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Policy Measures, Practices and Challenges of Waste-to-Energy: Perspectives from Nigeria and Nepal

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ABSTRACT. There are environmental and health concerns associated with some waste-to-energy (WtE) technologies, such as incineration, which emit pollutants that can harm the environment and public health. Furthermore, there is limited research on the sustainability and feasibility of WtE. This study provides a comparative analysis of waste management practices in Nigeria and Nepal and highlights the challenges and potential for implementing WtE plants. A comprehensive literature review was conducted, and data were gathered from online sources for analysis. The findings of this study suggest that both countries face significant challenges in managing solid waste, including inadequate infrastructure, lack of awareness among policymakers, and limited resources for managing waste. However, there is potential for implementing WtE technologies as a sustainable solution for managing solid waste in these regions. The challenges associateed with WtE technology, including the high capital cost of establishing facilities and environmental and health concerns, must be addressed to fully realize the benefits of this technology.

Keywords: Nepal, Nigeria, solid waste, waste-to-energy, waste recovery

1. Introduction

Municipal solid waste (MSW) is a significant byproduct of human activities, and its management has become a growing concern globally due to the rapid increase in waste production. According to the World Bank (2018), the global average generation rate of MSW was 0.74 kg per capita per day in 2010. Furthermore, it is projected that the global production of MSW will increase by 1.5% annually, reaching 3.0 billion tons in 2030. Developing countries, which currently produce an average of 0.54 kg of waste per capita per day, are projected to increase their waste production by around 1.1% per year, reaching 0.63 kg of waste per capita per day in 2030. It is generally observed that higher gross domestic products (GDPs) are associated with higher waste generation (Agamathu et al., 2020).

Despite the increasing waste production, waste management practices are still inadequate in many countries, with developing countries facing major issues (Ferronato et al., 2023). According to the World Bank (2018), about 37% of MSW is disposed of in landfills globally, 8% in sanitary landfills, 4% in controlled landfills, and 25% are unspecified, while 33% of waste is still openly dumped. This inadequate waste management has led to severe environmental and public health problems, including soil, water and air pollution, greenhouse gas emissions, and the spread of diseases. Hence, it is crucial to implement sustainable waste management practices to mitigate these issues.

The current waste management practices and the rapid increase in waste production have raised concerns globally, and many countries are seeking sustainable solutions for waste management (Khanal, 2022). The ideal hierarchy of sustainable solid waste management (SSWM) is to avoid waste generation, followed by 3R (reuse, recycle, and recover), and landfilling is the least recommended alternative (Pariatamby et al., 2020; Subedi et al., 2023). However, current waste management practices still rely heavily on traditional landfilling, which is not a sustainable practice (Nanda and Berruti, 2021). The United Nations' sustainable development goals (SDGs) aim to ensure that everyone has access to affordable, reliable, sustainable, and modern energy (McCollum et al., 2017). Waste-to-energy (WtE) conversion technology aligns with this goal, and several studies have claimed it to be an environmentally friendly option (Kothari et al., 2010; Tozlu et al., 2016; Moustakas et al., 2023). WtE is a viable approach to manage waste and generate energy, which merits intensive scientific consideration (Vlachokostas et al., 1ably while generating energy. There are about 2,179 WtE facilities worldwide, with Japan, Taiwan, Singapore and China having the most facilities (Fetanat et al., 2019). Different WtE

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conversion technologies, such as incineration and anaerobic digestion, are available to generate electricity from waste. WtE generation also helps to reduce greenhouse gas emissions (Yi et al., 2018) and creates new employment opportunities (Rehan et al., 2017). Moreover, it offers a more efficient waste management system (Jeswani and Azapagi, 2016) and contributes to sustainable development (Khan, 2019).

Despite the benefits of WtE, there are also concerns and challenges associated with this technology. One of the main challenges is the high capital cost of establishing WtE facilities, which makes it unaffordable for many countries, especially developing ones (Al-Salem, 2019). Additionally, there are environmenttal and health concerns associated with some WtE technologies, such as incineration, which emits pollutants that can harm the environment and public health. Furthermore, there is limited research on the sustainability and feasibility of WtE.

