

A COMPARATIVE ANALYSIS OF POLAND, UKRAINE, AND NIGERIA CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT LEGISLATION

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Abstract

Emerging economies like Poland experienced a sharp increase in the construction sector while war-ravaged Ukraine required the urgency to reconstruct their nation, and developing nations like Nigeria had a high demand for housing to meet their teeming populations. Considering the growth rate in construction activities in these nations, the volume of construction demolition and waste (CDW) will be on the rise. Hence, this study compares the various legislative frameworks regarding construction demolition and waste management (CDWM) in the three nations by focusing on policy enforcement, stakeholder involvement, infrastructure, and innovation. The results show Nigeria has a basic legislative framework with different implementation and infrastructural challenges. On the other hand, Poland has a comprehensive framework and advanced infrastructure with a great commitment to sustainable waste management, while Ukraine is in the developmental stage of enhancing its CDWM practices. The countries have unique opportunities to improve their CDWM practices through planning, stakeholder involvement, and support from international organizations focusing on best practices. Through this comparative analysis, the government of nations, and stakeholders (investors and professionals) can review and improve their CDWM policies through international collaboration and move toward a sustainable approach.

Keywords: construction and demolition waste, legislation, management, Nigeria, policy, Poland, regulation, stakeholder, Ukraine

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1. INTRODUCTION

CDWM has been a worldwide issue with increasing attention. CDW was defined as a mixture of surplus materials generated from the construction, renovation, and demolition activities, for example, site clearance, land excavation, roadwork, and demolition [1]. According to the [2] these also include waste generated from buildings, industrial, rail, and road construction works at various stages, from development to rehabilitation or renovation to demolition. [3] refers to CDW as abandoned substances generated in the building and infrastructure activities of construction, renovation, and demolition. The quantity and composition of CDW differ between regions depending on factors such as population increase, regulation, regional planning, and the country's construction industry (CI). In China, the CDW volume increased from 0.47 to 3.04 billion tonnes in 2006-2020 [4]. A 4.2% reduction was observed in the total waste generation per capita in the European Union (EU) -27 member states between 2010- 2020 [5]. 29 million tonnes of CDW were generated in Australia between 2021 and 2022, which is 38% of the entire nation's waste [6].

The rapid development in urban areas demands an advanced system of laws and enactments for CDWM [7]. All stakeholders, including the government, have a significant combined role in CDWM [8]. Regulations define the basic concepts, roles, responsibilities, and standards of performance of facilities and operations as well as highlight sanctions in situations of non-adherence and violation. The principles of good regulations are hinged on openness, balance, targeting, consistency, and responsibility [9]. The EU regulations on waste aim to ensure waste management in an environmentally friendly way with full potential to transition into the circular economy [10]. The European Commission (EC) developed the Waste Framework Directive (WFD) in 2008 and the EU CDW Protocol and Guidelines in 2018, proposing improvements in waste identification, source separation and collection, logistics, processing, and quality management [11].

Over the years, several researchers have studied the CDWM. [12] evaluated the measures for controlling waste in the Nigerian CI. They discovered that onsite sorting and a site waste management plan (SWMP) were not in place to control waste effectively. [13] examined the CDW by creating a model for waste quantification using material flow analysis. The sustainability assessment of CDWM using the multidimensional sustainability framework (environmental, social, and economic) was done by [14]. [15] identified a lack of monitoring and control, as well as a lack of awareness and preparation time for the SWMP, as top challenges affecting the effective implementation of SWMP in Poland. [16] assessed the practical value and applicability of various regulations in construction waste management from several points of view, e.g., re-use and end-of-waste regulations.

Furthermore, several nations have adopted specific legislative frameworks within the EU member states and other countries. Onsite sorting and recycling are typical in Spain while promoting onsite reuse of CDW has been adopted in Australia [17], [18]. Finland is committed to recycling aggregates while contaminated CDW are sent to the landfill [19]. CDWM policy measures were considered one of the factors affecting construction waste generation [7]. [20] studied the CDWM current practices in Saudi Arabia concerning major factors such as regulatory policy, economic and technical factors. [21], studied the amount of CDW generated in EU member states, as well as the amount of this waste that is being recycled and the different measures that these nations have applied to solve this situation. The waste regulations in Finland have significantly increased the level of recovery and adequate final disposal of waste [22].

Considering the high volume of construction-related activities in Nigeria and Poland and the current plan for the reconstruction of Ukraine after the hostilities, it is essential to examine the legislation pertaining to the management of CDW in Poland, Ukraine, and Nigeria, with a focus on comparing and analyzing the differences and similarities- the challenges and opportunities experienced in these

countries. Moreover, Poland is an advanced economy with strict EU and national CDW regulations, while Nigeria is a developing country with speedy urbanization and weak implementation and enforcement of CDW regulations. Ukraine is a transitioning nation on the verge of becoming a member of the EU and is positioning its waste management legislation with the EU requirement. The selection of these nations helps to close the gap between developed, evolving, and developing nations, providing valuable lessons for initiating effective and adaptative CDWM systems globally. This research would greatly benefit the governments of nations to revive and review their legislative and implementation strategies. Policymakers and stakeholders (investors and professionals) would be able to review the CDWM procedure in line with the legislative framework of the nations and collaborate with international organizations to achieve global best practices, thereby improving the effectiveness of the available legislation. The research scope is limited to the legislative frameworks in these three countries.

