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Article

Urban solid waste innovative employment opportunities: The role of Nigerian cart pushers in promoting Sustainable Development Goals 1 and 11

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Abstract: The urban solid waste (USW) emanating from the increasing urbanisation calls for concern. Integrating cart pushers into the private sector participation (PSP) may bridge the lacuna in sub-urban planning and PSP truck inefficiencies, especially in developing countries. There is a paucity of studies concerning cart pushers' role in sub-urban and issues hindering them from achieving Sustainable Development Goals (1 and 11) in developing countries. Thus, the study seeks to appraise cart pushers' role in Nigeria's sub- and urban areas, investigate their challenges, and propose measures to improve the achievement of the Goals by integrating them into PSP waste management systems. The researchers utilised a qualitative approach using face-to-face interviews and observation. The study covered seven of Nigeria's major cities, including Lagos, Kano, and Abuja. Forty semi-structured interviews were conducted. The participants include selected waste managers, NGOs in waste-related matters, cart pushers, legislators, households, environment and housing experts, and solid waste government agencies/regulators. The researchers adopted a thematic approach to analyse the collected data and presented it in a theme pattern. Findings reveal that despite the significance of cart pushers to the three pillars of sustainable development, including stimulating support for potential employment creation and sustainable cities and communities in Nigeria, they face challenges in their daily operation. The study proposed a revised USWM policy, where the informal waste sector should be embraced and recognised with specific rules and regulations. This is germane to improve achieving SDGs 1 and 11. This study holds significant implications for USWM policymakers and other stakeholders in embracing and integrating cart pushers into the formal waste collection process supported by statutory regulations to enhance practice. Also, this concept will increase employment opportunities and improve achieving Goals 1 and 11 in Nigeria.

Keywords: cart pusher; Nigeria; SDGs; sub-cities; urban; waste management

1. Introduction

The increasing urbanisation and rural-urban migration of people for better employment opportunities contribute to an exponential increase in the urban population. It has been estimated that the urban population may hit six billion by 2050 (Amorim et al., 2019). Since there is a relationship between urban population and solid

household waste, an inclusive approach that requires critical thinking should be developed to manage urban solid waste (USW). USW is a global issue (Essien and Spocter, 2023; Ikiriko et al., 2024). Because of lax sustainable policy, this may be more critical for developing countries' cities. Ebekozien et al. (2022) identified insufficient budget and associated costs to connect to the USW system as top implementation issues. Based on these issues, the government engaged the private sector to improve the waste management system (Abdulfatah, 2023; Ebekozien et al., 2022; Oyebode, 2018). Nigeria generated 540,959 tonnes of municipal solid waste daily, or 14.95 million tonnes a year, in 2016. Nigeria is projected to generate 54.8 million tonnes of solid waste in 2030 and 107 million tonnes in 2050 (Africa Check, 2019). The slow growth of the urban solid household waste industry is of concern to stakeholders, especially a notable gap in the Nigerian municipal solid waste management (MSWM) policy (Abdulfatah, 2023; Ebekozien et al., 2022; Mbah and Nzeadibe, 2016). Zadawa et al. (2015) found insufficient collection methods are a critical issue affecting USW management (USWM) in many developing countries, including Nigeria. The need to make USWM an all-inclusive (informal and formal waste management) household collection point to recycle point cannot be over-emphasised. This submission, among others, strengthened the study's motivation to explore how cart pushers can play a significant role in achieving this goal and, by extension, achieving Goals 1 and 11.

Past studies demonstrated either how cart pushers could enhance solid waste management (Akiyode and Sojinu, 2006; Mbah and Nzeadibe, 2016; Olugbenga, 2006; Salvaire, 2020, 2023) or how solid household waste could be managed (Agbabiaka et al., 2022; Ebekozien et al., 2022; Essien and Spocter, 2023; Ikiriko et al., 2024; Gandu and Abubakar, 2023; Zadawa et al., 2015). Agbabiaka et al. (2022) focused on transforming USW process through mixed methods research design in Kano Metropolis, Nigeria. Essien and Spocter (2023) emphasised the implication of lax solid waste management in selected Accra markets on achieving Goal 11 but not from the perspective of the cart pushers' role. The essence of the transformation ought to be to contribute to achieving SDGs 1 and 11, but the findings needed to be more robust and in-depth. Besides the restricted location of the study, the emphasis was on something other than the cart pushers' role in improving achieving Goals 1 and 11. Also, none of these studies addressed cart pushers' role in sub- and urban solid waste household management to improve achieving SDGs 1 and 11 besides Olugbenga (2006), which focused on achieving the Millennium Development Goals (MDGs). The MDGs were between 2000–2015 (Ebekozien et al., 2024). The United Nations attempted to improve issues like urban cities' sustainability, which birthed the 17 SDGs in 2015. The SDGs are supported by the New Urban Agenda in 2016. It has increased policy attention and funding to urban areas to enhance sustainable development (Valencia et al., 2019). Mbah and Nzeadibe (2016) reported that the Waste Collection Workers Welfare Initiative claimed to have over one million cart pushers operating in Nigerian cities. This study was unable to verify this figure. Still, as of 2012, it is quite significant to the urban labour force and, by extension, contributes to the economy's growth. This study focuses on how integrating cart pushers into the mainstream would improve achieving Goals 1 (eliminate poverty) and 11 (sustainable cities and communities). This study, among others, intends to offer measures to improve the embracing and

