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Public-Private Partnership (PPP) in residential solid waste management in Ibadan: Challenges and opportunities

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Waste management authorities have adopted different strategies at different times in managing waste in Nigeria. In spite of the various efforts put in place, municipal solid waste remains one of the most conspicuous and repugnant environmental problems that threaten the Nigerian city. This paper examines the challenges and opportunities of Public-Private Partnerships (PPP) in residential solid waste management in Ibadan, Nigeria. Data for the study were obtained from the Oyo State Solid Waste Management Authority (OYOWMA). Findings revealed that the commonly-generated wastes were organic wastes and there existed a mismatch between waste generation and collection. Between 2012 and 2015, city waste managers collected and transported 2,411,145.78 metric tonnes of waste to the four dumpsites in Ibadan. The dumpsites' locations were sub-optimal, surrounded by sprawling neighbourhoods due to inadequacy in urban planning and enforcement of development control. This has adverse effects on the well-being of residents. Municipal solid waste management is capital-intensive and the decline in budgetary allocations to waste management necessitated the PPP user-charges arrangement. This intervention notwithstanding, indiscriminate dumping of wastes continued to be cheap means of disposing of solid wastes, with implications for drainage system and flooding. Waste sorting, recycling and conversion should be given adequate consideration and the informal waste managers should be mainstreamed into the urban waste management architecture.

Key words: Private waste contractors, Oyo State Solid Waste Management Authority, residential solid waste, informal waste collectors, dumpsite, Ibadan.

INTRODUCTION

Individuals, organizations and governments have advanced several definitions to describe the term waste (Cointreau-Levine, 1982; Centre for Africa Settlement Studies and Development (CASSAD), 1998; Harris et al., 2001). Waste is often associated with unused or discarded material (Harris et al., 2001). Kasim and Arobo (2016) conceptualise waste as material thrown away or set aside as worthless. Waste can also be seen as a scrap from the application of any process, or any substance, which requires to be disposed of Igoni et al.

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(2007). Thus, it can be defined as any material discarded as having no consumer value to the person abandoning it (Cointreau-Levine, 1982). However, what an individual calls a waste is subject to the value judgment of such a person. An output of a process may be considered a waste if it has no further use, but it could be a valuable by-product if reused or recycled. Harris et al. (2001) contend that a material is only a 'waste' if it is useless; as soon as it is usable, it becomes a resource.

Waste could be in gaseous, liquid or solid forms. Solid waste is seen as a heterogeneous mass of discarded materials arising from human activities (Wahab and Sridhar, 2014; Kasim and Arobo, 2015). Sources of municipal solid waste can be classified into seven: residential (household or domestic waste), commercial, institutional, street sweeping, construction and demolition, healthcare/sanitation and industrial wastes (Ndum, 2013). Residential solid wastes are generated by everyday activities of a household. These include paper, cans, food waste, yard waste, ashes, glass bottles, aluminium, metal, plastic, and some specific wastes which require special handling, such as household hazardous wastes (electronics, light bulbs, batteries, asbestos) (Ukem, 2008). Residential solid waste has become a major environmental issue in Nigerian cities. With reference to Ibadan, for example, Wahab and Ola (2016) observe that solid waste has become one of the most challenging and enduring urbanization-induced challenges.

Waste generation has been on the increase since 1960 in Ibadan. The rate of waste generation increased from 0.37 kg/capita/day in the late 1960s/early 1970s (PAI Associates, 1982; Egunjobi, 1986, 2008) to 0.55 kg/capita/day between 2012 and 2015 (Odewumi et al., 2016; Wahab and Sridhar 2014; OYOWMA, 2017; World Bank, 2017). In 2012, about 635,000 tons, approximately 0.55 kg/person/day quantity of waste was generated in the city (Odewumi et al., 2016). Oyelaran and Rufai (2015) disaggregate the waste generated in the city of Ibadan into organic waste (accounting for 42% by weight), paper (10%), textile (2%), glass (4%), metal (5%), wood (3%) and plastics (9%). Some of the wastes are hazardous, flammable, or non-biodegradable. Without adequate provision for residential solid waste management, a diverse range of disease vectors will likely breed or feed within and around houses and residential neighbourhoods, reducing quality of life, well-being and hindering sustainable development (Archor, 1998; Asubonteng, 2011; Agbola et al., 2012).

