APPRAISAL OF CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PRACTICES IN LAGOS METROPOLIS, NIGERIA

SAMUEL OSAYAMEN TONGO
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
tongo.samuel@oouagoiwoye.edu.ng
UMAR OBAFEMI SALISU
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
umar.salisu@oouagoiwoye.edu.ng

Abstract

Construction and demolition waste CDW is debris from construction or destruction of a construction that are no longer useful, which has to be carefully disposed to avoid or minimize environmental hazards and prevent infliction of injuries to the people in and around the environment where such exercise takes place. The massive numbers of activities within the construction industry over the last few years continue to increase the generation of construction and demolition wastes at both macro and micro scale with unorganized management practices among contractors. Hence, the need to examine the practices of CDW management in Lagos Metropolis, Nigeria. A survey research design was adopted for this study. A snowball sampling technique was used to administer 200 copies of a questionnaire to contractors within the Lagos Metropolitan Area. Major findings revealed that most of the respondents are male (94%) and have over 15 years of professional working experience (76%). The top-ranked CDW in the study area are concrete with steel, glass, and broken tiles. Furthermore, the study revealed that the high cost of waste evacuation, inadequate adaptive disposal vehicles, poor waste logistics, quantity of waste, and poor information are the top-ranked challenges of CDW management practices in Lagos Metropolis. Findings also revealed that increasing competitiveness in the construction industry, increasing profit maximization, reducing environmental degradation, reducing the cost of waste disposal, and increasing employment opportunities are among the top-ranked prospects of CDW management practice. The result of the ANOVA revealed a significant variation among the challenges of CDW management practices in Lagos Metropolis ($F= 956.137$, $p= 0.000 < 0.05$). The study concluded and recommended the full adoption of the carrot-and-stick approach to achieving effective CDW management practices in the Lagos Metropolis and other cities in Nigeria.

Keywords: Construction, construction and demolition waste CDW, contractors, Lagos Metropolis, solid waste management practice

JEL classification: C12, H83, I31, L74, L80, L85

1. INTRODUCTION

Solid waste has been and will remain one of the major urban pollutants contributing hazardously to the public's health. The improper collection and disposal of discarded materials generated from municipal activities, including households, health care facilities, markets, industrial constructions and demolitions, and among others, amounting to an average weight of 2.01 billion tons per year, have created unsanitary urban situations and occasioned multiple adverse health, environmental, and socioeconomic impacts, especially among the vulnerable groups across the globe (World Health Organization WHO, 2022). According to the Britannica (2022), the emergence and development of a technological approach to solid waste management (SWM) practices in the 19th century, with the creation of watertight garbage cans, garbage grinders, incinerators, and sturdier vehicles to collect and transport solid wastes in the United States, drastically reduced the effect of hazardous solid waste and minimized the risks to public health and the environment.

In other words, non-hazardous solid wastes, which are mostly found in construction and demolition activities, have remained the dominant constituent of open dumping and improper incineration, endangering public health and causing pollution and poor environmental conditions in urbanized areas, particularly in developing countries, including Nigeria. Also, construction and demolition waste (CDW) refers to solid waste generated in the building and construction industries. For instance, Cook, Velis, and Blade (2002) observed that construction and demolition waste (CDW) has been the most significant contributor of solid waste, accounting for more than 36percent of total solid waste generated globally in 2022. CDW is generally referred to as the waste generated within the construction industry in relation to the various activities and works such as civil construction works, demolitions, evacuations, site clearing, and infrastructure upgrades, etc. (Oyenuga, Bhamidiarri & Naoum, 2014; Tam, 2011).

Also, Ajayi, Oyedele, Akinade, Bilal, Owolabi, Alaka and Kadiri (2016), and Taghipour et al. (2018) are of the view that construction and demolition waste as waste or discarded materials generated by both natural and human actions during the construction, renovation, and demolition of buildings, bridges, site clearance, renovations, land formation, and road excavation. The increasing CDW generation rate is triggered by the unprecedented population increase, urbanization rate, uncontrolled physical development, increasing housing demands, and socio-economic affluence of the people (Tam, 2011; Poon, Ann & Ng, 2001). Meanwhile, the cumulative effects of massive CDW generation and poor disposal, which are visible in urban areas, have significantly increased waste of natural resources and land resources, street lighting, inappropriate land filling, and the proliferation of dangerous dump sites, which promote health risk and the spread of vector-borne diseases (Taghipour et al., 2018, Tam, 2011; Poon et al., 2001). Hence, this constrains the quality of individual healthy living and public health. The causes of the construction and demolition waste are mostly changes in building design, ordering errors, inclement weather, cutting of materials to designed sizes, poor security, poor design standards, and poor construction and demolition waste

management strategies. WHO (2022) observed that the latter, i.e., the weakness of CDW management strategies across the globe, has limited the effectiveness of solid waste management practices.