engaging of cart pushers, especially in sub-urban and unplanned locations, in the solid waste household management sector in managing USW generated from households. Although the study's focus is on improving achieving SDGs 1 and 11, it may positively influence other SDGs like Goal 3 (good health and well-being), Goal 8 (decent work and economic growth), and Goal 17 (partnerships for the goals) before the year 2030.

Regarding Goals 1 and 11, besides stating the plan to achieve an improved sustainable future (United Nations News Centre, 2018), Goal 1 has five main targets and nine indicators, and Goal 11 has seven main targets and 11 indicators. Goal 11 is among the top goals to increase employment prospects and influence economic growth with a sustainable livelihood (Ebekozien et al., 2019a). It corroborated the World Bank Press Release (2017), which affirmed that a habitable location enhances the well-being of the inhabitants. In Nigeria, cart pushers may assist the main actors under a regulated system in the urban solid household waste industry in improving sustainable clean cities, especially in sub-urban and unplanned locations, and by extension, create more jobs to mitigate hunger. Also, this study argues that relevant government authorities need to embrace cart pushers as members of the state-organised actors in managing solid waste, especially in sub-urban and lax-planned locations. The output intends to improve the achievement of sustainable clean sub- and cities and increase low-income group employment in a developing setting like Nigeria. The output has direct implications regarding achieving SDGs 1 and 11. This is one of the study's motivations. Thus, the study seeks to appraise cart pushers' role in Nigeria's sub- and urban, investigate encumbrances facing them, and proffer measures to improve achieving SDGs 1 and 11 through the following objectives:

To appraise the role of cart pushers in managing USW in Nigeria.

To investigate the encumbrances facing cart pushers in the solid waste sector.

To offer measures to improve the achievement of SDGs 1 and 11 through integrating cart pushers into PSP waste management systems.

2. Literature review

The concern for managing USW is a concept that has been introduced previously. Truitt et al. (1969) reported the mechanism to transport waste within the waste management system. The approach regarding waste management varies from region to region. Elsaid and Aghezzaf (2015) affirmed that factors like location and categories of income earners influence the type of waste generated. Historically, scholars have conducted studies on USWM encumbrances, as summarised in **Table 1**, focusing on developing countries. Themelis (2006) reported that the generation rate of USW in the EU and Asia ranges from 0.9 to 1.6 kg/capita/day and 0.7/1.5 kg/capita/day, respectively. The global cities generate about 1.3 billion tons/year of solid waste. Sadef et al. (2016) projected an increase to 2.2 billion tons/year by 2025. For this study, most of the USW comprises waste generated from households, shops, schools, industrial waste, medical waste, construction and alteration/demolition waste, household electronics waste, and agricultural activities waste (UNEP, 2011). Ismail and Nizami (2016) affirmed that the composition of USW varies from developed to developing countries. Managing USW could be challenging, depending on the

composition and other factors.

Ebekozien et al. (2022) clustered USWM challenges into five in Nigeria. This aligns with the phases regarding recycling. This includes generation and separation, collection, transfer, and transport, treatment, disposal, and recycling. Studies concerning cart pusher's role in USWM are few, especially contributing to improving achieving Goals 1 and 11. This is a theoretical gap. A call to formally recognise cart pushers and scavengers under a regulated system (PSP) has been ongoing for over two decades (Akiyode and Sojinu, 2006) in developing cities like Lagos, Nigeria. In Lagos, the ban on cart pushers was one of the outcomes of the Clean Lagos Initiative (CLI) campaign in 2018. The inability of the Lagos State Waste Management Agency and its Public-Private Partnership (PPP) operation to cover all streets and sub-urban makes the cart pushers inevitable (Nwachu, 2019).

Table 1. Encumbrances facing USWM in selected developing countries.