Some of the research gaps include the lack of sustainability assessments for the supply chain for electricity generated from waste and the need to investigate every viable sustainable path in various industries. The study was based on four main objectives: (i) to identify the current solid waste management practices in Nigeria and Nepal, (ii) to analyze waste-to-energy systems in Nigeria and Nepal, (iii) to understand the current policy measures related to waste-to-energy, and (iv) to identify research gaps in waste-to-energy systems in the two countries. These objectives were chosen to provide a detailed understanding of the current state of waste management in Nigeria and Nepal and to identify areas for future research. This study also aimed to identify the gaps in the literature and provide insights into the direction of future research in this field. The novelty of this study lies in its comprehensive review of global WtE options, with a focus on practices and challenges of the WtE system in Nigeria and Nepal.

2. Methods

The study was designed to conduct a comprehensive review of existing literature on solid waste management and WtE systems in underdeveloped countries. To facilitate collaboration and knowledge sharing among the researchers involved in this study, the Global Research Institute and Training Center (GRIT) served as the primary collaborative platform. GRIT provided a framework for researchers from diverse backgrounds and locations to come together, ensuring a multidisciplinary approach to the review process.

2.1. Selection of Countries

Two underdeveloped countries, Nigeria from Africa and Nepal from Asia, were purposefully selected as the focus countries for this study. The choice of these countries was based on their shared economic status as underdeveloped nations, despite their distinct cultural and geographical contexts. Nigeria, located in Africa, is one of the most populous countries globally and faces significant waste management challenges due to rapid urbanization and population growth. Nepal, situated in South Asia, has its unique socio-economic and environmental factors influencing waste management practices. By including both countries, the study aimed to capture a diverse range of perspectives and experiences in addressing waste management issues.

As of 2021, Nigeria had a population of approximately 213.4 million people and a GDP of 440.78 billion US dollars. In terms of waste generation, Nigeria had a per capita waste generation rate of 0.79 kilograms per person per day. On the other hand, Nepal had a smaller population compared to Nigeria, with around 29.7 million people in 2021. When it comes to waste generation, Nepal had a lower per capita waste generation rate of 0.30 kilograms per person per day, suggesting relatively less waste production compared to Nigeria.

Table 1 provides key details about the countries involved in the study, including their populations, GDP, GDP growth rates, population growth rates, and per capita waste generation. Additionally, Figure 1 presents a map indicating the study sites of Nigeria and Nepal, highlighting their geographic locations and context. Furthermore, a comprehensive table was created to summarize the number of journal articles, books, reports, and other resources obtained for each specific topic within the study, demonstrating the depth and breadth of the literature review process.

2.2. Review Process

The literature review process involved an extensive search of relevant secondary sources. Various online platforms, including Google Scholar, Elsevier, Springer, ResearchGate, and Academia, were utilized to gather a wide range of scholarly articles, books, reports, and other reputable sources. Specific search phrases such as "solid waste Nigeria", "solid waste Nepal", "waste management", "waste-to-energy", and "benefits and challenges of waste-to-energy" were employed to refine the search and gather relevant literature (Table 2).

The inclusion and exclusion criteria were established to ensure the selection of high-quality and pertinent sources. Only peer-reviewed journal articles, books, reports, and other reputable publications were considered for inclusion in the review. Additionally, the criteria included relevance to the research topic, recent publication dates (mostly within the last 15 years), and availability of full-text articles in the English language.

The identified articles and publications were initially screened based on their titles and abstracts to assess their relevance to the research objectives. Subsequently, a thorough full-text review was conducted for the selected studies. During this process, relevant data, key findings, methodologies, and conclusions were extracted and synthesized to provide a comprehensive overview of the existing knowledge and research findings related to solid waste management and WtE systems in Nigeria and Nepal.

3. Results

3.1. Current Solid Waste Management Practices

Waste management requires sufficient attention from all parties in order to achieve a cleaner environment, a circular econ-

Table 1. Details of the Countries Involved in This Study (World Bank Data)

Countries	Population (2021)	GDP (2021, Billion US $)	GDP Growth (2021)	Population Growth (2021)	Per Capita Waste Generation (kg/person/day)
Nigeria	213,401,323	440.78	3.65%	2.44%	0.79
Nepal	29,674,920	36.29	4.20%	1.80%	0.30

omy, and effective waste management (Oyebode, 2022). Solid waste management is a significant challenge in Nigeria, with approximately 32 million tons of waste generated annually, 2.5 million of which are plastics (FME, 2021). Unfortunately, up to 70% of the waste generated is not properly disposed of, ending up in landfills, sewers, beaches, and water bodies (FME, 2021). The solid waste management strategies remain inefficient, and most states are using dumpsites as their preferred method of waste disposal, causing detrimental effects on the environment (Nwosu and Chukwueloka, 2020).