The Nigerian construction industry consisting of the organized and unorganized sector, according to Dantata (2008) is very small highest in the West African sub-region, but only accounts for 0.2% ($3.15bn) of the global total estimated to be about $4 trillion in 2008. However, the industry's growth rate has been very impressive over the last few years outgrown most other sectors of the local economy. In addition, the Nigerian construction industry, no doubt has been consistently growing since and after the independence in 1960 especially with the discovery of petroleum resources and subsequent exploration. In fact, the construction industry has outgrown all other sectors of the Nigerian economy. In supporting this view, Ajayi et al. (2016) opine that the Nigeria construction is very large with market size of $127.7 billion in 2021 which is projected to grow than 3percent during between 2023 and 2026. The sector continued to witness boom with many political development and decisions favoring various forms of construction and reconstruction activities at all levels of government.

Basically, construction projects, especially building and infrastructure in Nigeria are driven by both the government and private investors. With this, government provides key critical infrastructure such as roads, bridges, dredged water ways and ports, Sand railways via several means including full government financing, public-private partnerships (PPPs), multilateral development banks (MDBs), and bilateral creditors, while the private sector which include individual and private enterprises are equally involved in various construction and reconstruction activities towards achieving their goal and objectives. The ineffective and inefficient management of construction and demolition waste worldwide, especially in developing countries including Nigeria, is fast becoming alarming and a major concern due to the observed weak practices due to poor public awareness and the observed attributed negative consequences. Poor CDW management practices in Lagos, Nigeria, have resulted in major urban crises such as water and marine contamination, soil and air pollution, blockage of city drains, disease spread including cholera, malaria, and other vector-borne diseases, unpredictable travel times and congestion, fire outbreak flooding, and other related environmental challenges (Salisu, Fasina, Akanmu & Sanni, 2022). However, the Lagos State Government has, at different times, initiated efforts to minimize the waste generated during construction and demolition activities, associated problems, and the negative consequences of CDW through several organized programs and projects within the state (Salisu et al., 2022).

Unfortunately, these efforts are insufficient to significantly increase value creation through CDW, improve citizens' quality of life and liability, eliminate environmental nuisances caused by CDW, or effectively implement various strategies and policies on construction and demolition waste management practices in Lagos metropolis. It is against this background that this study examines the challenges and prospects of construction and demolition waste in Lagos Metropolis,

Nigeria with a view to improve health disposal and management of construction and demolition waste in the commercial capital of Nigeria. In order to achieve this aim, the following objectives guided the study: examine the profile of the contractors; the nature of construction and demolition waste (CDW) generated; the method of collection, sorting, and disposal as components of CDW management practices; the challenges of CDW management practices; and the prospects of CDW management practices in Lagos Metropolis.

2. REVIEW OF LITERATURE

The issues of construction and demolition waste have been of interest in recent times. Scholars, researchers, government, and non-governmental organizations have shown considerable interest, particularly in the recent threat of CDW-related challenges, particularly as they affect residents and the environment in cities in developed countries. Accordingly, construction and demolition waste is debris from a construction or destruction of a construction that are no longer useful, but has to be carefully disposed to avoid or minimize environmental hazards and prevent infliction of injuries to the people in and around the environment where such exercise takes place (Markandeya & Kameswari, 2015). However, study on this topic is limited, both in scope and context, in many developing cities around the globe.

Construction and demolition waste are defined by Burcu, Cosgun, Ipekçi and Karaday (2020) as a mixture of inert and non-inert materials arising from construction, excavation, renovation, refurbishment, demolition, road works, and other construction-related activities. Thus, the inert materials can be either soft inert materials, which include soil, earth, and slurry, or hard inert materials, such as rocks and broken concrete, while the constituents of non-inert materials are made up of metals, timber, plastics, and packaging materials, among others. In the view of Elshaboury, Al-Sakkaf, Mohammed and Alfalah (2022), the building and construction industry utilizes enormous natural resources and produces much waste; thus, construction and demolition waste treatment has become an increasingly pressing economic, social, and environmental concern across the world. As a practice and procedure, construction and demolition activities usually come with associated and ancillary waste and consequently result in the production of massive construction and demolition (C&D) waste at the construction site and adjoining areas of such projects.

In other parts of the world, the study of Yu, Poon, Wong, Yip and Jalion (2013) revealed that the construction industry is responsible for about 29 percent of landfilling in the United States, 40percent in Brazil, 44percent in Australia, 44percent in the United Kingdom, 27 percent in Canada, and 23percent in Hong Kong. However, while materials and resources for construction and demolition activities are usually considered and sourced prior to the commencement of construction activities, Almusawi, Karim and Ethaib (2022) opined that the construction and demolition waste are rarely considered and often neglected in the process, hence the littering of the environment and project site with waste products

produced during the process of construction, renovation, or demolition of structures in the built environment, with residents and others bearing the brunt of the adverse consequences of such actions.