Source	Country/City	Challenge(s)
Essien and Spocter (2023); Samwine et al. (2017)	Accra, Ghana	Increased volumes of waste are due to faster generation and the high cost of waste management. It cut across many cities, not only Ghana but other African countries, Asia, South America, and even some European countries. Prudent waste management processes are very costly, and short-term returns are intangible. The country is beset with modern technology, range from equipment and tools to the break-down of waste collection trucks and dustbins due to poor maintenance to inadequate skills required in tackling the solid waste menace. The encumbrance of poor attitude of persons in complementing the efforts of waste managing firms. Inadequate engineered landfill sites for treatment and disposal of solid waste.
Kubanza and Simatele, (2019)	Johannesburg, South Africa	There are the weaknesses and inadequacies of national and local government institutions in the face of rapid urban change. Absence of political will and knowledge.
Teshome (2021)	Ethiopia	The present waste management system can be described by 3 I's (Irregular, inadequate, and inefficient). Absence of inconsistent collection and low coverage There is technical frailties and inadequate enforcement of laws
Zainu and Songip (2017)	Malaysia	High cost in managing waste Inadequate landfills
Malinauskaite et al. (2017)	European countries covered (Estonia, Greece, Italy, Latvia, Lithuania, Norway, Poland, Slovenia, Spain, and the UK)	Inadequate cooperation between different lawyers of multi-governance in waste management and the political-will Having problems with cost-efficient and socially acceptable. Problems related to technological advancement
Ebekozien et al. (2022)	Nigeria's major cities	Challenges facing the generation and separation phases, e.g., inadequate waste pickers collection recyclables. Challenges facing the collection, transfer, and transport phases, e.g., bad roads and streets and inconsistencies in house numbering. Challenges facing the treatment phase, e.g., absence of local knowledge on waste management. Challenges facing the final disposal phase, e.g., inadequate management of a few dumpsites. Challenges facing the recycling phase, e.g., leakage in the informal sector and inadequate funding for the recycling business.

Source: Upgrade from Ebekozien et al. (2022).

Discussion on global development will be incomplete without SDGs. This is because SDGs are the road map for global growth in the 21st century. Mbah and

Nzeadibe (2016) asserted that 11 SDGs have a relationship with socio-economic and spatial inclusion components targeting reducing inequalities within and between states; employment within inclusive settlements and societies; energy, sanitation, ensuring access to water, attaining gender equality, enhancing education, improving health, and ending poverty and hunger. Thus, SDGs are prima facia strong on inclusiveness (Gupta and Vegelin, 2016). As argued in this study, relevant Nigerian Government authorities should recognise the informal waste sector. The outcome intends to improve lives and waste management service delivery.

3. Research method

The investigators utilised a qualitative research design to proffer answers to the main research objectives. This is because the adopted research design is entrenched in interpretivism (Chandra and Shang, 2019) to assist scholars in understanding the meanings of human actions. Hence, it adopted a phenomenological qualitative research design, as presented in **Figure 1**. The term "phenomenology" derived the "meaning" of the scenario by interviewing a group of people from the longitudinal perspective (Paley, 2016). The study adopted observation, semi-structured interviews, and literature review as the data collection tools in line with Mbah and Nzeadibe (2017). The study utilised a purposeful sampling technique. This technique targets interviewees considered important and knowledgeable in the field (Ibrahim et al., 2022). Forty semi-structured interviews were conducted. The participants include selected waste managers, NGOs in waste-related matters, cart pushers, legislators, households, environment and housing experts, and solid waste government agencies/regulators (state waste management authorities). The interviews took place from March 2023 to November 2023 across seven Nigerian cities, including Lagos, Kano, and the Federal Capital Territory, as illustrated in **Table 2**. The cities covered were Lagos, Kano, Port Harcourt, Benin City, Kaduna, Jos, and Federal Capital Territory. This aligns with Ebekozien et al. (2022), which covered the same cities in a similar USWM, but their studies focused on how 4IR can improve the waste sector. The interview lasted 45 min on average, and saturation was achieved at the 36th participant.

Table 2. Summary of participants' description.

Participant/Rank	**City/Code**							
	A	**B**	**C**	**D**	**E**	**F**	**G**	**Total**
	FCT	**Kano**	**Jos**	**Kaduna**	**Benin City**	**Port Harcourt**	**Lagos**	
Resident	P1	P2	P3	P4	P5	P6	P7	7
Waste manager	P8	P9	P10	P11	P12	P13	P14	7
Govt agencies	P15	P16	P17	P18	P19	P20	P21	7
Cart pusher	P22	P23	P24	P25	P26	P27	P28	7
Environment and housing expert	P29	P30	P31	P32	P33	P34	P35	7
Lawmaker	P36 & P37							2
Environment and health NGOs	P38, P39, P40							3
Total Number of Participants								**40**

P = Participant.