Several studies (Figure 2) have reported that per capita waste generation in various Nigerian cities ranges between 0.3 and 1.1 kg/person/day (Solomon, 2009; Atta et al., 2016; Ogunjuyigbe et al., 2017; Adekunle et al., 2020). However, the inefficient management of solid waste can be attributed to inadequate information on waste management benefits, poor implementation of government policies, and the absence of waste disposal facilities (Babayemi and Dauda, 2009; Nkwachukw, et al., 2010; Abila and Kantola, 2013). Inadequate solid waste disposal facilities are one of Nigeria's biggest environmental and public health problems today. Because it can be a source of revenue, the government should take waste management seriously (Oyebode, 2019). In Lagos State, the idea of turning waste into a useful commodity rather than an exhausted resource has not yet been fully applied as a means of successful solid waste management (Oyebode, 2013). For public health, prosperity, and effective energy systems, solid wastes must be managed effectively (Oyebode, 2018).

Waste is typically dumped in open pits, on roadsides, and into flowing gully water and open channels (Nkwachukwu et al., 2010; Laro and Raheem, 2021). Lagos generates the highest amount of solid waste in the country (Figure 2). The indiscriminate disposal of municipal waste is becoming more prevalent in urban areas. Common methods of MSW disposal in Nigeria include open dumping, incineration, unregulated landfills, composting, and dumping into drain channels, streams, and rivers (Nubi et al., 2022). Recycling depots are not regulated by government agencies, leading to the unplanned development of such facilities (Ogunseye et al., 2020).

Landfill, incineration, composting, and recycling are the most common techniques used for solid waste management SWM in Nigeria (Nubi et al., 2022). However, the major challenges facing recyclers are lack of funds, complaints by neighbors, and non-recognition by the government. Institutional failure and inadequate understanding by authorities have made proper waste disposal unachievable (Afon, 2007).

A comparative analysis of SWM effectiveness between the public and private sectors in Owerri and Umuahia (capitals of two Nigerian states) showed that SWM was better handled in Umuahia by the private sector (Uchegbu, 2002). As a result, Umuahia had a cleaner environment and a higher degree of acceptability by the populace than Owerri, which was managed by the public sector. This scenario is replicated in state capitals across Nigeria.

According to the World Bank (2020), Nepal generates approximately 4,900 tons of solid waste, with an average of 0.30 kg of waste generated per person (Table 3). The majority of waste generated in urban areas of Nepal is organic, accounting for 56% of total waste, followed by glass (16%), plastic (13%), and paper (8%). Unfortunately, Nepal lacks a system for source segregation of waste, which means that most of the waste ends up in landfills (Khanal, 2021; Khanal et al., 2023a). In 1984, the first landfill was built with aid from German Technical Cooperation (GTZ) in Gokarna (Dangi et al, 2009). Later, a land-

Figure 1. Study sites as Nigeria and Nepal [source: SurferToday (2023)].

Table 2. Search Terms Used to Review Different Types of Literatures

Topic	Number of Journal Articles	Number of Books	Number of Reports	Others
Solid Waste in Nigeria	20	2	4	1
Solid Waste in Nepal	12	1	3	1
Waste Management	15	1	2	0
Waste-to-energy	10	2	3	2
Waste-to-energy in Nigeria	8	1	2	1
Waste-to-energy in Nepal	10	1	1	1
Benefits and Challenges of Waste-to-energy	7	0	1	1
Total	82	8	16	7

fill site was established in Sisdole with assistance from the Japan International Cooperation Agency (JICA) in 2005. Kathmandu, the capital city of Nepal, generates the highest amount of solid waste in the country. In 2021, Kathmandu Metropolitan City (KMC) MSW was measured at 766 tons per day and it is expected to rise to 1259 tons by 2035 (Khanal, 2023a). There is a projected 64% increase in KMC's MSW generation over the next 15 years (Figure 3).

It is challenging to estimate the actual amount of solid waste generated and sent to recovery centers in Nepal due to the absence of a waste tracking system. Additionally, the informal sector plays a crucial role in reducing the amount of waste sent to landfills, but the exact number of informal waste workers and scrap centers is unknown and requires further study (Khanal, 2023b). There is a lack of source segregation practices in Nepal with maximum waste reaching the landfill site (Khanal, 2021). In addition to the lack of source segregation and the role of the informal sector, there are other challenges in solid waste management in Nepal. These include the lack of proper waste management infrastructure and facilities, as well as limited funding and technical capacity for waste management. Furthermore, the lack of awareness and education among the public about waste management practices contributes to the challenges in waste management in Nepal.