2. LITERATURE REVIEW

2.1. Overview of the construction demolition waste management

The construction industry's activities generate large volumes of waste with high impacts on the environment. These negative effects range from high energy consumption, pollution, resource dilapidation, soil erosion, and emission of greenhouse gas (GHG). Developing nations like Nigeria and Ukraine lack the proper management of the CDW, which has resulted in illegal dumping and increased landfill activities. According to [23], development and high urbanization have caused increased awareness of proper CDWM. [24], provides a framework perspective to the effective management of CDW through a combination of CDW generation, economic, environmental, and social performance with 30 indicators identified.

Following the CDWM practises, the use of reduction, reusing, and recycling, (3Rs) or reduction, reusing, recycling, and recovery (4Rs) principle of the waste hierarchy categorizes waste in order of desirability [25]. Methods of waste reduction are regarded as the most effective and efficient in that they minimize waste generated and reduce logistics costs such as transportation, sorting, disposal, and recycling [26]. According to [27], governmental regulations, design, effective CDWM systems, and technologies attitudes are the major waste reduction grouping. The lack of confidence and the potential health issues that could emanate from the recycling and re-use of CDW materials are the major hurdles in the EU [28].

2.2. Legislative Frameworks in Various Nations

In 2015, the Global Waste Management Outlook [29] described effective waste management as a continuous combination of direct regulation, economic instruments, e.g., incentives and disincentives, and social instruments. Therefore, government or state intervention and participation (active or passive) are important according to [30], [31]. The government's legislative and regulatory control and monitoring of CDWM is crucial towards achieving environmental sustainability [32], [33] emphasized the need for legislative support to quantify construction waste using a waste registry in Slovakia. Legislation and regulatory frameworks worldwide embrace the principle of waste minimization hierarchy of 4Rs [34], [35]. In line with the WFD 2008/98/EC [36], Member States have enacted legislation establishing incentives for CDWM. The regulatory and policy framework is one of the interconnected factors used in the CDW strategy in Malta with the aim of breaking the link between waste generation and development, transitioning into the circular economy and secondary market [37].

[38] concluded that the EU legal framework is robust and more mature in their comparative study of the CDWM in China and the EU. [39], [40], A review proceeding confirmed that the differences in the CDWM regulations and landfill charges at the various jurisdictional levels in Australia prevent effective and consistent management of waste in the country. Some of the legislation on the CDWM includes the extended producer responsibility (EPR), willingness to pay (WTP), polluters pay principle (PPP), and a waste charging scheme to impose fees on the direct polluters of the environment.

Few studies have examined the effectiveness of CDWM legislations and policies in different nations. [41] research establishes the need for legislative policies like pay-as-you-throw (PAYT), SWMP, and a ban on landfills, which could reduce waste disposal to landfill. [42] used the contingent valuation technique to interpret the WTP for CDW in Chile. They discovered that the stakeholders are unwilling to improve CDWM at the expense of increased cost. [43], highlighted how waste management policies influenced the movement of municipal waste by analysing a case of 14 EU member states. They discovered that the landfill tax and deposit refund scheme contributed to waste generation. [44], in their research, highlight strict legislative measures, tax incentives, and fiscal policies as some of the factors recommended by industry professionals for CDW minimisation from landfills in the UK. [45], In their analysis of CDW strategies in Nigeria, they suggested that the procurement procedure and policies focus on waste elimination and minimisation.

3. METHODOLOGY

Figure 1 outlines the different phases of this research. Phase 1 of this study deals with the overview of the CDWM and the legislative frameworks in various nations. Document review is presented as a systematic way of assessing documents with examples and guidelines [46]. In phase 2, the legislative and policy documents of the three nations under consideration were analysed, and the key features of each policy were identified. The policies considered have not been repealed and are related to CDW. Phase 3 contains the comparative analysis of the countries by analyzing their policy enforcement, CDW infrastructure, public and stakeholder involvement, innovation and best practices. In phase 4, the challenges and opportunities of the CDWM legislation in these countries will be identified. Recommendations for the formulation of better policies and improvement of the existing legislation will be provided. Conclusion and direction for future research will be carried out in phase 5.