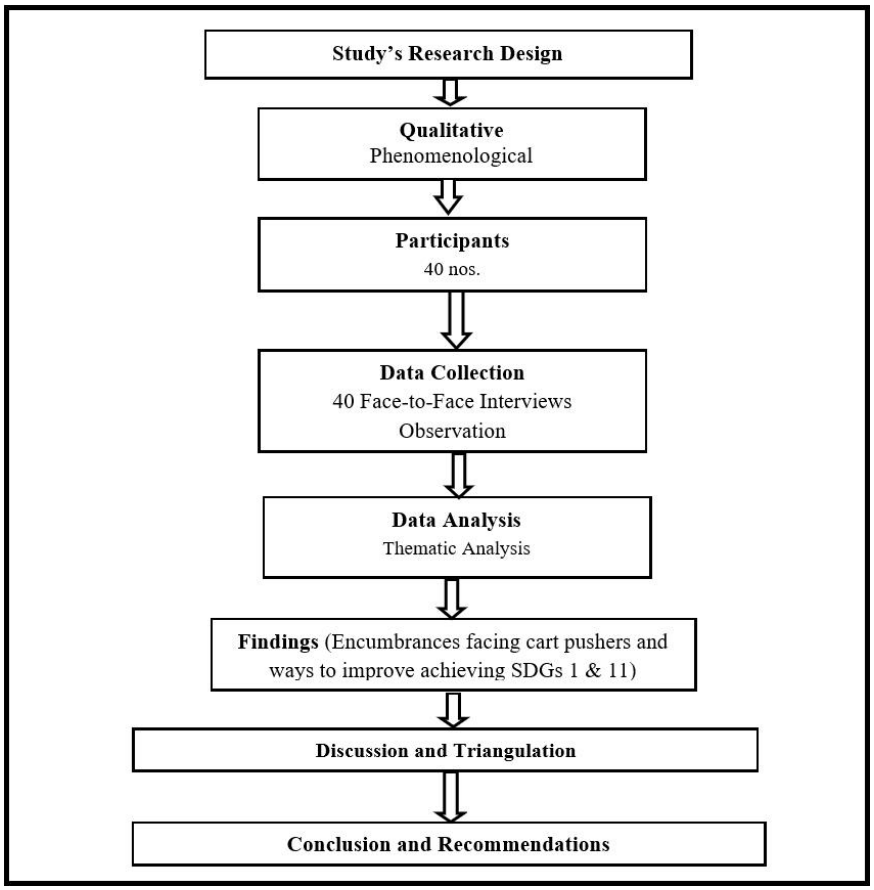

Figure 1. The study's research design.

Source: Modified from Ebekozien et al. (2022).

The interviewees' identities were concealed in line with the study's ethics. Concerning ethical matters, the interviewees were informed about the research's main aim and agreed to take part without being pressured. Background information from participants reveals that most are knowledgeable about cart pushers and USWM in Nigerian cities. Hence, responses from the participants were presented in an unidentified pattern. The researchers adopted the semi-structured approach, as presented in Appendix (Creswell and Creswell, 2018). The essence is to discover in-depth from the interviewees' perspective. The researchers adopted open coding and assigned labels to key sentences for smooth coding aligned with the objectives. The researchers utilised invivo, emotion, narrative, and theming coding techniques (Corbin and Strauss, 2015; Jaafar et al., 2021). Three main themes emerged from the 12 sub-themes. Ninety codes were re-clustered and re-organised based on occurrence, frequency, and reference to generate the 12 sub-themes. The analysed data and findings presentation were based on the 40 participants' understanding.

4. Findings

4.1. Theme one: Role of cart pushers in achieving SDGs 1 and 11

Cart pushers collect household solid waste at a fee and dispose of it at a designated location. They belong to the informal sector and can be relevant if well-regulated. The cart pushers' role in improving and achieving SDGs 1 and 11 in Nigeria

deserves growth and policy support in Nigeria. The benefits will enhance social, economic, and environmental innovative ingenuities in USWM governance (majority). Attention should be given to innovations related to the three pillars of sustainable development. Participant P38 says, "*…The benefits of cart pushers (informal USWM), if integrated into the main actors, will be remarkable, and attention needs to be paid to the informal sector if Nigeria wants to achieve significant targets and indicators of Goals 1 and 11…*" The informal sector is critical for the economic development of sectors, and the waste industry cannot be exempted (P1, P3, P12, P13, P23, P28, P30, P34, & P39). The role of cart pushers in unplanned and sub-urban locations cannot be over-emphasised. Participant P14 says, "*…in Nigeria's major cities, the formal urban waste managers are overwhelmed with households' solid waste and compounded with 'epileptic trucks' leading to poor services. If not for cart pushers in my area between November 2022 and February 2023, an epidemic may have erupted because of the faulty truck. Can you imagine what would have happened if cart pushers were not there to render services...?*" Findings show that besides creating jobs for the low-income group via the service of cart pushers, they assist in cleaning the environment. Other roles are:

Increase revenue generation (majority).