Given the composition of the construction and demolition waste, Almusawi, Karim and Ethaib (2022) evaluate the generation and management issues of CDW in Kuwait and Iraq and found that the average CDW quantity generated by construction activities were 49.5 kg/m^2 for public or commercial building projects and 35 kg/m^2 for residential projects, while those of public or commercial construction, residential construction, and demolition works generated 1.480 ton/m^2, 0.0495 ton/m^2, and 0.035 ton/m^2, respectively. As a result, among the major sources of waste generation in the building industry are construction, demolition, and rehabilitation exercises in any building construction. In this regard, Markandeya and Kameswari (2015) state that construction and demolition waste is usually bulky and heavy and is mostly unsuitable for disposal by incineration or composting. As such, they opined that the major constituents derivable from construction and demolition waste are soil, sand, gravel, bricks, masonry, concrete, metals, and wood, among others (see figure 1). In addition, the study by Almusawi et al. (2022) on the impact of the construction waste disposal charging scheme on work practices found the average composition of CDW from the construction sector to be dominated by 35.4percent concrete waste, 19.2percent tiles and blocks, and 14.2percent metals, among others.

In the same vein, the Nigerian construction industry, according to Dantata (2008) has recorded some impressive numbers over the last few years due to its heavily dependent on government expenditure and the expansion of the national economic development strategies which facilitate the involvement of private sector in the activities at various scale. This implied the increased generation of construction and demolition wastes at both macro and micro scale. However, landfill dumping remained the most common disposal method in developed world while the situation in many Nigerian cities including Lagos is worrisome; hence, the need to evolve improved management practices for construction and demolition waste in Nigeria, especially in Lagos Metropolis, Nigeria.

3. MATERIALS AND METHODS

3.1. THE STUDY AREA

Lagos Metropolis is located within Lagos State, which is one of the 36 states of Nigeria. It accounted for 16 of the 20 LGAs in Lagos State (Figure 1) and was ranked the world's third largest megacity in 2015. Lagos Metropolis' land area is put at 3577 sq. km., which accounted for 0.39percent of Nigeria’s 923,773 sq. km. land area. The population of Lagos Metropolis is estimated to be 22 million people, with 2.5 million households, and a 6percent annual growth rate in 2021. The solid waste generation in Lagos Metropolis, according to the Lagos Bureau of Statistics, is around 20,000 MT of waste per day and 1.2 kg per person per day (generation per capita) (Lagos State Government, 2022). This study, however, is locally limited to

the Lagos Metropolis, Nigeria, and it is based on the opinions of building contractors towards understanding the issues of CDW management practices.

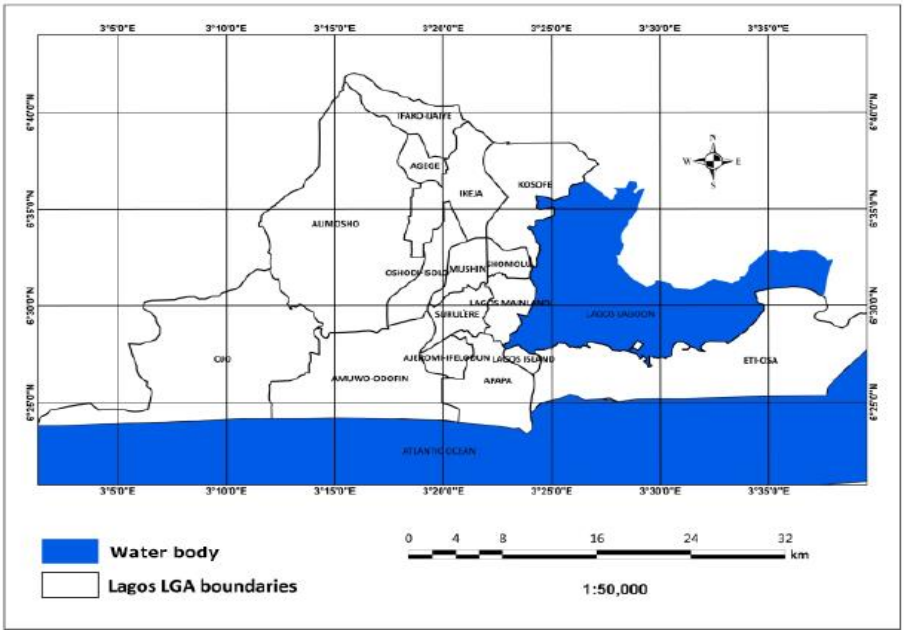

Figure 1: Metropolitan Lagos in the Context of Lagos State
Source: Lagos State Government (2022)

3.2. METHODOLOGY

This study adopted a survey research design that is based on the opinions of contractors, who are identified as the sample unit and regarded as the respondents for this study. Both primary and secondary sources of data were used in this study. The primary data involved the use of a questionnaire survey administered to the building contractors within Lagos Metropolis, while the secondary data, sourced from both published and unpublished documents such as topical or thematically related books, journal articles, newspaper articles, etc., was used to build up the literature review and the research gap.