In the past, waste management tends to be the responsibility of the public sector. However, this responsibility cannot be performed exclusively by the public sector because government alone cannot afford the huge financial, technical, administrative and human resources required to carry out the responsibility effectively. It is on this premise that this paper examined the various challenges and opportunities associated with public-private partnerships (PPP) in residential solid waste management in Ibadan, Nigeria.

Conceptual anchor

The concepts of Public-Private Partnership and sustainable waste management provided the conceptual anchor for this study. PPP can be defined as an arrangement between a public body and a private party or parties (including community beneficiaries) for the purpose of designing, financing, building and operating an infrastructural facility that would normally be provided by the public sector (Asubonteng, 2011). Asian Development Bank (ADB) (2012) states that PPP presents a framework that, while engaging the private sector, acknowledges and structures the role for government in ensuring that social obligations are met and successful sector reforms and public investments achieved. It is a contractual agreement between a governmental organization and a private party whereby the latter performs whole or certain parts of the government organization's service delivery, infrastructure provision or administrative function, and assumes the associated risks (Asubonteng, 2011).

Effective PPP structure allocates tasks, obligations, and risks among the public and private partners in an optimal way. The public partners in a PPP are government entities, including ministries, departments, municipalities or state-owned enterprises. The private partners can be local or international entities and may include businesses or investors with technical or financial expertise relevant to the project. The PPP may also include non-governmental organizations (NGOs) and/or community-based organizations (CBOs) that represent stakeholders directly affected by the project.

Effective PPP recognises the fact that the public and the private sectors have certain advantages, relative to the other, in performing specific tasks. The government's contribution to a PPP may take the form of capital for investment (available through tax revenue), transfer of assets, or other commitments or in-kind contributions that support the partnership. The government also provides social responsibility, environmental awareness, local knowledge and ability to mobilise political support. The private sector's role in the partnership is to make use of its expertise in commerce, management, operations and innovation to run the business efficiently (Adegoke, 2011). The private partner may also contribute investment capital, depending on the form of contract. The partnership in residential solid waste management service delivery is expected to reduce the burden of the public sector that is finding it difficult to achieve sustainable waste management.

Afroz et al. (2010) state that sustainable solid waste management involves control of generation, storage, collection, transportation, processing and disposal of

solid wastes in a manner that is in accordance with the best principles of public health, economics, engineering and other environmental concerns. The idea of sustainable waste management, which shows the interdependence of waste management and sustainable development process, was codified at the 1992 UN Rio Conference. At the heart of the Agenda 21 emanating from the 1992 conference is a vision of promoting sustainable waste management. Having examined the opportunities and the challenges of rapid urbanization, most especially in the developing countries, the Habitat Agenda concluded that properly-planned and properly-managed cities hold the promise for human development and the protection of the world's resources by supporting large numbers of people and limiting their impact on the natural environment. A rapidly-growing city with inefficient wastes management systems poses a huge threat to the environment (Babayemi and Dauda, 2009).

One of the most pressing problems facing urban managers in developing countries is how to manage residential solid waste in a sustainable manner. Long-term sustained development cannot occur in situations of deteriorating environmental circumstances and improper management of waste can lead to irreversible destruction of natural resources. Sustainable management of residential waste is imperative if the goals of city managers are to reduce the health-endangering potential of residential solid waste, improve human welfare, and promote sustainable human settlement development.

MATERIALS AND METHODS

Ibadan is located in south-western Nigeria, about 130 km in land northeast of Lagos and 530 km southwest of Abuja, the federal capital. The city is a prominent transit point between the coastal region and the areas in the hinterland of Nigeria. In 2006, the National Population Commission (NpopC) put the population of Ibadan at about 3 million. At present, the national population growth rate is 3.18% and the city's population was estimated to be 3,565,108 in 2018 (World Population Review, 2018). The rate at which the population of Ibadan is growing has significant implications for solid waste generation. As the city is rapidly expanding in area and population, the residential solid waste management issue has become a major urban environmental problem.