Enhanced inclusion (P22–P28, P32, P35, & P38–P40).

Charges are fair compared to the formal USW managers (P1–P7, P14, P24, P34, & P38).

Specialist and embrace recycling (scavengers) (majority).

Create employment potentials (majority).

Mitigate society vices (P7, P14, P22, P30, P35, P37, P39, & P40)

Also, findings reveal that most cart pushers are experts in manually sorting out recycling materials. Recycling is critical to sustainable development and should be embraced (majority). "*…recycling is a critical and most productive way to help make the planet a better place. Recycling can be overwhelming, but it's the easiest if made a normal routine…*" said Participant P10. Also, this model is profitable to society because it mitigates the threat of people who may have become a threat to society by employing them through inclusive USWM policy.

4.2. Theme two: Encumbrances facing cart pushers in the solid waste sector

This theme identifies the issues facing cart pushers in the USWM sector. Findings reveal that many of Nigeria's Environmental Laws, like Lagos State, prohibit cart pushers and those patronising them. The illegality of the job is the most complicated issue facing cart pushers without consideration of the services rendered. The lack of government support is unquantified, and their services are branded as criminal acts. Participant P28 says, "*…it's painful to see Lagos State Government implementing the 2018 law than ban cart pushers without making provision for efficient trucks to evacuate USW from locations to the designated sites. This is more pitiable, stopping the means of livelihood of some Nigerians who are attempting to contribute to economic growth…*" Please refer to **Figure 2**. Other issues are:

Absence of statutory regulation (majority).

Labelled illegal job (majority).

Restricted from government dumpsites (majority).

Shortage of sites to deposit USW (majority).

Unplanned locations (P3, P10, P12, P33, & P38).

Inefficient collection methods (P17, P20, P22–P28).

Inadequate coverage of the collection system (P8, P12, P18, P23, P29, P35, & P39).

Funding for recycling equipment (majority).

Attitude towards digital innovation and lack of training (P5, P16, P23, P30, & P36–P40).

Consigned informal waste sector to the bottom (P5, P16, P23, P36, & P39).

Municipal solid waste management (MSWM) excludes the informal economy (majority).

Lack of awareness and poor education background (P7, P14, P23, P29, P34, & P40).

Figure 2. Lagos state enforcement team.

Source: Modified from Adedamola (2024).

Among the 12 emerging issues, the absence of statutory regulation, labelled illegal job, restricted from government dumpsites, shortage of sites to deposit USW, funding for recycling equipment, and municipal solid waste management (MSWM) excluding the informal economy were frequently identified as issues facing cart pushers in the solid waste sector. Findings agree that most people in this category are less educated in the community. Regarding restriction from government dumpsites, findings reveal that some cart pushers dispose of their waste uncoordinated and improperly planning in bin collection, leading to air pollution and other environmental hazards. Participant P18 says, "*…their services would have been useful in sub-urban and unplanned locations, but some of these cart pushers perpetuate unethical practices at night, leading to environmental nuisance…*" The consequences of unethical practices include the emergence of most illegal dumpsites and the dumping of waste on road medians and in the canals (Participants P8–P21, P29, P34, P37, &

P39). Lack of training regarding waste management in the informal sector is challenging and encourages mediocracy in the waste industry. This is because of a lack of professionalism and inadequate basic knowledge of solid urban waste regarding recycling mechanisms. These issues, among others, can be addressed to promote embracing cart pushers into the formal stream because of their relevance in sub-urban and unplanned locations. Moreso, many developing countries' formal waste management systems cannot successfully manage waste without collaboration with the informal sector to yield optimum results. The next sub-section presents the measures.

4.3. Theme three: Cart pushers' role in improving achieving SDGs 1 and 11

This theme proposes measures to improve the achievement of SDGs 1 and 11 by integrating cart pushers into PSP waste management systems. Findings show that inclusiveness is a critical attribute of the SDGs. Participant P36 says, "*…the world is tailored towards inclusiveness and engagement of stakeholders to enhance productivity and healthy working environment. This is key to achieving SDGs…*" Findings agree that global development thinking concerning USWM has drawn attention to the relations between SDGs and inclusive USWM (majority). Other measures are:

Informal USWM, like cart pushers, should be recognised (majority).

Cart pushers should embrace advanced technologies in managing USW to recycle materials (P3, P7, P15, P28, P34, P38, & 40).

Framework to regulate practices (majority).

Inclusiveness of the informal sector (majority).