A non-probability sampling procedure was adopted in this study. A snowball sampling technique was used to administer 200 copies of a questionnaire to contractors practicing and actively engaged with construction and demolition projects within the Lagos Metropolitan Area. The contractors (sample) was selected using non-probability sampling techniques which consist of purposive and snowball sampling technique was based on the peculiarity of the unavailability of population data for contractors within the study area. Given this, a total of 200 copies of a questionnaire administered to the contractors were completed, revised, and used for analysis. The questionnaire was segmented into four sections, with sections A, B, C, and D aligned with the study objectives. Section A dealt with the profiles of the respondents, and Section B focused on the questions that related to the components of the CDW management practice in the study area. Sections C and D dealt with the

challenges and prospects of the CDW management practice in the study area, respectively. The questionnaire design consisted of close-ended questions. The study used Cronbach's alpha for the reliability test, and the values of the scale used for sections C and D were 0.86 and 0.88, respectively. This indicates that the parameters used are relevant and appropriate for measuring the challenges and prospects of CDW management practice.

The method of data presentation involves the use of descriptive statistics, which include percentage tables, charts, and mean weighted analysis (MWA). The mean weighted analysis is based on the sum of the weighted value SWV, the relative mean index (RMI), and the mean index value (MIV), as well as a four-point Likert scale with gradation values of strongly disagree SD = 1, disagree D = 2, agree A = 3, and strongly agree SA = 4. The MWA was introduced to understand the parameters of the challenges and prospects of CDW management practices that ranked high or low in the Lagos Metropolis. The data presentation and analysis, which is based on both a quantitative and qualitative approach, were achieved through the statistical package for social sciences (SPSS) in the IBM version.

4. RESULTS AND DISCUSSION

This section presents the results of data collected from the field survey which are descriptively and inferentially analyzed. Thus, the results presented and discussed include the profile of the building contractors who are the respondents, the construction and demolition waste management practices in Lagos Metropolis (i.e. nature of CDW-generated, method of CDW collection and sorting, and method of CDW disposal), challenges of CDW management practice, and prospects of CDW management practice in Lagos Metropolis, Nigeria.

4.1. THE PROFILE OF THE BUILDING CONTRACTORS (RESPONDENTS)

Understanding the profile of building contractors is important as it helps in understanding the behavior and dispositions of the respondents to the CDW management practice within the context of Lagos State, Nigeria. Table 1 presents the profile of the sample building contractors. The findings on the gender of the building contractors showed that the majority, 94percent, were male, while the remaining 6percent of the respondents were female. Findings revealed that most of the respondents, above two-thirds, were aged between 40 and 60 years. This is followed by those who are above 60 years old (15percent), while the remaining percentage is less than one-tenth of the respondents (7percent) who are below 39 years old. The implications of this finding are that the majority of the respondents were within the active age group. Findings on the marital status of the sampled contractors show that the majority, far above two-thirds (78percent), are married, while those respondents who are divorced account for the least number of respondents (4percent). Furthermore, findings on the highest educational attainment of the sampled building contractors show that a majority above one-third of the respondents have higher degrees of PGD, M.Sc., and/or equivalents. This is closely

followed by those who are first-degree holders, which accounted for less than one-third of the respondents (30percent). The respondents with the highest educational attainment are those with a secondary or technical school diploma, who account for less than one-tenth of the total (7percent).

Furthermore, findings on the occupational status of the sampled building contractors show that the majority, slightly more than two-thirds of the respondents (69percent) are engaged as private workers or entities; 21percent, or slightly more than two-tenths of the respondents, are government workers; and the remaining 10percent work for corporate organizations. Table 1 also presented the findings on the years of professional experience of the respondents in the building construction industry. Interestingly, a majority far above two-thirds of the respondents have more than 15 years of working experience within the construction industry (76percent); this is followed by those who have between 10 and 15 years of professional experience, which accounted for less than one-third of the respondents (20percent). The remaining percentage, which is less than one-tenth of the respondents, has an age below 10 years. The implications of this finding are that the majority of the sampled building contractors have reasonable years of professional experience, and hence their opinion on the subject matter is relevant in giving appropriate judgment to all the issues raised concerning CDW management practices in this study.

Table 1: *The Profile of the Building Contractors (Respondents)*

Category	Profile of the Building Contractors	Frequency	Percentage
Gender	Male	188	94
	Female	12	6
	Total	200	100
Age	Below 39 years	14	7
	Between 40 and 60 years	156	78
	Above 60 years	30	15
	Total	200	100
Marital Status	Married	172	86
	Single	20	10
	Divorced	8	4
	Total	200	100
Highest Educational Level	Secondary Education	14	7
	National Diploma	46	23
	First Degree (HND/B.Sc)	60	30

	PGD, M.Sc. and/or Equivalent	80	40
	Total	200	100
Occupational Status	Private	138	69
	Government	42	21
	Corporate Organizations	20	10
	Total	200	100
Years of professional experience	Below 10 years	8	4
	10 and 15 years	40	20
	Above 15 years	152	76
	Total	200	100

Source: Author's Fieldwork (2022)

4.2. THE CDW MANAGEMENT PRACTICE IN LAGOS METROPOLIS

This sub-section focused on the findings on the CDW generated and the collection and disposal methods used in the study area.