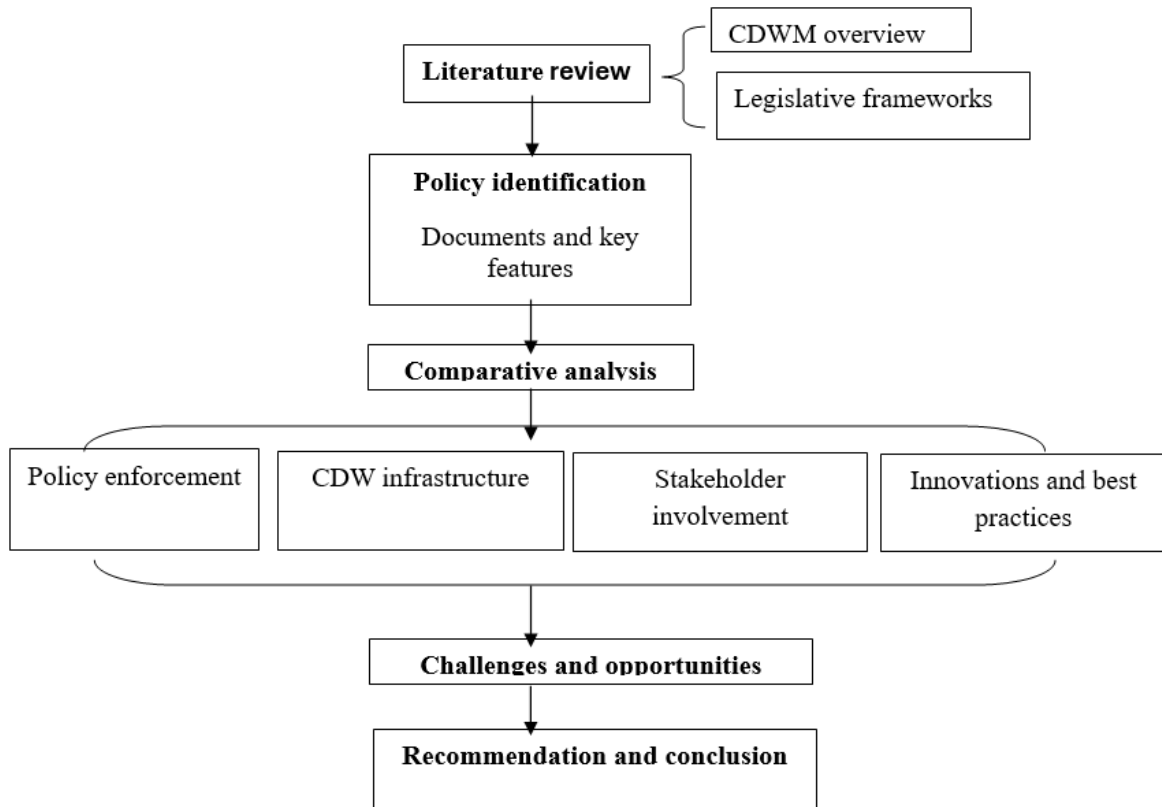


Fig. 1. The framework of the research

4. RESULTS

4.1. Policy Identification

4.1.1 CDWM regulations and policies in Nigeria

The most populous nation in Africa and 6th in the world, Nigeria has a teeming estimated population of over 220 million with a landmass of 923,770Km² [47]. The western African nation has 36 states and federal capital located in Abuja. With the rapid urbanization of its major cities and population growth, the need for constructed facilities has been on the rise. One of the resulting effects of increased activities in the CI is the problem of waste management. The Federal Ministry of Environment is responsible for the management of waste in the country. In 1988, the Federal Environmental Protection Agency (FEPA Act) was enacted, later repealed, and substituted with The National Environmental Standards and Regulations Enforcement Agency Act (NESREA) 2007. However, the state and local governments manage waste at different levels. Table 1 shows the country's various federal legislations and policies regarding CDWM, including regulations emanating from its populous state, Lagos.

Table 1. CDWM legislation in Nigeria

Year	Name of regulations	Key points of policies/ regulations	Sources
2020	National Policy on Solid Waste Management	<ul style="list-style-type: none"> • Reduction and complete elimination of solid waste heaps in the country • Development of waste management infrastructures • Wealth creation and employment • Promotion of the 4R initiatives • Facilitate private sector involvement in solid waste management 	The Federal Republic of Nigeria 2020 [48]
2017	Lagos State Environmental Management and Protection Law	<ul style="list-style-type: none"> • Advise the state government on issues regarding environmental management policies • Public enlightenment and awareness on methods of environmental management • Monitoring control and enforcement of disposal of waste generated • Collaboration and cooperation in environmental science and technology with local and international bodies. 	[49]
2011	National Environmental (Construction Sector) Regulations	<ul style="list-style-type: none"> • Prevention and minimization of pollution from deconstruction, CDW activities of the Nigerian environment. • Minimization of pollution from new construction works • Compliance with the generation, transportation and disposal of waste 	[50]
2007	The National Environmental Standards and Regulations Enforcement Agency Act [NESREA] 2007	<ul style="list-style-type: none"> • Charged with the protection and development of the environment. • Biodiversity conservation of the nation's natural resources • Initiation of policies with respect to research and technology • Collaborate with the federal and state governments on enforcement and implementation of policy 	Cap 131 Laws of the Federation of Nigeria, 1990 [formerly Decree No. 58, 1988] Cap. F10 LFN 2004. [51]

4.1.2 CDWM regulations and policies in Poland

The eastern European nation of Poland had an estimated population of 37.61 million in 2023 with a landmass of 306,230Km² according to [47]. In Poland, the adoption of the EU WFD Acts was in 2012; there is no specific legislation for the CDW, but the National Waste Management Plan (NWMP) was developed in 2014 and later updated in 2022 by the provision of the Acts of 14th December 2012. The NWMP is subject to a 6-yearly revision according to the Act. The NWMP, 2022, categorize CDW under group 4a, 'Other waste'. Table 2 summarises the waste management policy and programme available in Poland. The focus is on the change in waste management, waste management evaluation, waste generation prevention, and development of waste management systems. The outcome of the NWMP will be to create rational waste management and reduce the negative impact of waste on the environment.