Provide a roadmap to embrace implementation (regulate cart pushers operation) (P37, P39, & P40).

Sensitisation and upskilling/re-training on how to manage waste (P29, P34, & P39).

Access to government-designated dumpsites (majority).

Collaboration with PSP or PPP for effective service delivery (P7, P22, P29, P34, & 39).

Among the eight emerging measures, informal USWM like cart pushers should be recognised, a framework to regulate practices, inclusiveness of the informal sector, and access to government-designated dumpsites were frequently identified as measures to improve achieving SDGs 1 and 11 through integrating cart pushers into PSP waste management systems. Also, for progressive efforts toward USWM in Nigeria, the informal sector needs to be recognised. This is pertinent because of its role, especially in sub-urban and unplanned locations. Besides, one is sure of its sustainability with a good framework to regulate its practices. Also, findings reveal that MSWM reform across major cities is inevitable because of the increasing population rate, especially sub-urban locations. The reform should integrate the inclusiveness of the informal sector from the start of the recycling to its completion. This is germane because informal MSWM can advance green and inclusive development if well implemented (majority). Also, from observation, cart pushers are

experts in recycling (separation of waste); though done manually, it can promote a recycled-based society, thus contributing to the actualisation of SDGs 1 and 11. The outcome will reduce poverty by creating more jobs for more people engaged in recycling and making the community safe, resilient, and sustainable (majority). Cart pushers are experts in scavenging and recycling urban solid waste materials (majority). Participant P38 says, "*…the separator and recycling skills in them are unquantified and can be fruitful if harmonised and engaged formally. They know how to engage house users to separate their waste for economic reasons. My neighbour separates his steel and cartoon paper from perishable waste, including can containers. Sometimes, he is given a certain amount against him (waste owner), paying the cart pushers based on the separated waste that has economic value…*"

5. Discussion of findings

Findings reveal that formal urban waste managers are overwhelmed with households' solid waste. This is complicated with incapacitated trucks, leading to poor service delivery, especially in remote locations. A quick check on the newsprint shows that the operation of the Lagos State Waste Management Agency and its Public-Private Partnership agents is poor in some areas, like the Okota area of the state, as of 2019 (Nwachu, 2019). Likewise, the same issue with the Rivers State Waste Management Agency (Ikiriko et al., 2024). Hence, the role of cart pushers remains largely unexplored making this study novel. Cart pushers, operating informally, are often overlooked despite their significant contributions to waste management, especially in remote locations. This research breaks new ground by emphasising their role and recommending ways to integrate them into formal waste management systems, particularly in developing countries like Nigeria, to achieve Goals 1 and 11. There are challenges facing the cart pushers, especially the absence of government support. Results align with Mbah and Nzeadibe (2017) and Zadawa et al. (2015). Zadawa et al. (2015) found that the Nigerian Government does not recognise the informal sector, like cart pushers in USWM. Mbah and Nzeadibe (2017) discovered that the lack of an inclusive informal waste management sector as one of the notable gaps in the Nigerian MSWM. Meanwhile, studies such as Nzeadibe and Mbah (2015) found that the informal waste sector has progressively become an advantage in helping cities mitigate waste management costs. A quick check on the newsprint on the 6 February 2024 saw some seized cart push trucks by the Lagos Waste Management Authority (LAWMA) enforcement team (Adedamola, 2024). Please refer to Plate 1. Nwachu (2019) found that indiscriminately dump on major roads and highways necessitated the ban in Lagos State, Nigeria. The consequences of illegal dumpsites and the dumping of waste on road medians are heavy. This action may have contributed to extreme flooding in these cities for the past four years, especially in Lagos (Princewill, 2021), Benin City (Aliu, 2020), and Port Harcourt (Ibunge, 2021).

For measures to improve the achievement of Goals 1 and 11 through integrating cart pushers into PSP waste management systems, findings agree with Brown and MacGranahan (2016), Gupta and Vegelin (2016), Mbah et al. (2019) and The United Nations Department of Economic and Social Affairs (UNDESA) (2015). Gupta and Vegelin (2016) emphasised that the debate for inclusive development is motivated by

environmental, security, social, economic, legal, and moral benefits. This is summarised in some of the Goals, including Goals 1 and 11 (UNDESA, 2015). Brown and MacGranahan (2016) discoursed that issues of spatial and socio-economic inclusion of the informal sector concern the global development agenda. This is part of the study's motivation and emphasis that fruitful dialogue among stakeholders is the way to go in this new era for successful MSWM planning and interventions (Abdulfatah, 2023; Lederer et al. 2015). Regarding integrating cart pushers into the major actors' stream of the USWM and embracing digitalisation for recycling processing, results align with Zadawa et al. (2015). They suggested that suitable digital technologies need to be explored. Also, for progressive efforts toward USWM in Nigeria, the informal sector needs to be recognised. This is pertinent because of its role, especially in sub-urban and unplanned locations. Besides, one is sure of its sustainability with a good framework to regulate its practices. The reform should integrate the inclusiveness of the informal sector from the start of the recycling to the completion. The findings agree with Mbah et al. (2019). They found that integrating the informal MSWM policy into the sector may evolve an inclusive growth mechanism while enabling sustainable USWM to achieve SDGs, including Goals 1 and 11.