4.2.1. THE NATURE OF CDW-GENERATED

It is worth knowing that there are various types or natures of CDW generated in the study area, like every other city in the world. Specifically, the findings on the nature of the CDW generated in Lagos Metropolis are presented in Table 2 below using the Likert scale measurement, which was graded based on four (4) points captured as strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4. Given this, respondents were asked to rate the CDW, which was mostly generated doing construction and demolition activities in the study area, and their responses were analyzed. In accordance with the methodology presented, nine (9) waste categories from Table 2 were analyzed using mean weighted analysis. The analysis produced a relative mean index of 29.67 and a mean index value of 3.30 (Table 2).

A close review of Table 2 shows that 5 out of 9, which accounted for more than half (56percent) of the total evaluated CDW, have a relative mean index (RMI) greater than the MIV. According to the findings, the majority of the CDW are good fits and are categorized as the most commonly generated CDW in Lagos Metropolis, while the remaining CDW that rated lower than the MIV are not common waste in the study area. Furthermore, findings also show that concrete with steel scored the highest related mean index (3.55) as the most commonly generated CDW, while cement and granite stones accounted for the least generated and common CDW in the study area (RMI = 2.88**).** Furthermore, the test of variability show that the evaluated parameters based on the mean deviation results are not very homogenous

in nature. It is important to note that those in the CDW with high RMI and MD are highly homogenous relative to those with low RMI scores.

Table 2: *The Nature of CDW Generated*

CDW	SD	D	A	SA	Total Weight Value	Relative Mean Index	Mean Index Value	Mean Deviation
Concrete with steel	0	22	207	480	709	3.55	3.30	0.25
Glass	2	20	219	460	701	3.51		0.21
Broken tiles	0	20	219	468	707	3.54		0.24
Blocks and bricks	1	20	240	436	697	3.49		0.19
Sands	2	24	333	300	659	3.30		0.00
Planks and woods	5	40	321	272	638	3.19		-0.11
Ceramic blocks and tiles asbestos	10	36	315	268	629	3.15		-0.16
Plastics and paints	17	20	333	248	618	3.09		-0.21
Cement and granites	19	70	294	192	575	2.88		-0.43
Total						29.67		

Note: SD- Strongly Disagree, D- Disagree, A- Agree, SA- Strong Agree
Source: Author's Fieldwork (2022)

4.2.2. THE METHOD OF CDW COLLECTION AND SORTING

The findings on the method of the CDW collection and sorting in Lagos Metropolis are presented in Table 3 below using the Likert scale measurement graded based on four (4) points captured as strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4. Given this, respondents were asked to rate the use of the identified methods for collection and sorting of CDW generated doing construction and demolition activities in the study area, and their responses were analyzed. In accordance with the methodology presented, five (5) waste collection tools from Table 3 were analyzed using mean weighted analysis. The analysis produced a relative mean index of 17.21 and a mean index value of 3.44 (Table 3). A vivid observation and check of Table 3 shows that 3 out of the 5, which accounted for more than half (56 percent) of the total evaluated CDW collection and sorting tools, have a Relative Mean Index (RMI) greater than the MIV.

According to the findings, the majority of the methods are good fits and are categorized as the most commonly used in collecting CDW generated in Lagos Metropolis, while the remaining parameters that rated lower than the MIV are not commonly used in the study area. Furthermore, truck and hydraulic cart tippers were found to be the most commonly used methods in collecting CDW generated (RMI = 3.55), while centralized city solid waste drains and stations with restricted openings were found to be the least used in the study area (RMI = 3.30). Furthermore, the test

of variability show that the evaluated methods based on the mean deviation results are not very homogenous in nature. It is important to note that the methods with high RMI and MD are those that are highly homogenous relative to those with low RMI scores.

Table 3: *The Method of CDW Collection and Sorting*

CDW	SD	D	A	SA	Total Weight Value	Relative Mean Index	Mean Index Value	Mean Deviation
Truck/hydraulic cart tipper	3	22	180	504	709	3.55	3.44	0.11
Various sizes of wheeled carts	1	10	246	448	705	3.53		0.09
Open top containers	1	20	240	436	697	3.49		0.04
Compactors	1	0	375	296	672	3.36		-0.08
City centralized solid waste drains and station with restrictive openings	2	24	333	300	659	3.30		-0.15
Total						17.21		

Note: SD- Strongly Disagree, D- Disagree, A- Agree, SA- Strong Agree
Source: Author's Fieldwork (2022)

4.2.3. THE METHOD OF CDW DISPOSAL

The findings on the method of CDW disposal in Lagos Metropolis are presented in Table 4 below using Likert's scale measurement. Given this, respondents were asked to rate the use of the identified methods for the disposal of CDW generated doing construction and demolition activities in the study area, and their responses were analyzed. In accordance with the methodology presented, six (6) waste disposal tools from Table 4 were analyzed using mean weighted analysis. The analysis produced a relative mean index of 19.43 and a mean index value of 3.24 (Table 4). A further check of Table 3 shows that 3 out of the 6, which accounted for a half (50 percent) of the total evaluated CDW disposal methods, have a relative mean index (RMI) greater than the MIV.