Table 2. CDWM legislation in Poland

Year	Name of regulations	Key points of policies/ regulations	Sources
2022	National Waste Management Plan	<ul style="list-style-type: none"> Recent state of the waste management practices. Identification of the problems of waste management with respect to the waste streams Changes in the waste generation and management of the sector with the year 2030 in perspective Determination of waste management goals including management systems, infrastructure, and technologies Identification of contractors and financing options Monitoring and evaluation standard for the implementation of the objectives. 	Act of 14 December 2012 on waste (Journal of Laws of 2013, item 21, as amended) [2]
2014	National Waste Prevention Programme	<ul style="list-style-type: none"> Reduction of waste and hazardous substances effects Reduced environmental impact at the extraction of raw materials and logistics with a focus on harmful materials Reduced burden on gross domestic product (GDP) attributable to waste Preservation of economic growth while maintaining reduced waste generated 	Environmental Protection Agency [52]
2010	Programme for Asbestos Abatement in Poland for 2009-2032	<ul style="list-style-type: none"> Removal and disposal of asbestos product Reduction of the negative effects of asbestos Elimination of the dangerous impact of asbestos on the environment 	Resolution of the Council of Ministers No. 39/2010 of 15 March 2010 (M.P. No. 33, item 481) [53]
2013	Packaging and Packaging Waste Management	<ul style="list-style-type: none"> Introduction of packaging Activities in the recovery of packaging waste Exportation of packaging waste and products Organisation responsible for packaging recovery Intra-community delivery of waste packaging and product Introduction of products in packaging 	[54]

4.1.3 CDWM regulations and policies in Ukraine

Ukraine has a landmass of 579,320Km² and an estimated population of 36.74 million in 2023 [47]. The eastern European nation is currently experiencing war. This has affected several economic activities with the destruction of infrastructure. The regulation on waste in Ukraine consists of laws on environmental protection, radioactive waste management, processing, recovery and destruction of harmful products and the subsoil code of Ukraine as stated in Article 2 Law of Ukraine, No 1825-VI, January 2010 as amended.

Currently, Ukraine's bid to join the EU has led to the development of a reform on waste management. The sole aim of the law would be to improve the management of waste in the country significantly. Issues relating to licensing, collection, and processing of hazardous waste are highlighted. According to [55], this new regulation is only the starting point in the waste management system in the country; integration of other sectoral and bylaws is essential for the completion of the waste reform. Tale 3 illustrates the key features of the available waste management laws in Ukraine.

Table 3: CDWM legislation in Ukraine

Year	Name of regulations	Key points of policies/ regulations	Sources
2022	Waste management law	<ul style="list-style-type: none"> • Adoption of EU management hierarchy • Introduction of waste management information technology for the ease of reporting and accounting • Special regulations on the disposal of waste resulting from the war. • Collaborations with investors in the creation of recycling plants that will meet the EU standard. • Closing of old landfills and upgrading the existing ones to EU standards. 	Law of Ukraine on Waste Management, Law No 2849-IX, December 2022 [56]

4.2. Comparative Analysis

4.2.1 Policy Implementations and Enforcement

In a review of recent situations and challenges of CDWM by [57], general and specific CDW legislation and enforcement were observed to have a decreasing impact on CDW generation. The implementation of CDWM varies in different nations, though they can be similar in their approach. In Poland, the NWMP, 2022 contains indicators for monitoring and evaluation of the implementation of waste management at the regional level. A percentage will be allotted to 3Rs based on the level of achievement. The overall objective of the implementation of the NWMP will be to provide an effective waste management system and reduce the negative effect of waste on the environment. The NWMP,2022, identified unfair and illegal practices such as abandoning the waste generated, providing waste to unauthorised entities, and bad disposal techniques by the stakeholders of CDW.

In implementing legislative policy in Nigeria, the Federal Ministry of Environment in collaboration with stakeholders e.g. organisations, researchers, and professionals is responsible for developing a workable solid waste management plan for the nation. This plan shall include technological systems and public-private sector participation for effective and sustainable waste management practices

to achieve '*Reduce, Reuse, Recycle, Recover, and Replace*' (5Rs) [48]. Part iv of the National Environmental (construction sector) Regulations 2011 highlights the enforcement procedure which includes notices, reminders, mode of delivery and suspension notices for organizations that contravene the NESREA Act.

Compliance assessment, also known as compliance auditing or compliance review, is a systematic evaluation process conducted to assess an organization's adherence to applicable laws, regulations, policies, procedures, and industry standards. Compliance assessment aims to determine the extent to which the organization complies with legal and regulatory requirements, internal policies, and ethical standards. Environmental protection standards, legislation enforcement, and compliance with international standards are some of the procedures for compliance management stated in the National Solid Waste Management Policy. Chapter ix, Article 57-59 of the [56] on waste management describes the violations of regulations, compensation for non-compliance and dispute resolution in the Ukrainian waste management sector. Individuals or organizations in contravention of the stipulated regulations face disciplinary action which could be civil or criminal.

4.2.2 CDW infrastructure

Following the EU waste hierarchy and Section 5.4.1 of the [2], the development of CDW infrastructure which will enhance the selective handling, treatment and reuse of waste in Poland should be carried out. The thermal treatment of waste is considered the best method for safe and environmentally friendly disposal of non-recyclable waste. Hence, the Polish government has greatly invested in infrastructure to manage waste effectively. The city of Krakow has the largest municipal waste thermal treatment plant (MWTTP) in Poland. The facility was completed with a total sum of 18 million euros and has completely thermally changed over 1.5 million tonnes of waste, and a minimum of 6.4GJ of heat has been delivered to the city [58]. The constituted activities have led to integration with the public, as seen in the case of Krakow, where several social and developmental projects have been birthed. With a total capacity of 974,000 Mg/year, Figure 2a shows an example of Poland's city-wide waste management infrastructures using MWTTP and cement kilns.