The government and private companies collect waste in urban areas of Nepal, with private waste management companies dominating the industry. Despite this, there is still much work to be done to improve waste management in Nepal, including implementing a waste tracking system and studying the role of the informal sector more closely (Khanal et al., 2023b).

3.2. Waste-to-Energy System

In Nigeria, the need for consistent and sufficient electricity has led to an increase in interest in producing renewable energy from wind, solar, hydro, and biomass resources, including MSW. The country generates an average of 0.49 to 0.56 kg of MSW per capita per day (Okafor et al., 2022), and according to estimates by Hoornweg and Bhada-Tata (2012), the nation will produce around 100,000 tonnes of MSW per day by 2025. MSW is a potential source of renewable energy and can help to reduce greenhouse gas emissions, provide incentives for investments in renewable energy sources, and promote environmental development in Nigeria.

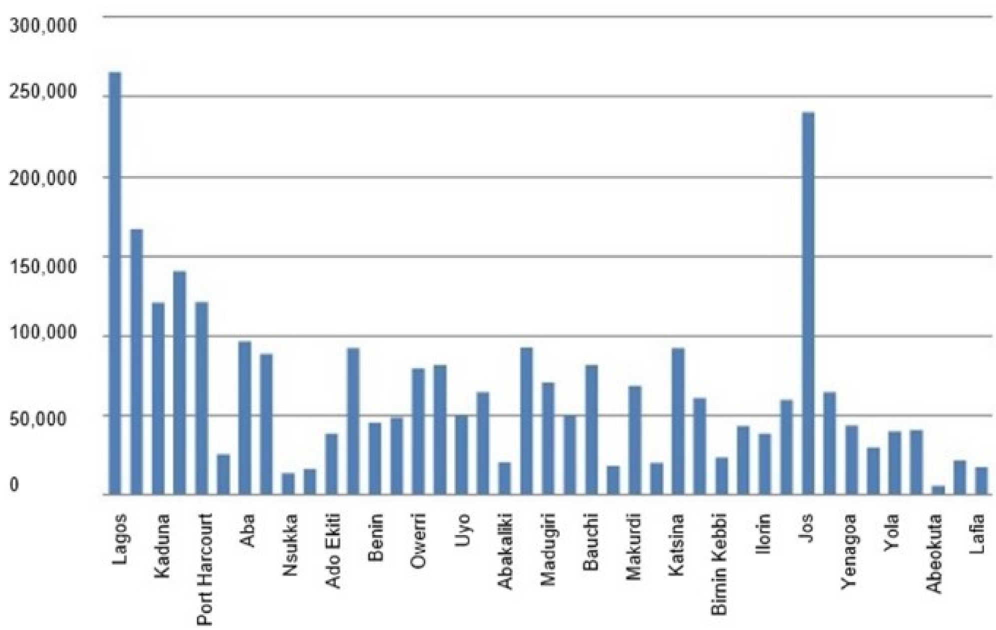

Figure 2. Solid waste generation in some Nigerian cities in tonnage per month (Onu, Price, Surendran, and Ebie, 2012).

Table 3. Solid Waste Generation and Recovery Data of the Studied Countries

Countries	Total Waste Generation (tons per year)	Waste Collection Efficiency	Recycling Rate
Nigeria	32 million	75% (in urban areas)	Less than 30%
Nepal	1.8 million	62%	4.10%

Note: Nigeria: Oyelola et al. (2017) and Ezeudu et al. (2021); Nepal: World Bank (2020) and CBS (2021).

A study conducted in Nigeria by Sulaiman et al. (2021) focused on Ogun State, one of the South-west states of Nigeria, and identified the energy potential of MSW in seven cities in the state. The study collected data on MSW generation and population and forecasts made for the next ten years using standard equations. An increase in municipal waste generated was observed from 2014 to 2030 in all the cities. Through incineration, the MSW has a potential of 4,848,839 MWh/year in 2030, with 336,751,474.9 MW electric power potential of MSW of which only 227,307,246 MW can be supplied to the metropolis' electric power grid. The study highlights the potential of MSW as a source of renewable energy in Nigeria.