The responsibility for solid waste management in the city currently lies with the Oyo State Government, Ministry of Environment and Water Resources, Oyo State Solid Waste Management Authority (OYOWMA) and local governments. Each organ of government has different roles and responsibilities. In terms of waste management, OYOWMA is the statutory body established in 1997 by the state government to undertake waste collection, processing and disposal (Wahab and Ola, 2016). It has the direct and operational responsibility for residential solid waste management in the city. The Ministry of Environment and Water Resources performs a supervisory role over the Oyo State Solid Waste Management Authority. The Oyo State Solid Waste Management Authority is charged with the responsibility of collecting wastes along major roads, markets, inner city areas and other areas not covered by private waste contractors. Prior to Edict No. 8 of 1997 establishing OYOWMA, municipal solid waste collection and disposal were undertaken by the Ibadan Solid Waste Management Authority. The authority was functioning under the Ibadan City Council and later when Ibadan Municipal Government was created, the responsibility was transferred to Ibadan Municipal Council. Later, Ibadan city and its environs were constitutionally divided into eleven local government areas (LGAs) to shoulder the responsibility of collecting, transporting and disposing of municipal solid wastes (Omoleke, 2004; World Bank, 2017). The idea of involving the private sector in residential solid waste management started in 1985. According to Cointreau-Levine (1994), the collection service by licensed private contractors was initiated in 1985 when private franchise of residential waste collection in high-income residential layout areas was implemented.

The data for this research were obtained from secondary sources and they were mainly quantitative. Data were collected from published and unpublished documents of OYOWMA and from the 11 LGAs that constitute the Ibadan region. Information on the number of registered private waste zones and routes covered (Figure 1), mode of operation, frequency of waste collection, time of collection, service charges and quantity of waste collected and transported to dumpsites and maintenance procedure of the dumpsites were obtained from OYOWMA and registered private waste contractors (PWC). A reconnaissance survey was conducted to validate the data obtained from OYOWMA, LGAs and the private waste contractors. Additional data on the PWC were sourced from the records of the Association of Refuse Contractors and the exiting literature. The Master Plan of Ibadan and the Map of Ibadan Region were used to identify the routes, residential neighbourhoods and zones covered by private contractors. Data were analysed using descriptive statistics, with the results presented in map, tables and chart.

RESULTS

Fifty-eight registered private waste contractors (PWCs) were in operation in the 11 LGAs in Ibadan. These registered private contractors collect waste from residential, commercial and industrial zones that are ready to pay for their services (Odewumi et al., 2016; OYOWMA, 2017). Each of the private contractors pays for an operation permit, which often remains valid for a year. The operational permit is granted after the payment of registration and license fees. After meeting statutory requirements, OYOWMA designates areas that each operator is permitted to cover. Currently, 64 routes are covered by the 58 registered private contractors. Table 1 shows residential areas that PWCs cover in Ibadan sub-urban LGAs and Table 2 shows residential areas assigned to private contractors in Ibadan urban area LGAs.

Various routes were covered by the private wastes contractors, the local governments (LGs) and OYOWMA workers. Routes were delineated based on capacity to pay for services rendered. Therefore, all the routes allocated to private waste contractors were within formal and semi-formal residential neighbourhoods, industrial and formal commercial zones. Waste management activities within the informal neighbourhoods, in the city, were managed by either LG or OYOWMA. Private operators and contractors undertook door-to-door collection of wastes mostly from residential buildings