Unlike Poland, Nigeria and Ukraine have a waste infrastructure gap. Despite the obstacles and major gaps in collection, recycling, and waste disposal facilities, Nigerian cities are using creative waste management methods to solve the problem and create a greener future. The Lagos Waste Management Authority (LAWMA) uses integrated waste management approach to reduce, recycle, and recover resources. However, using the right technology and facilities, Nigeria has the potential to convert 27 million tonnes of waste to generate 14.52 to 23.08TWh of electricity per year [59]. Figure 2b shows no working MWTTP or incineration plant in the country to harness this opportunity. Articles 38 and 39 of the Law of Ukraine highlight the process of waste treatment using an incineration plant. The location and technical specifications of the plants shall be determined by the Cabinet of Ministers. Figure 2c shows the location of the only functional incineration plant in Kyiv, which is over 35 years old according to a survey by United Nations Industrial Development Organization [60]. In an editorial by the Ukraine Business News, Ukraine's Ministry of Environmental Protection and Natural Resources estimated that 4 billion euros would be required to facilitate the construction and operation of 200 waste processing projects in the country [61].

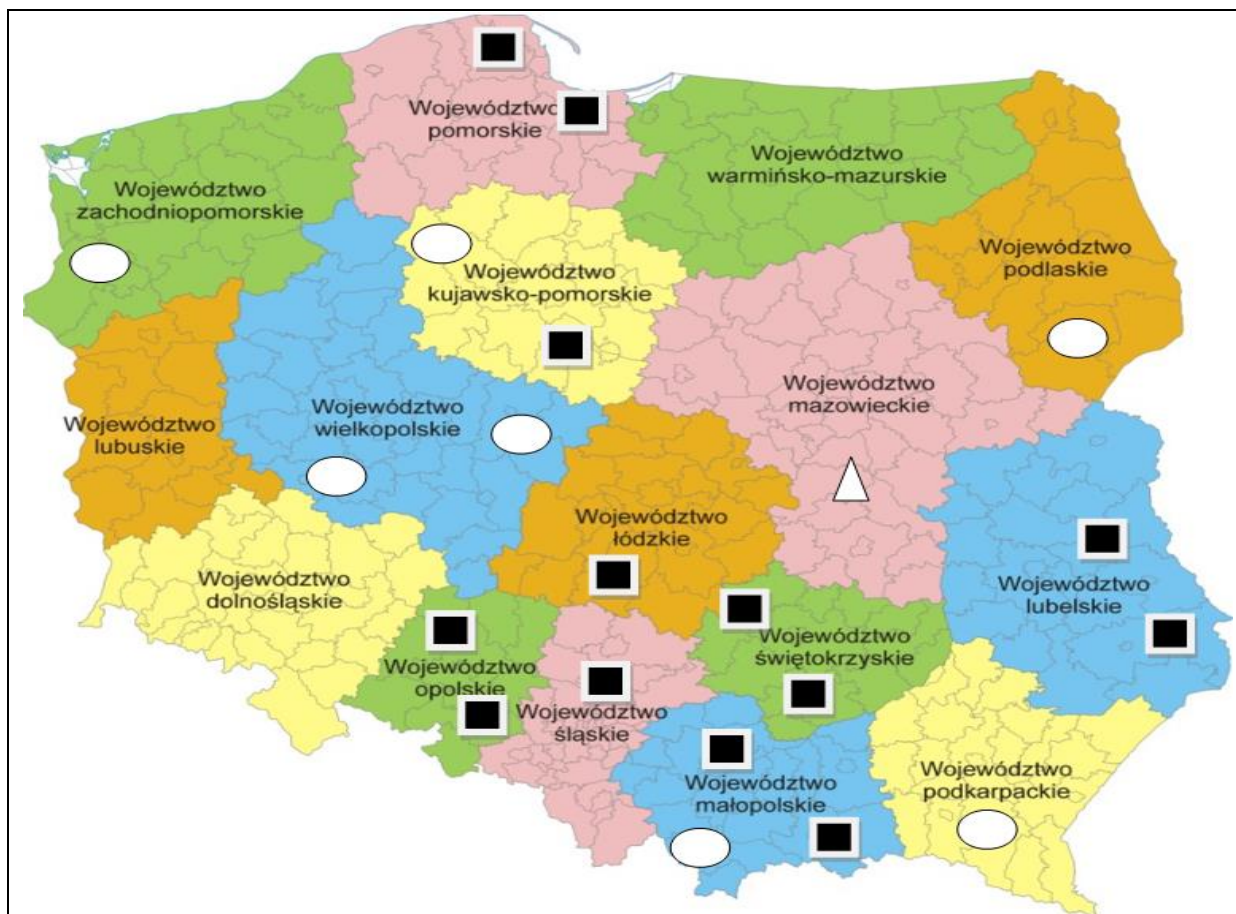


Fig 2a. City-wide waste management infrastructure using MWTP and cement kilns in Poland [2], [62]