WtE plants are running in major cities of Nepal including Pokhara, Syangja, Nawalparasi, and Dharan. Based on the composition and nature of waste generated in Nepal, it can be used to produce bio-CNG (bio-compressed natural gas) and than burned in incinerators to produce electricity. A study found the heat content of waste generated in Kathmandu as less than 4.8 MJ/kg which makes it unsuitable to generate energy using incineration in KMC (Lohani et al., 2021). The plasma arc technology is the best technology to generate waste-to-energy in Nepal compared to pyrolysis, gasification and incineration with the lowest payback period (Sodari and Nakarmi, 2018). Nepal has a long history of generating biogas at household and community levels from cow dung for the last 48 years. However, there are just less than 1% of large-scale commercial plants.

A study conducted in KMC used 409 tons of MSW with 60% organic waste and shared the possibility of generating about 130,294 m^3 of biogas per day (Lohani et al., 2021). Based on the same assumption at similar waste composition (for 4,900 tons of waste per day), Nepal has the possibility of generating around 362,935 m^3 of biogas per day which is equivalent to around 11,757 LPG cylinder per day (assuming 1 m^3 biogas equivalent to 0.46 kg LPG gas and 1 LPG cylinder equivalent to 14.2 kg). Based on the current consumption of around 150,000 LPG cylinders per day in Nepal, around 13% of the demand of the country can be fulfilled by the organic waste generated in the country. Based on the WtE potential of Nepal as 52 MW from 1435 tons per day (Sodari and Nakarmi, 2018), under the hypothetical condition of similar waste composition and moisture content, the total solid waste generated in Nepal is capable of producing around 178 MW of electricity per day.

Renewable energy sources are a vital component in meeting the energy needs of many countries worldwide, including Nigeria and Nepal. As under-developing countries, Nigeria and Nepal face several challenges in meeting their energy demands, including insufficient access to electricity, a lack of reliable energy infrastructure, and low levels of investment in the energy sector. These challenges have led to a shift towards renewable energy sources such as WtE systems to meet their energy needs.

3.3. Solid Waste Management Rules and Policies

The Nigerian government has adopted several policies to improve urban management, including the National Urban Development Policy formulated in 1992, which provided guidelines for urban development and the establishment of the Urban Development Bank to support these initiatives (Sridhar et al., 2017). Waste management in Nigeria is regulated by the National Environmental Standards Enforcement Agency (NESREA) Act, 2007, which is responsible for protecting and developing the environment in Nigeria and enforcing all environmental laws, regulations, standards, policies, and conventions. The NESREA Act allocates different policies for different waste types to ensure environmental safety and security. Despite these efforts, there are still several challenges in the enforcement and implementation of waste management laws and policies in Nigeria (Ibrahim and Imam, 2015; Ladan, 2015).

One potential solution to Nigeria's waste management challenges is the conversion of waste-to-energy technology. The average calorific value of waste in Nigeria is approximately 9.6 MJ/kg, and WtE facilities could potentially produce up to 3000 MW of electricity to complement the existing sources of energy in the country (Akhator et al., 2016). However, WtE technology is still in its infancy in Nigeria's power sector compared to other countries, where it has been successfully utilized to generate heat and electricity in commercial quantities for the benefit of their citizens.

In Nepal, the government has also adopted policies to improve solid waste management. The first national policy on solid waste was formulated in 1996, with an emphasis on waste minimization and the involvement of the private sector in the waste management sector. The policy also mentioned providing licenses to the private sector involved in solid waste management and gave them access to collection charges for the services they provided. The current Solid Waste Management Act of 2011 in Nepal emphasizes the source segregation of waste and encourages individuals to reduce, reuse, and recycle solid waste. Furthermore, the Constitution of Nepal includes the right of access to sanitation under fundamental rights, and the current Environment Protection Act emphasizes the polluters pay principle and the fundamental right of every citizen to live in a clean and healthy environment.