6. Implication and benefit of this study

This study encourages embracing an informal waste sector mechanism to improve achieving SDGs 1 and 11 through integrating cart pushers into PSP waste management systems in Nigerian cities. Findings show that the benefits cut across the three pillars of sustainable development (social, economic, and environmental). Evidence reveals that in the era working towards achieving SDGs in less than a decade, inclusive (formal and informal) is a key variable required by most SDGs and their targets to improve achieving SDGs, including Goals 1 & 11 (Brown and MacGranahan, 2016; UNDESA, 2015). It implies that excluding the informal waste sector from Nigeria's USWM policy (Mbah and Nzeadibe, 2017; Zadawa et al., 2015) may be counter-productive in achieving SDGs. Therefore, encouraging stakeholders, especially policymakers, to embrace the informal waste sector (cart pushers) to the mainstream, enhance better performance for job creation, and sustainable cities and communities across Nigerian cities cannot be over-emphasised. Academic materials concerning how cart pushers can improve achieving SDGs 1 and 11 if embraced in USWM in major cities and the encumbrances facing them are scarce. This study has addressed this gap, among others.

Regarding the research's practical implications, these recommendations will support and offer a better perspective into the encumbrances facing cart pushers and contribute to educating waste management stakeholders to develop an enabling environment to embrace the informal urban solid waste sub-sector into the mainstream. Besides the significance of the informal sector as encapsulated in some of the SDGs (UNDESA, 2015), the inclusion of the informal sector is of interest to the international development agenda (Brown and MacGranahan, 2016), to enhance inclusive development and stimulate support for employment creation. The development cuts across environmental, security, social, economic, legal, and moral aspects. For

effective enforcement and implementation of USWM policy, meaningful dialogue is required among formal and informal waste managers. Also, the study intends to stir up household USWM stakeholders, including policymakers, to create reforms to improve cart pushers and their associates' lives and waste management performance in Nigeria. As a matter of urgency, USWM policymakers should formulate inclusive policies to integrate the informal waste sector into the mainstream. The recognition of the informal waste industry is long overdue to enhance sustainable clean-up in cities and communities.

From the social implications, the study argues that excluding the informal waste industry from the mainstream would enhance ill-vices-related social needs in solid waste governance, which the informal waste sector engagement tries to mitigate. The researchers suggest measures that would be used to engage cart pushers and others in the informal waste sector for inclusive development to improve achieving Goals 1 and 11 in Nigeria. Hence, this study emphasises that the informal sector, including the waste sector, is key to achieving SDGs targets (UNDESA, 2015). Goal 11 (making cities and human settlements inclusive and sustainable) is among the top three SDGs relevant to the informal sector. Findings reveal that the cart pushers' mechanism/model creates more jobs and improves the USWM system. This is the focus of Goal 1 (eliminate poverty). Besides job opportunities, many that would have become a threat to society are engaged through this means. This is profitable to the society.

7. Conclusion and recommendations

This study explored how wealth and jobs can be generated from USWM through a systematic and all-inclusive (formal and informal actors in the industry) approach. The study appraised the role of cart pushers in sub- and urban, investigated the encumbrances facing them, and proffered measures to improve achieving SDGs 1 and 11 through integrating cart pushers into PSP waste management systems in developing cities, using Nigeria's cities for the study. The study identified the significance of cart pushers to the developing economy in terms of job creation, efficiency, and productivity in USWM, clean cities and communities, society's safety, and bridging income inequality (mitigating poverty). Despite these benefits, cart pushers face challenges. The study offered measures to improve the achievement of SDGs 1 and 11 by integrating cart pushers into PSP waste management systems in Nigerian cities. Although a few policy remedies to embrace the inclusion of the informal waste industry have been made, as reported, they are comprehensive regarding large coverage like the current and specific to cart pushers. The current paradigm would require mainstreaming the informal sector in USWM policy. The study argues the economic and financial benefits to society and the environment in all ramifications (increased employment and better sustainable cities). This study concludes that revising the USWM policy in Nigeria's major cities will inevitably align with global best practices and stimulate support for employment creation and sustainable cities and communities. The proposed revised policy should embrace the informal waste sector, recognise it, and be guided by specific rules and regulations. This is germane to improve achieving SDGs 1 and 11.