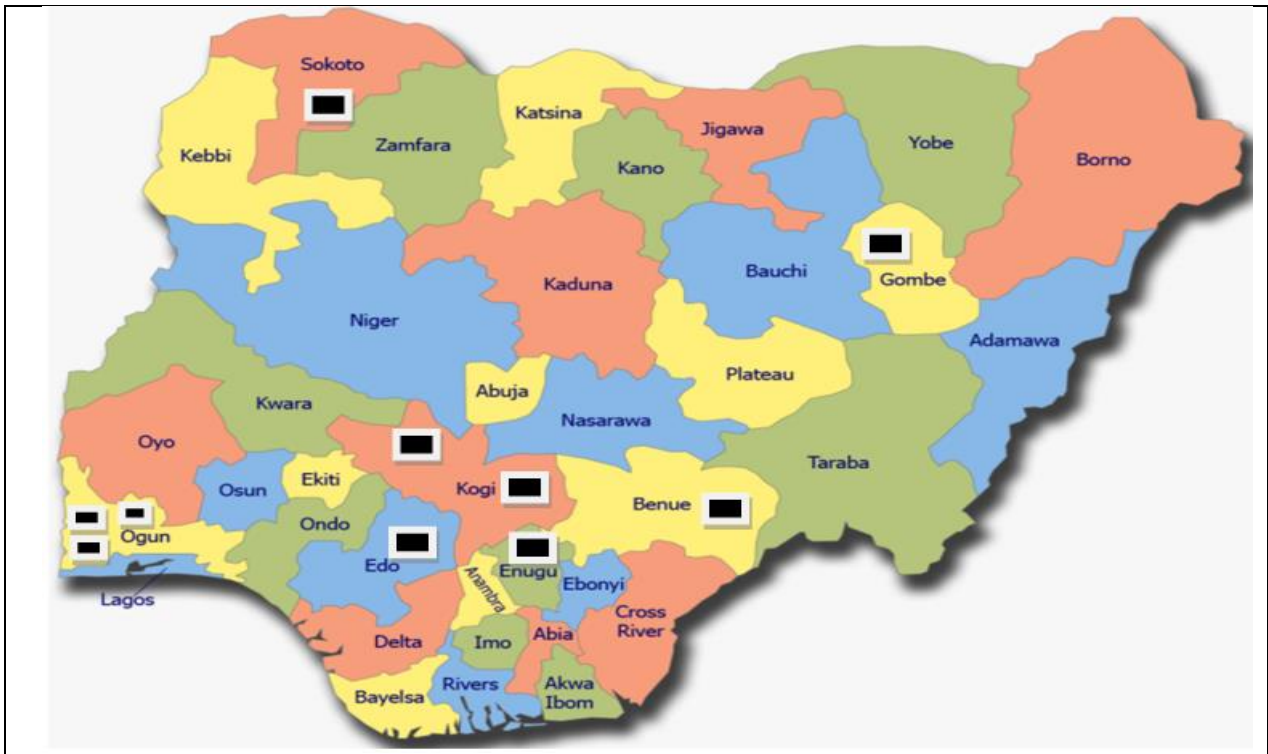


Fig 2b. City-wide waste management infrastructure using MWTTP and cement kilns in Nigeria [62]

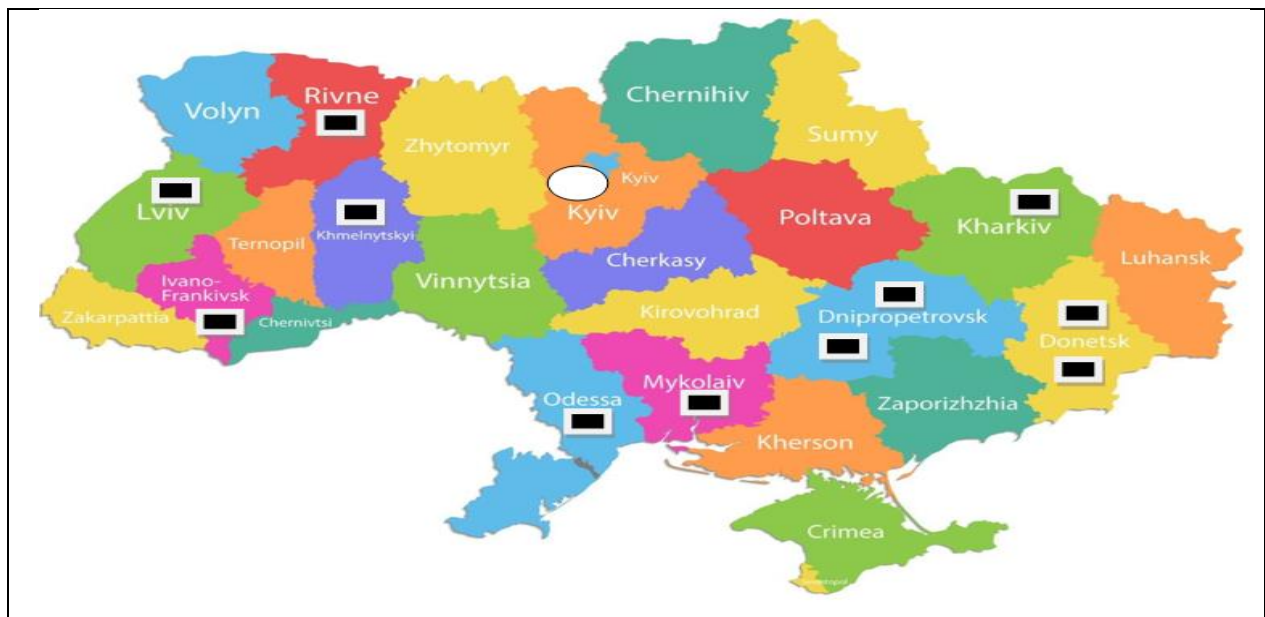





Fig 2c. City-wide waste management infrastructure using MWTTP and cement kilns in Ukraine [60],[62]