The Solid Waste Management Act, of 2011 defines solid waste collection as the collection of solid waste from such waste production sites, house-to-house collection, sweeping, depositing, weed uprooting, waste materials from public places, and collection of posters or pamphlets which are pasted without permission at a public place (Nepal Law Commission). Similarly, Section 6 of the Act, has made provision for segregating waste at least into organic and inorganic waste where waste generators need to store the waste differently (for the ease of

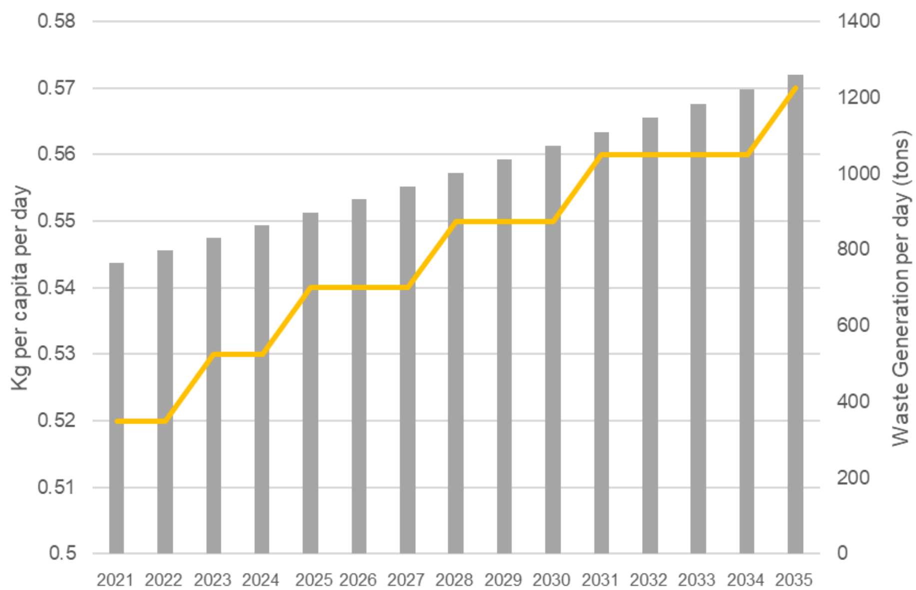

Figure 3. Daily solid waste prediction of KMC, Nepal (Khanal, 2023a).

recycling and reuse) at the source until it gets collected., the waste should be segregated at the source according to its nature. Article 4 of the act confirms the responsibility for the management of solid waste is of the local body (now local government). Furthermore, article 6 of this act explains the segregation of solid waste being the responsibility of the local body which shall prescribe separating the solid waste into at least organic and inorganic including different kinds at its source. Similarly, Article 7 of the act describes the discharge of solid waste mentioning harmful waste or chemical waste shall not be discharged at a solid waste collection centre or transfer centre.

This shows waste management policies and regulations have been adopted by the Nigerian and Nepalese governments to improve urban management and protect the environment. However, both countries still face challenges in the enforcement and implementation of these policies, including poor awareness among policymakers and inadequate monitoring and evaluation. WtE technology presents a potential solution to Nigeria's waste management challenges, while Nepal has emphasized the involvement of the private sector and source segregation of waste in its policies. It is essential for these countries to continue to prioritize waste management and invest in technology and infrastructure to ensure sustainable and environmental-friendly waste management practices.

4. Discussion

Both countries, Nigeria and Nepal, face similar challenges in waste management, including inadequate solid waste disposal facilities and the need for better technology and resources to divert recyclables from landfills (Table 4). As a result, informal sectors have emerged as significant players in waste recovery in both countries.

Nigeria has implemented various waste management practices such as composting, recycling, and incineration. The country has the potential to generate 26,000 MW of electricity from 26,500 metric tons of waste generated per day. In comparison, Nepal generates only 4,900 tons of waste per day, but it has the potential to generate 178 MW of electricity. However, Nepal still lacks proper recycling and incinerating plants on a larger scale.

For WtE technologies in Nigeria, the proposed approach includes incineration and anaerobic digestion. The implementation details and potential costs of these technologies would depend on factors such as the scale of the facilities, waste composition, and local infrastructure. In Nigeria, the potential costs can vary, but incineration plants can range from several million dollars to tens of millions of dollars, depending on the capacity and technology used. Anaerobic digestion facilities can also have varying costs depending on the scale and specific requirements of the project. For Nepal, the proposed WtE technology focuses on the production of bio-CNG (bio-compressed natural gas) and the utilization of biogas from organic waste. Bio-CNG can be produced through the processing of organic waste and used as a renewable energy source. Biogas, produced through anaerobic digestion of organic waste, can also be utilized for energy generation. The implementation details and costs of these technologies would depend on factors such as waste composition, infrastructure availability, and the scale of the projects. The costs can range from a few hundred thousand dollars to several million dollars, depending on the capacity and technology used.