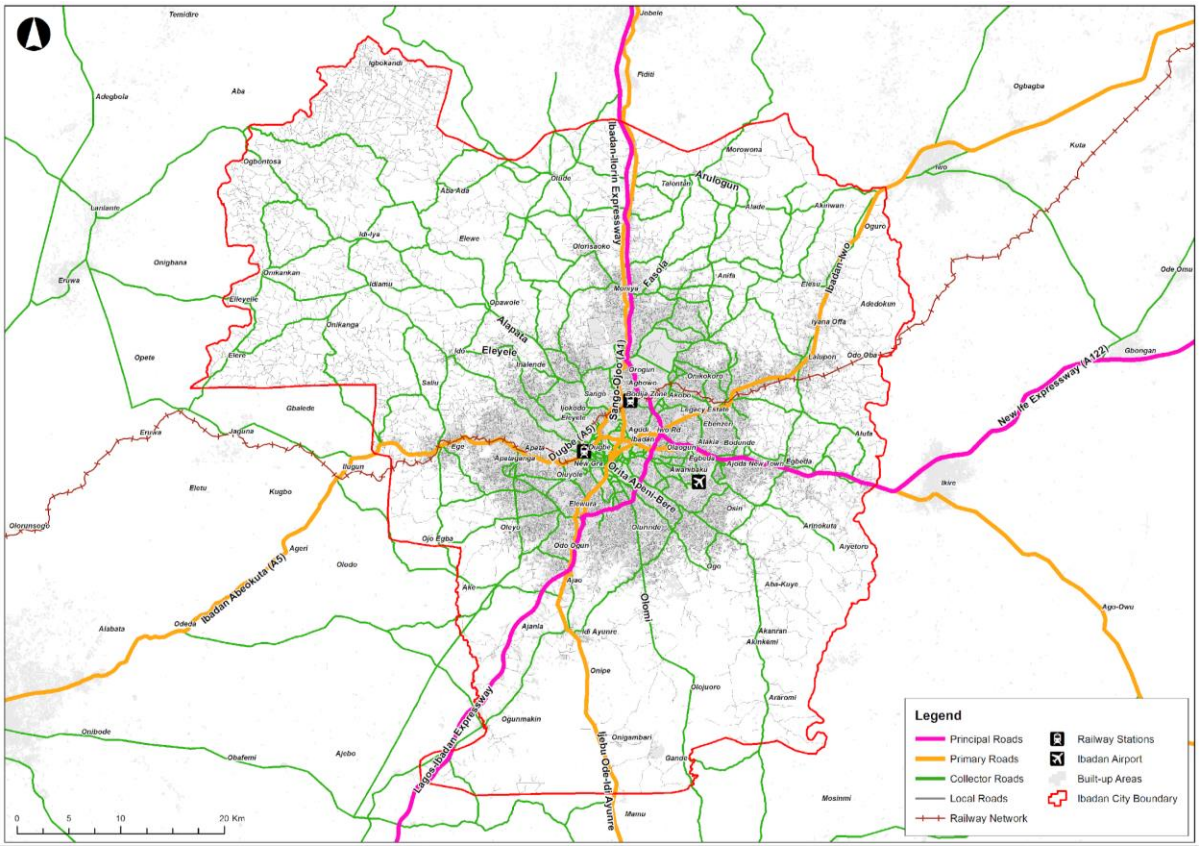

Figure 1. Road networks and routes plied by waste contractors in Ibadan.
Source: Adapted from Ibadan City Master Plan Report (2018).

twice in a month; commercial/institutional buildings three times in a week; and industrial buildings and zones on a daily basis. The mode and time of collection were based on agreed payment structure and service supported by the OYOWMA's laws and regulations. The OYOWMA and some local governments were responsible for general wastes collection, especially along principal and major transport corridors. Part of the function of the agency included collection of wastes dumped along major roads, waste swept by street sweepers, and wastes in public areas and open spaces within Ibadan. Local government wastes managers performed skeletal wastes management activities within the geographical jurisdiction of the LGAs.

Oyo State Solid Waste Management Authority oversees waste collection, street cleaning, and management of landfill sites. The four landfills in the city are easily accessible and located along major routes: Aba-Eku, on Akanran Road; Lapite, on Oyo Road; Awotan, on Akufo Road; and Ajakanga, on Odo-Ona Elewe Road. If the four landfills (covering about 50 hectare of land) are properly managed, they could store up to 3,000,000 tons of wastes (World Bank, 2017). The amount of solid wastes collected and transferred to the landfills by waste management authority was 862,393.70 metric tonnes (MT) in 2012, 2013 (586,436.96 MT), 2014 (503,309.68 MT) and 2015 (459,005.44 MT), as shown in Figure 2.

From 2012 to 2015, OYOWMA, LGs and private waste contractors (PWCs) collected and transported 2,411,145.78 MT to the four dumpsites in Ibadan. Oyo State Solid Waste Management Authority (OYOWMA) transferred and deposited the highest volume of solid wastes (1,477,565.51 metric tonnes). However, there was reduction in the volume of wastes transferred by OYOWMA between 2012 and 2015. In 2012, 658,867.85 metric tonnes were transferred by the Authority but this reduced to 306,941.18 metric tonnes in 2013, 265,176.32 metric tonnes in 2014 and further to 246,580.16 metric tonnes in 2015 (Table 3). This reduction could be attributed to the returning of the wastes collection responsibility to the LGs in 2013. LGs and PWCs were able to transport 327,855.12 and 605,725.15 metric tonnes, respectively within the same period to designated dumpsites in Ibadan.