According to the findings, the majority of the parameters are good fits and are categorized as the most commonly used methods of disposing of CDW generated in Lagos Metropolis, while the remaining methods that rated lower than the MIV are not commonly used in the study area. Furthermore, findings show that landfilling is the most commonly used disposal method of CDW generated (RMI = 3.51), while shredding is the least commonly used disposal method of CDW generated in the study area (RMI = 2.88).Furthermore, the test of variability show that the evaluated methods based on the mean deviation results are not very homogenous in nature. It is important to note that the methods with high RMI and MD are those that are highly homogenous relative to those with low RMI scores.

Table 4: *The Method of CDW Disposal*

Method of CDW Collection	SD	D	A	SA	Total Weight Value	Relative Mean Index	Mean Index Value	Mean Deviation
Landfilling	0	12	258	432	702	3.51	3.24	0.27
Open dumping	5	52	162	460	679	3.40		0.16
Incineration	9	68	126	460	663	3.32		0.07
Donation of unwanted materials	5	40	321	272	638	3.19		-0.05
Reuse or Recycle	10	36	315	268	629	3.15		-0.10
Shredding	19	70	294	192	575	2.88		-0.37
Total						19.43		

Note: SD- Strongly Disagree, D- Disagree, A- Agree, SA- Strong Agree
Source: Author's Fieldwork (2022)

4.3. THE CHALLENGES OF CDW MANAGEMENT PRACTICE

It is important to note that there are various challenges affecting CDW management practice in the study area, like every other developing city in the world. Specifically, the findings on the challenges of the CDW management practices in Lagos Metropolis are presented in Table 5 below using the Likert scale measurement, which was graded based on four (4) points captured as strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4. On this note, the respondents' perceptions of the challenges affecting CDW management practices in the study area and their responses were analyzed. In accordance with the methodology presented, nine (9) waste management challenges in Table 5 were analyzed using mean weighted analysis. The analysis produced a relative mean index of 30.47 and a mean index value of 3.39 (Table 5). A close review of Table 5 shows that 5 out of 9, which accounted for more than half (55.6percent) of the total evaluated challenges affecting CDW management practice, have a Relative Mean Index (RMI) greater than the MIV. According to the findings, five (5) challenges ranked as a major problem affecting CDW management practice in Lagos Metropolis, while the remaining challenges, which accounted for the majority, rated lower than the MIV and were perhaps not common attributed challenges in the study area.

Furthermore, findings also show the high cost of waste evacuation (3.56), inadequate adaptive disposal vehicles (3.55), poor waste logistics (3.53), quantity of waste generated (3.51) and poor information (3.40) as the highly rated and top challenges of CDW management practice, while poor infrastructure accounted for the least rated and most common challenges of CDW management practice in the study area (RMI = 3.02**).** Furthermore, the test of variability show that the evaluated challenges based on the mean deviation results are not very homogenous in nature. It is important to note that the challenges with high RMI and MD are highly homogenous relative to those with low RMI scores.

Table 5: *The Challenges of CDW Management Practice*

Challenges	SD	D	A	SA	TWV	Relative Mean Index	Mean Index Value	Mean Deviation
High cost of waste evacuation	34	66	120	372	592	3.56	3.39	0.17
Inadequate adaptive disposal vehicles	3	22	180	504	709	3.55		0.16
Poor waste logistics	1	10	246	448	705	3.53		0.14
Quantity of waste generated		12	258	432	702	3.51		0.12
Poor information	5	52	162	460	679	3.40		0.00
Poor funding	1	0	375	296	672	3.36		-0.03
Inadequate Manpower	9	68	126	460	663	3.32		-0.08
Poor Planning and Policies	15	52	162	420	649	3.25		-0.15
Poor infrastructure	29	68	126	380	603	3.02		-0.38
Total						30.47		

Note: SD- Strongly Disagree, D- Disagree, A- Agree, SA- Strong Agree
Source: Author's Fieldwork (2022)

4.4. THE PROSPECTS OF CDW MANAGEMENT PRACTICE IN LAGOS METROPOLIS

It is worth knowing that there are various possible prospects for CDW management practices in the study area, like every other city in the world. The findings on the possible CDW management practice in Lagos Metropolis are presented in Table 6 below using the Likert scale measurement, which was graded based on four (4) points captured as strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4. Given this, respondents were asked to rate the identified possible prospects of CDW management practice if properly implemented or enforced in the study area, and their responses were analyzed. Table 6 shows the evaluation of twelve (12) potential prospects using the methodology's mean weighted analysis. The analysis produced a relative mean index of 42.47 and a mean index value of 3.54 (Table 6). A vivid observation and review of Table 6 shows that 7 out of 12, which accounted for close to two-third (58 percent) of the total evaluated possible prospects of CDW management practice, have a Relative Mean Index (RMI) greater than the MIV. According to the findings, seven (7) evaluated prospects ranked as major possible prospects for CDW management practice in Lagos Metropolis, while the remaining items, which accounted for the majority, rated lower than the MIV in the study area.