Keys

	New facility		Existing facility		Cement kilns
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4.2.3 Public and Stakeholder Involvement

In Poland, the result of the sharing formula of public-private partnership for the implementation of major investment projects in the waste sector has been a fundamental development in the waste sector as stated in the [2]. Moreover, it is crucial to cultivate alliances and cooperation between stakeholders, e.g. government agencies, corporate entities, civil society organisations, and local communities in order to gather resources, exchange exemplary methods, and stimulate joint efforts towards shared objectives. In Lagos state, Nigeria, the operation of the private-sector partnership (PSP) has been effective for household waste in the 20 local council areas of the state, while the CDW has not witnessed such effectiveness. As stipulated in Section 20 of the [49], the practice and business of waste requires extensive registration with the appropriate government offices. This is similar to the rights and duties of the entities involved in waste management practices in Ukraine as stated in Section II, Article 14-17 of the Law of Ukraine on waste management.

The EPR procedure stipulated in Article 10 of the law of Ukraine on waste management highlights the role of manufacturers in collecting, generating, and implementing waste information and publishing waste information to achieve the target for waste hierarchy. This is like the Solid Waste Management Policy adopted in Nigeria and the NWMP in Poland. In Part II Section 18 of the [50], the adoption of the polluters-pay-principle was described in an effort to combat the effect of waste on the environment and socio-economic. *'The constructed site or facilities that caused the damage shall file the report, and the consequence or penalty will be analyzed by the right government office'*. This is in line with Article 3.2 of the Law of Ukraine on waste management and Chapter 9 of the [2].

4.2.4 Innovation and Best Practices

In Nigeria, the Federal Ministry of Environment will approve novel and imported technology for the management of solid waste, while local, state, and national governments will establish various measures to decrease waste generation and implement the principles of the 5Rs. In line with Section 6.1.2 of the [48], technologies will be implemented and, if necessary, modified to support various aspects of the solid waste management system in accordance with the needs of the nation, states, and local communities. The provision for research and a database for waste collection and disposal, though, is established but not effective. Innovative practices in the Nigeria waste sector have been marred by inadequate funding, infrastructural deficit and lack of technical capability which has led to the overreliance on the informal practices of recycling.

The Polish government at all levels has adopted the best practices and various innovations driven by the EU directives and financing. Chapter 7 of the [2], highlights the different financing options available to the waste sector in Poland. The provision of grants at the national and international level e.g. National Fund for Environmental Protection and Water Management (NFEPWM), EU, and aid from public resources, loans and credit, has been a major developmental factor in the waste management sector in Poland. One of the oversight functions of the National Centre for Research and Development involves organising and helping to execute scientific and research activities related to waste management. This includes overseeing research projects and demonstrations focused on waste prevention, collection, reuse, recycling and disposal technology and the dissemination of research findings. The adoption of innovation and best practices in the Ukrainian waste sector is still in its infancy. The recent support from the international community has further advanced their course in this sector.

4.3. Challenges and opportunities

Waste prevention is ranked first in the EU WFD hierarchy, though, waste regulation is not necessarily a criterion for waste prevention. Policies can be moved from the management of waste to the overall lifecycle of the materials [22]. The implementation of the 2012 Act on Waste and the [2] were carried out at the national and regional level in Poland, these regulations incorporate the EU WFD and other relevant EU Directives. Nevertheless, they do not explicitly target CDW. The Act primarily addresses waste management, encompassing a wide range of waste streams and industrial emissions. The challenges encompass guaranteeing uninterrupted adherence to regulations and incorporating ideas of the circular economy. The key to success is to utilise EU cash and technology effectively. In Nigeria, inadequate and poor CDW infrastructure, low awareness, and insufficient legislation are some of the challenges faced by the waste management sector. According to [63], operating a CDW involves high investment risk, and this is considered the main problem of CDW. Furthermore, the lack of supervision and ineffective enforcement of regulatory policies contributes to the poor CDWM in Nigeria. Organizations manage their CDW as they deem fit without following the regulatory guidelines. The various systems of data collection and reporting techniques on waste have made the statistics unreliable in quality and comparison, thereby affecting policy makers to take informed decisions on waste.

According to the report of [64], waste management opportunities are an advancement towards the circular economy. Such advancement involves criteria like preventing waste in landfills and promoting reuse and recycling. This modification is intended to enhance the process of recycling and diminish the total volume of garbage produced. CDWM regulations tailored towards circular economy could result in environmental and socio-economic benefits. In a report published by the [65], the waste management market is predicted to reach 1598.1 billion US dollars by 2029 worldwide at a compound annual growth rate (CAGR) of 5.6% during the 5-year period considered. The advancement in waste management technologies, and collaboration among manufacturers, institutions and other stakeholders in the waste sector could lead to the acceleration of this market growth prediction.