Previously, OYOWMA collected wastes fees on behalf of PWCs from the households using government revenue contractors. The contractor's evacuated waste generated within the designated routes and zones. Evidence of payment would be presented by the clientele before waste would be evacuated. The OYOWMA, at the

Table 1. Residential neighbourhoods covered by private contractors in Ibadan.

LGA	Route	Residential neighbourhood	Private contractor
Akinyele	1	Ajibode, Shasa, Akingbinle and Moniya	Victom Function
	2	Ojoo, Arulogun, GOFAMINT, Arorokole, Idi-Ose, Shogunro, Abatakan, Shasa and IITA Environs	Addwest Midland
Lagelu	3	General Gas, Akobo Ojurin, Baptist, Basorun Estate and Okebadan Estate	Bukol
	4	Akobo Ojurin, Olorunda Aba, Yawiri, Olewuro, Unity and Wisdom Estates	Dapat
	5	General Gas, Kolapo Ishola and Carlton Gate estates, Iyana Church and Iwo Road	Global Brand
	6	Wofun, Exide Junction, Olodo Bank and Lalupon	Rite Environment
Egbeda	7	Iwo Road, Bishop Philips Academy, Agboola, Adogba, WEMA Area, Gbagi, Raji Alusekere and Shop Mesan	Arkman Associates Nig Ltd
	8	Adeojo Estate, Olaogun (Fash Fash), Gbaremu, Oremeji, Agugu, Onipepeye and Airport Junction	Admack
	9	Iwo Road, Onipepeye, Adegayi, Alakia, Oniyanrin Sarumi, Iyana Agbala, Egbeda, Alakia, Agadebgayi	Everest Dayton
	10	Olubadan Estate, Asaju Area, Adelubi, Agoro, Aroko, Alalubosa, Arolu and Isebo Alakia	Olounnu
	11	Monatan, Iyana Church, Nigeria Brewery Area	Ocean Wave Technical Chemical Product Ltd
	12	Wakajaye, Olodo Garage, Orogbangba, Sakute, Amero, Oki, Kumapayi and Eremu	Gboola-Toyin
	13	Isebo, Papa, Olosan, Akanle, Ogungbade, Ile Tintun, and Aladun and Egbeda	Kumaaz Ventures
	14	Akingbade, Mato, Oluso Aja Meta, Hope, Airport, Gbaremu and Idi Obi Road	Faytem Global
Oluyole	40	New Garage, Podo, Idi Ayunre, Abanla, Arapaja, Aba Ibeji, Kasamu area. Ajide I and II and Agara Environs	Alluvia
	41	Soka, Toll Gate, Atoni Village, Alomaja and Ajanla	Karyz
	42	Ireakari and Abese Estates, Oloruntedo, Irepodun, Elebu Junction, Yidi area, Akure Ajila, Abgeru, Akoto, Ashaupa Owo, Part of Ogunkeye, Araromi, Unity, Idi Aliu and Alaka	T.J Consultancy
	43	Elebu Junction, Akeredolu Street, Part of Eleta, Orita Merin, Olose Community, Aba Paanu, Oke Alaro, the right side of Elebu junction and Jankata	Wallyco
	44	Wallam Hall, D'Rovans Hotel to Mile 110, Gada Area of Odo-Ona, Apata and Oke Ayo	Prime Plus
	45	Muslim Academy and Olomi	Kanfalad
	46	Boluwaji and Sanyo	John
Ido	47	Apete Garage, Lakoto, Arola, Awotan, Orisun, Dump Site and Life Fort	Joy and Goodness
	48	Ologuneru Bridge, Aba-Nla Junction, Lulu Hanah Junction, Adetokun, Ologuneru Entrance, Ajadi and Ologuneru Bus/Stop	BGML
	49	Wema Bank Junction, Apata, Owode Estate and Omi-Adio	Tamfol
	50	Ologuneru Bus/stop to Ekerin Area, Gbopa, Peace Cathedral, Olunde Estate, Idi-Igbaro	Sandel Ventures
	51	Apete Market, Papa, Ori-Oda, Adaba/Akowo Community and Life Fort Environs	Joy and Goodness
	52	Bcj Apata, Adebisi Layout, NNPC, Wire & Cable, Bako and Environs	Five Star
Ona Ara	53	Babanla, Oniyangi and Airport Area	Ona Opemipo
	54	Oju-Odo Olunloyo, Amuloko and Aba Ekun	Ajitop Nigeria Enterprises
	55	Olorunsogo and Muslim	Osundeyi Tijani
	56	Oremeji Agugu, Olorunsogo and Olunloyo	Botreed