Furthermore, findings also show increasing competitiveness in the construction industry (3.96), increasing profit maximization (3.90), reducing environmental degradation (3.87), reducing the cost of waste disposal (3.85), and increasing employment opportunities (3.59) as the top-five highly rated and ranked possible prospects of CDW management practice in the study**.** Furthermore, the test

of variability show that the evaluated prospects based on the mean deviation results are not very homogenous in nature. It is important to note that those prospects with high RMI and MD are highly homogenous relative to those with low RMI scores.

Table 6: *The Prospects of CDW Management Practice in Lagos Metropolis*

Prospects	SD	D	A	SA	TWV	Relative Mean Index	Mean Index Value	Mean Deviation
Increasing competitiveness in the construction industry	0	0	24	768	792	3.96	3.54	0.42
Increasing profit maximization	0	0	60	720	780	3.90		0.36
Reducing environmental degradation	0	0	78	696	774	3.87		0.33
Reducing the cost of waste disposal	0	0	90	680	770	3.85		0.31
Increasing employment opportunities	1	2	234	480	717	3.59		0.04
Serves as new sources of revenue	0	10	228	476	714	3.57		0.03
Promoting national economic stability and sustainability	0	6	246	460	712	3.56		0.02
Promoting spatial orderliness	2	8	297	380	687	3.44		-0.11
Reducing potential public health challenges	4	14	333	312	663	3.32		-0.23
Promoting resource conservation	2	50	318	268	638	3.19		-0.35
Promoting Reduce, Reuse and Recycle	9	20	333	280	642	3.21		-0.33
Increasing the sales value of CDW	9	70	294	232	605	3.03		-0.52
Total						42.47		

Note: SD- Strongly Disagree, D- Disagree, A- Agree, SA- Strong Agree
Source: Author's Fieldwork (2022)

4.5. HYPOTHESIS TESTING

H_0: *There is no statistically significant variation among the challenges of CDW Management Practice in Lagos Metropolis*

In a bid to understand whether or not there is a statistical significant variation among the challenges of CDW Management Practice in the study area, further investigated were conducted through the repeated measures Analysis of Variance ANOVA and the results of the analysis are presented in Table 7. Table 7 present the result of the Mauchly's Test of Sphericity which is used to assess the statistical assumption of sphericity when using repeated-measures ANOVA. The result of the Mauchly Test of Sphericity revealed a significance value 0.500 which is greater than the 0.05 alpha level. Since the observed significance level is greater than the alpha level, the findings show that the dataset meet the requirements for repeated-measures ANOVA and assumption must be met before trusting the p-value generated by the standard repeated measures ANOVA which explains the homogeneity-or-variance among variables.

The result of the output of the test of within-subject effects also presented in Table 7 was used to confirm the variability among the variables as well as confirm if the observed data meets the assumption of Sphericity. The findings revealed a F-

value of 48.746 with a p-value of 0.000, which reaches significance at less than the 0.05 alpha level. In other words, there is a statistically significant variation among the challenges of the CDW management practices in Lagos Metropolis based on the results of the test of within-subject variables. F-value and p-value of Greenhouse-Geisser and Huynh-Feldt also confirmed this result; both produced a significant result with the calculated p-value of 0.000 lower than 0.05 tabulated p-value.

Also, the repeated measure of Analysis of Variance (ANOVA) was used to compare the variability among the 9 observed constraints through the test of between-subject effects which confirms whether there is a significant variation or not among the observed variables. The result of the analysis revealed that the F-ratio is 956.137 which reached significance with a p-value 0.000. Importantly, while comparing the calculated p-value and the tabulated p-value, the result shows that the calculated p-value of 0.000 is less than the tabulated p-value of 0.05 level of significance; hence, the decision accepted the H_1 (alternative hypothesis) and rejected the H_0 (null hypothesis). This implies that there is a statistically significant variation among the challenges of CDW Management Practice in in Lagos Metropolis, Nigeria. By these findings, the observed identified challenges of CDW Management Practice in in Lagos State varies from one another. These challenges have peculiar effects on waste management practices and performance of construction activities in the study area. In order to achieve effective and efficient CDW management practice and improve urban development of Lagos, requires addressing each constraint independently.

