Solid Waste Characteristics and Its Impacts on Environment and Human Health. *Technical Landfills and Waste Management: Volume 1: Landfill Impacts, Characterization and Valorisation*, 135-155. https://link.springer.com/chapter/10.1007/978-3-031-52633-6_5.

Sipra, A.T., Gao, N., Sarwar, H., (2018). Municipal solid waste (MSW) pyrolysis for bio-fuel production: a review of effects of MSW components and catalysts. Fuel Process. Technol. 175, 131–147. https://doi.org/10.1016/j.fuproc.2018.02.012. Smith, Y. R., Nagel, J. R., & Rajamani, R. K. (2019). Eddy current separation for recovery of non-ferrous metallic particles: A comprehensive review. *Minerals engineering*, *133*, 149-159.

Smol, M., Duda, J., Czaplicka-Kotas, A., & Szołdrowska, D. (2020). Transformation towards circular economy (CE) in municipal waste management system: Model solutions for Poland. *Sustainability*, *12*(11), 4561. **https://doi.org/10.3390/su12114561**

Sniatala, B., Kurniawan, T. A., Sobotka, D., Makinia, J., & Othman, M. H. D. (2023). Macro-nutrients recovery from liquid waste as a sustainable resource for production of recovered mineral fertilizer: Uncovering alternative options to sustain global food security cost-effectively. *Science of The Total Environment*, *856*, 159283.

Solid waste management [WWW document], (2022). URL. World Bank. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management. 10.6.22.

Sondh, S., Upadhyay, D. S., Patel, S., & Patel, R. N. (2022). A strategic review on Municipal Solid Waste (living solid waste) management system focusing on policies, selection criteria and techniques for waste-to-value. *Journal of Cleaner Production*, *356*, 131908. https://doi.org/10.1016/j.jclepro.2022.131908

Sondh, S., Upadhyay, D. S., Patel, S., & Patel, R. N. (2024). Strategic approach towards sustainability by promoting circular economy-based municipal solid waste management system-A review. *Sustainable Chemistry and Pharmacy*, *37*, 101337. https://doi.org/10.1016/j.scp.2023.101337.

Tang, Z., Li, W., Tam, V.W.Y., Xue, C., (2020). Advanced progress in recycling municipal and construction solid wastes for manufacturing sustainable construction materials. Resour. Conserv. Recycl. X 6, 100036. https://doi.org/10.1016/j.rcrx.2020.100036.

Tilmatine, A., Medles, K., Bendimerad, S.E., Boukholda, F., Dascalescu, L., (2009). Electrostatic separators of particles: application to plastic/metal, metal/metal and plastic/plastic mixtures. Waste Manag. 29, 228–232. https://doi.org/10.1016/j.wasman.2008.06.008.

Upadhyay, D.S., Khosla, A., Chaudhary, A., Patel, R.N., (2019). Effect of catalyst to lignite ratio on the performance of a pilot scale fixed bed gasifier. Energy 189, 116229. https://doi.org/10.1016/j.energy.2019.116229.

Vence, X., & López Pérez, S. D. J. (2021). Taxation for a circular economy: New instruments, reforms, and architectural changes in the fiscal system. *Sustainability*, *13*(8), 4581.

Wilson, D. C. (2023). Learning from the past to plan for the future: An historical review of the evolution of waste and resource management 1970–2020 and reflections on priorities 2020–2030–The perspective of an involved witness. Waste Management & Research, 41(12), 1754-1813. https://doi.org/10.1177/0734242X231178025.

Wu, J.S., (2018). Capital Cost Comparison of Waste-To-Energy (WTE), Facilities in China and the U.S. Columbia University

Xavier, L. H., Ottoni, M., & Abreu, L. P. P. (2023). A comprehensive review of urban mining and the value recovery from e-waste materials. *Resources, Conservation and Recycling*, *190*, 106840.

Xin-gang, Z., Gui-wu, J., Ang, L., Yun, L., (2016). Technology , cost , a performance of waste-to-energy incineration industry in China. Renew. Sustain. Energy Rev. 55, 115–130. https://doi.org/10.1016/j.rser.2015.10.137.

Yousefloo, A., & Babazadeh, R. (2020). Designing an integrated municipal solid waste management network: A case study. *Journal of cleaner production*, *244*, 118824. https://doi.org/10.1016/j.jclepro.2019.118824.

Zhironkin, S., & Cehlár, M. (2022). Green economy and sustainable development: The outlook. *Energies*, *15*(3), 1167. **https://doi.org/10.3390/en15031167**

Zhou, Z., & Zhang, L. (2022). Sustainable waste management and waste to energy: Valuation of energy potential of MSW in the Greater Bay Area of China. *Energy Policy*, *163*, 112857.