This study has limitations. The study's qualitative research design and coverage of seven Nigerian cities are possible hindrances to the findings' generalisation. However, the in-depth literature review, coverage of the top two largest cities (Lagos and Kano), and experts' participation would mitigate any negative influence on the overall findings. For future studies, the researchers suggested a mixed-methods research design to enhance generalisability and validate new constructs. Also, future studies should consider embracing advanced technologies and integrating cart pushers for efficiency. Integrating cart pushers into the formal waste sector would improve achieving Goals 1 and 11 and its targets. Therefore, the research proffered measures as follows:

1) The government should formulate feasible policies and laws promoting and embracing cart pushers and associated activities as components of formal USWM. The government should lead and give direction to other stakeholders. This is pertinent. It should be an inclusive policy initiative supporting informal activities in USWM. This is missing in many Nigerian cities, including Lagos State. This policy should include an institutional framework regarding rules, regulations, and penalties for defaulters. The cart pushers may have to register under the formal waster managers but are supervised by the government agencies as the regulatory authorities to avoid abuse of privileges. This process would take control of the locations and management of dumpsites linked to the cart pushers via the based company (main waster manager).

2) The study recommends that laws banning cart pushers and associated activities should be reviewed and regulated to enhance the smooth operation of the informal waste industry. Clauses that would recognise and regulate their activities should be inserted in the revised version and fully harness the informal economy's potential to improve stakeholders' lives and livelihoods. This process would mitigate the perception of vulnerabilities in making wealth or income from the informal waste sector.

3) The upskilling and reskilling of cart pushers regarding professionalism in managing urban solid household waste will stir up viable leadership and transformational learning skills in the cart pushers and scavengers. Practical issues regarding manual equipment for on-the-spot recycling should be well-defined and ensure compliance with environmental laws. Therefore, besides creating more jobs for the low-income group because of the process of turning 'waste to money' via separation and recycling, the professionalism of the cart pushers is enhanced through the upgrading training programmes, and productivity is assured.

4) The study suggests more in-depth and specific research collaboration and engagement between academia and the waste industry. This is the best approach to enhance the recycling and sustainability of USWM in a scarce resource-developing country like Nigeria. The role of urban governance in SWM through infusing the informal sector as a critical component of urban governance systems is germane for successful and sustainable cities and communities. To achieve this task, inclusiveness is key and plays a major role. This should be encouraged and sustained.

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Abbreviations

USW	Urban Solid Waste
SWM	Solid Waste Management
USWM	Urban Solid Waste Management
PSP	Private Sector Participation
MSWM	Municipal Solid Waste Management
CLI	Clean Lagos Initiative
PPP	Public-Private Partnership
SDGs	Sustainable Development Goals

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Appendix

Oral interview questions

Dear Participant,

Request for Interview

The urban solid waste (USW) emanating from the increasing urbanisation calls for concern. Integrating cart pushers into the private sector participation (PSP) may bridge the lacuna in sub-urban planning and PSP truck inefficiencies, especially in developing countries. There is a paucity of studies concerning cart pushers' role in sub-urban and issues hindering it from achieving SDGs 1 and 11 in developing countries. Therefore, this research is titled: Urban Solid Waste Innovative Employment Opportunities: The Role of Nigerian Cart Pushers in Promoting Sustainable Development Goals 1 and 11. Specifically, the researchers will achieve the aim through the following objectives:

i) To appraise the role of cart pushers in managing USW in Nigeria.
ii) To investigate the encumbrances facing cart pushers in the solid waste sector.
iii) To offer measures to improve the achievement of SDGs 1 and 11 through integrating cart pushers into PSP waste management systems.

Please note that questions for the interview are going to be within the paper's stated objectives. Responses provided by you will be collated and analysed with those of other interviewees. It will make up the value and contribution to achieving the success of this work. Information provided will be treated with the greatest secrecy.

Hence, the researchers will highly cherish your valuable time in answering the questions.

With regards.

Yours faithfully,

(Research Coordinator)

Basic questions for the participants

1) Please, for record purposes, what is your organisation's name?
2) What is your position in the organisation?
3) How long have you been working?
4) Are you knowledgeable regarding USWM and cart pushers?
5) If yes to question 4, how can you describe the role of cart pushers in managing USW in Nigeria?
6) How can cart pushers be formally recognised in Nigeria's USWM policy?
7) What are the issues facing cart pushers in the USWM sector?
8) Please, tell us what role the key stakeholders can play in improving the achievement of SDGs 1 and 11 by integrating cart pushers into PSP waste management systems?