Table 7: *Statistical Variation among the challenges of CDW Management Practice in Lagos. Metropolis*

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
factor1	.963	1.836	35	.500	.963	.473	.125

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept Within Subjects Design: factor1

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	155.744	8	19.468	48.746	.000
	Greenhouse-Geisser	155.744	3.701	42.076	48.746	.000
	Huynh-Feldt	155.744	3.780	41.199	48.746	.000
	Lower-bound	155.744	1.000	155.744	48.746	.000
Error(factor1)	Sphericity Assumed	635.811	1592	.399		
	Greenhouse-Geisser	635.811	736.593	.863		

	Huynh-Feldt	635.811	752.287	.845		
	Lower-bound	635.811	199.000	3.195		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	339.736	1	339.736	956.137	.000
Error	70.709	199	.355		

Source: Authors' computation (2022)

5. CONCLUSION AND RECOMMENDATIONS

The CDW management practice in Lagos Metropolis, like any other Nigerian city, is still evolving as it is presently unpopular and being undertaken at the informal level. Based on this backdrop and the quest to minimize the consequences of the increasing CDW in the city, this study examined the challenges and prospects of CDW in the Lagos Metropolis. The study concluded that the practice of CDW in the study area is dominated by the informal sector, as most of the nature and methods of managing CDW in the study area are obsolete and are traditional waste management practices. As a result, the increasing challenges encountered during CDW management, while opportunities abound but remain untapped.

This study, through its findings, also noted five major prospects that are achievable if the stakeholders of the construction industry invest more and enforce sanity in the practice of CDW management in the study area. These possible prospects include increasing competitiveness in the construction industry, increasing profit maximization through reduction of wasting natural or land resources, reducing environmental degradation, reducing the cost of waste disposal, and increasing employment opportunities. To achieve these prospects in the study area and equally reduce the predominant health crisis attributed to poor waste management practices, this study recommended the full adoption of the carrot-and-stick approach to achieving effective CDW management practices in the Lagos Metropolis and other cities in Nigeria.

REFERENCES

Almusawi, M. B. H., Karim, A. T. B. A., Ethaib, S. (2022). Evaluation of Construction and Demolition Waste Management in Kuwait. *Recycling, 7*(88). https://doi.org/10.3390/recycling7060088.

Ajayi, S.O.; Oyedele, L.O.; Akinade, O.O.; Bilal, M.; Owolabi, H.A.; Alaka, H.A.; Kadiri, K.O. (2016). Reducing waste to landfill: A need for cultural change in the construction industry. *J. Build. Eng.*, 5, 185–193.

Britannica (2022). Waste disposal, types and methods. Available at www.britannica.com/technology/waste-disposal-system.

Burcu, S.; Co¸Sgun, N.; Ipekçi, C.A., Karadayı, T. T. (2020). Turkish architects' views on construction and demolition waste reduction in the design stage. *Environmental Engineering Management Journal, 19,* 439–452.

Cook, E., Velis, C. A., Black, L. (2022). Construction and demolition waste management: A systematic review of ricks to occupational public health. *Frontiers in Sustainability, 3,* 924-926. Doi:10.3389/fsus.2022.924926.

Dantata, S. A. (2008). General Overview of the Nigerian Construction Industry. Master's Thesis. *Massachusetts Institute of Technology,* United States of America.

Elshaboury, N., Al-Sakkaf, A., Mohammed A. E., Alfalah, G. (2022). Construction and Demolition Waste Management Research: A Science Mapping Analysis. *Int. J. Environ. Res. Public Health, 19,* 4496. https://doi.org/10.3390/ijerph19084496.

Lagos State Government (2022). Solid Waste Statistics in Lagos Metropolis. Available at www.lagostate.gov.ng./solid-waste-statisics

Markandeya, R. P., Kameswari, P. (2015). Construction and Demolition Waste Management A Review. *International Journal of Advanced Science and Technology, 84,* 19-46.

Oyenuga, A.A, Bhamidiarri, R and Naoum, S. G (2014). Challenges in managing construction and demolition waste. *Journal of Solid Waste Technology and Management, 1,* 1-11.

Poon, C. S., Ann, T. W. and Ng, L. H. (2001). On-site sorting of construction and demolition waste in Honk Kong. *Resources, Conservation and Recycling. 32,* 157-172.

Salisu U.O., Fasina, S.O., Akanmu, A.A., Sanni, S.M. (2022). Household waste management logistics practices in Lagos Metropolis, Nigeria. *KIU Journal of Social Science, 8*(2), 229-241.

Taghipour, H., Jazadani, R.T., Dehghanzadeh, R., Jafarabadi, M. A., Mohammadi, M. M., Ghayebzadeh, M. (2018). Construction and demolition waste and its management challenges in Iran. A case study in Tabriz City. *Health Scope, 8*(2), e62313.doi:10.5812/jhealth-scope.62313.

Tam, V.W.Y. (2011). Rate of reusable and recycling waste in construction. *The Open Waste Management Journal, 4*(1), 28-32.

World Health Organization (2022). Guidance on solid waste and health. WHO. Available at www.who.int/tools/compendium-on-health-and-environmental/solid-waste

Yu, A.T.W., Poon, C. S., Wong, A., Yip, R., Jalion, L. (2013). Impact of construction waste disposal charging scheme on work practices at construction sites in Hong Kong. *Waste Management, 33,* 138–146.