5. DISCUSSION

Policy implementation and enforcement are effective in Poland owing to the EU WFD that was adopted. The NWMP 2022 specifies the procedure and evaluation criteria for enforcement and compliance in Poland. This is similar to China, where the supervision of policies has a great effect on CDWM practices and the promotion of stakeholders' behaviour [66], [8], [7]. [67] concluded that the lack of external supervision of the construction firms at various stages of the construction activities results in the risk of violation of laws, hampering the effective practices of CDWM and illegal dumping while in Spain and Kuwait, a lack of legislation and insufficient legislation on illegal landfills and the use of recycled aggregates are some of the challenges experienced in the CDWM in the country [17], [68], [69]. Policy and regulatory frameworks have no meaning without society's regard and respect for such regulations [70]. This is a typical example of Nigeria's situation, where a legislative framework exists but is not effective due to implementation and infrastructural constraints. The public has a role in reporting environmental violations within their communities. USEPA uses online and phone call reporting formats [71].

In a proceeding, [72], identify the use of an online tracking system to integrate, mobilize and analyze the CDW from the construction sites in Taiwan, thereby improving the CDWM practices. [7], [73] also identify mutual collaboration among stakeholders, continuous application of emerging

technologies and inspection. [74] recommended policy integration and enforcement in their diagnostic study on the CDW generation in the EU. In a study, [75], identified the implementation of waste-sorting legislation as one of the most effective CDWM strategies to be adopted by the industry stakeholders. According to [76], in most developing countries where supervision of waste disposal behaviour is low, the effective coordination of the waste generation and disposal system through disposal fees could result in illegal dumping. [77], identified an immature legislative environment and multiple governmental departments as some of the challenges to the CDWM in China. Compliance is an indispensable aspect of construction project management. By complying with legal regulations, safety protocols, quality standards, and environmental guidelines, construction projects can run smoothly and sustainably. Proactive compliance management not only ensures legal and ethical operations but also offers benefits like improved efficiency, enhanced reputation, better risk management, and increased client confidence.

Stakeholders' involvement in CDWM has a tremendous impact on effective waste management. Tracking and reporting of inappropriate waste management practices should be encouraged. Poland, Nigeria and Ukraine have a similar regulation with respect to the participation of stakeholders (organizations and consultants) in the waste sector. An adequate registration procedure is outlined in the appropriate government offices. Furthermore, the three nations under study have implemented the EPR and polluters-pay principle, although they are at different stages of effectiveness in terms of implementation and enforcement. While Poland has stringent regulations and effective implementation and enforcement practices, Ukraine's EPR guidelines as stated in the Law of Ukraine on waste management are still in their infancy. Nigeria's enforcement practices have been hampered by several factors, including inadequate records and corrupt practices. [22], assessed how organisations respond to waste policy instruments such as regulations, charges, taxes, etc, in Finland. In their research, they observed that waste regulations were not a contributing factor to waste prevention. [78], analyzed the effectiveness of the Construction Waste Disposal Charging Scheme in Hong Kong. This scheme was designed to encourage the achievement of the 3Rs. The results showed that after 1 year of its implementation, the waste dumped in landfills was reduced by 65%.

CDW infrastructural deficit has been a menace in Nigeria resulting in improper waste management practices such as illegal dumping and unhealthy operation by the informal sector e.g. local cart operators. The Ukrainian government in collaboration with international organizations are making efforts for the construction and development of waste management facilities, which will enhance high waste management practices as stated in the waste hierarchy.

Innovation and adoption of best practices in CDWM cannot be over-emphasized. The Polish government in collaboration with other stakeholders have taken charge of the technology selection procedure at the level of governance, not at the level of practical management. Similarly, Ukrainian law on waste management adopted this approach, with cabinet members making crucial inputs to the selection of location and technical specifications for the waste infrastructure to be developed in the country. Adoption of best practices requires adequate funding as described by [79], who used Bayesian network analysis to classify the behavioural factors affecting the CDWM. The study identifies training, supervision, and financial bonuses as the corporate factors to be considered. In line with the results from the analysis of [80], governmental support through financing would help the demolition contractors in the effective recycling, reuse and adoption of less wasteful demolition techniques.

6. CONCLUSION AND RECOMMENDATION

Poland, Ukraine, and Nigeria have different levels of progress and execution in legislation related to CDWM. Poland is notable for its strong regulatory system and advanced infrastructure, which is significantly impacted by EU norms. Though Poland does not have explicit legislation for CDW, its waste management plans, and recent modifications indicate a commitment to sustainable waste management. Ukraine is currently improving and strengthening its procedures for managing chemical and hazardous waste with substantial assistance from the international community. Nigeria possesses a fundamental legislative framework but encounters significant obstacles in the execution and advancement of infrastructure. These three nations possess distinct possibilities to enhance the management practices of CDW by employing strategic planning, involving stakeholders, and utilizing international support and best practices. The opportunities in the waste management sector is a call for a reviewed regulation that will enhance the circularity of the waste stream economy thereby leading to sustainable environmental and socio-economic growth.

Investing public funds in waste management rather than other competing sectors like health, education etc. requires a wider study of the societal cost and benefits analysis of the investment. Therefore, further study can be on the cost-benefits evaluation on CDWM considering the monetary value of positive or negative impact on environment, economic, social and health. Furthermore, research on the efficiency of fiscal and financial incentive measures in the implementation of sustainable CDWM regulations can be studied. The NWMP in Poland has the sources of financing for the management of waste stipulated, but Nigeria and Ukraine need to have such indicated in their waste management law. Hence, there is a need to study the impact of public-private partnerships as an effective measure in the CDWM.

Declaration of Competing Interest

None

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