In the case of anaerobic digestion, the main concern is the potential release of methane, a potent greenhouse gas, during the process. To address this, it is crucial to implement proper waste collection and handling practices to minimize methane emissions. Effective gas capture systems can be utilized to collect and utilize the biogas generated during anaerobic digestion, thereby reducing methane emissions and utilizing it as a renew-

Table 4. Comparison Matrix on Solid Waste Practices and Potentials of Nigeria and Nepal

Aspects	Nigeria	Nepal
Total waste generated per day	26,500 metric tons	4,900 metric tons
Potential electricity generation from waste	26,000 MW	178 MW
Waste collection efficiency	75% in urban areas	62%
Recycling rate	Less than 30%	4.10%
Existing waste management practices	Open dumping, incineration, unregulated landfills, composting, recycling	Landfills, open dumping, composting, recycling
Challenges	Inadequate information on waste management benefits, poor implementation of government policies, absence of waste disposal facilities	Lack of source segregation practice, limited waste management infrastructure, funding and technical capacity, lack of awareness and education among the public
Government regulations and policies	National Environmental Standards Enforcement Agency (NESREA) Act, waste management policies and regulations	Solid Waste Management Act, 2011 emphasizes source segregation, involvement of the private sector, and the fundamental right to live in a clean environment

able energy source. Proper monitoring and maintenance of the facilities are also essential to ensure safe operations and minimize any potential health risks.

The proposed approach of WtE technologies in Nigeria and Nepal offers several potential advantages compared to existing waste management practices. Firstly, it provides a sustainable solution for waste management by converting waste into energy, reducing the reliance on landfilling and minimizing the environmental impacts associated with improper waste disposal. WtE technologies can also help in reducing greenhouse gas emissions by capturing and utilizing methane and other gases produced during the waste decomposition process.

Furthermore, WtE technologies can contribute to the diversification of the energy mix, providing a renewable energy source that can help meet the growing energy demands of both countries. This can help reduce dependence on fossil fuels and promote a transition towards cleaner energy sources.

In both countries, waste management is a significant environmental and public health problem. One of the main concerns is the emission of pollutants during the incineration process, which can have negative impacts on air quality and human health. To mitigate these concerns, it is important to employ advanced emission control technologies, such as flue gas treatment systems, to minimize the release of pollutants. Additionally, proper waste management practices and careful selection of waste streams can help reduce the potential environmental and health risks associated with WtE technologies.

However, there are potential disadvantages and challenges to consider. The implementation of WtE technologies requires significant investment in infrastructure, technology, and operational costs. These costs can be a barrier, particularly for developing countries like Nigeria and Nepal. Additionally, the availability and consistent supply of waste feedstock need to be ensured for the sustainable operation of WtE facilities. Proper waste segregation and collection systems are necessary to ensure the quality and suitability of the waste for energy conversion processes.

Thus, the government is urged to take waste management seriously to address the issue. Waste management can also be a source of revenue for the government. Therefore, turning waste into a useful commodity must be fully applied as a means of successful solid waste management.

The use of renewable energy and its commercialization, adequate attention to electronic waste management, and the potential of waste-derived energy to meet the energy demands of various sectors of the economy are essential. To achieve this, there is a need for collaboration between the government, private sector, and individuals to improve waste management practices in Nigeria and Nepal.

5. Conclusions

The solid waste management practices in Nigeria and Nepal are not satisfactory. Despite the high potential of waste recovery, a high amount of recyclables reaches the landfill sites. The informal sectors are active in both countries and depend on recyclables for their livelihood. There is a lack of big projects for utilizing solid waste to generate energy in both countries. Both countries even lack the proper policy for managing solid waste in the country. Both countries face similar challenges in solid waste management, including inadequate awareness among policymakers, lack of effective monitoring and reporting, and insufficient waste disposal facilities. However, both countries also have significant potential for generating energy from waste, which can contribute to their energy security and environmental sustainability.

The challenges associated with WtE technology, such as the high capital cost of establishing WtE facilities and environmental and health concerns associated with some WtE technologies, must be addressed to fully realize the benefits of this technology. To improve waste management in these countries, it is recommended that policymakers prioritize waste reduction, reuse, and recycling, and invest in appropriate technology and infrastructure. There is also a need to increase awareness and education on waste management practices among policymakers, waste operators, and the general public. Governments should also collaborate with private sector organizations and civil society groups to create public-private partnerships that can accelerate the adoption of best practices in waste management.

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