Source: Adapted from OYOWMA (2018).

end of every month, paid the private contractors for the services rendered based on agreed sharing formula (OYOWMA, 2016). Most of the private wastes contractors were not satisfied with this arrangement. Currently, the reverse is the case, the private waste contractors collect

Table 2. Residential neighbourhoods covered by private contractors in Ibadan Urban Core LGAs.

LGA	Route	Residential neighbourhood	Private Contractor
Ibadan North West	15	Idi-Ape, Oloronbo Express area and Iwo Road	Shekayate
	16	American Quarters, Yidi Area, Iyana Agbala, I.K Dairo, Holy Trinity, Fagbamila and Iwo Road	X-Clean
	17	Oremeji Agugu, Olorunsogo, Orita Aperin, Adekile, Beere and Iyana Oke-Adu	Richard Akinwale Elect.
	18	Odejayi, Aromolaran, Agugu and Oke-Ibadan	Dumapek
	19	Basorun, Olonrobo, Owo-Ade Adigun Street, Balogun Area and Akobo	Glorious G & C Consult.
	20	Dugbe, Labowo Street, Orita-Merin, Yemetu, New Palace Way, Dandaru, Kube Atenda and Molete Gate	Abbey Nigeria
Ibadan South East	21	Felel Junction, Keshiro, Molete, Scout Camp Area, Felele Express and parts of Boluwaji and Odo-Oba	Prime Reach Limited
	22	Olorunsogo and Academy	Boleso Company Limited
	23	Academy, Odo-Oba, Adeyemo Layout, Back of Ibadan Grammar School, Molete and Beere	Top Legend Citizens Ltd.
	24	J Allen, Iyaganku, Oke-Bola, Oke-Ado, Kobiowu, Joyce B, Oni & Sons, Liberty, Ososami, Cresent, Molefalafia, Ajeigbe, Anfani and Challenge	Babs
	25	Felele Straingt, Felele Express, Soka Bus/Stop, Orita Challenge, Orita Challnge and Yinka Ayefele environs	Adenad
Ibadan North	26	Agodi G.R.A, Ikolaba, Ikolaba Estate, Favours, Aare, Lekan Salami Estate and Oluwo Kekere	Crown FMS Limited.
	27	Bodija Market area, UI, Major Salawu street and Agbowo Junction and Express	H.O.K
	28	Awolowo Junction, Oshuntokun to Preboye Junction, Samonda and Aerodrome Estate	Musan Waste
	29	Awolowo Junction, Redeem Church Side, Adele and Davis,	Admok
	30	Veterinary, Oke Itunu, Sango, Okoro (Baracks Area), After Baracks, Olopo-Meta, Baba Legba and Benjamin	Mowaje
	31	Kongi, Akingboola, Ashi, Winners Way and Oluwo-Nla	Yemron
	32	Orogun and Ojoo	Justo Custodian
	62	Sabo	Garas Global Limited
	63	Onile Gogoro, Adeile Avenue, WEMA Bank Area and Old Tapa Community	Total Care Nigeria Ltd
Ibadan South West	24	J. Allen, Iyaganku, Oke-Bola, Oke-Ado, Kobiowu, Joyce B, Oni & Sons, Liberty, Ososami, Cresent, Molefalafia, Ajeigbe, Anfani and Challenge	Babs
	33	Eleyele, Idi-Ishin, Alafara and Elenu Sonso	Joint Envmtal Cleaning Services
	34	Adeoyo Hospital road, Filade, Mobil, Lister, Federal High Court Area, Mobil, Heritage Estate, Aremolekun and Alebiosu Close.	Alpha-Skin
	35	Mobil, Aare Lanre, Sharp Coner and Ada Ibeji	Metropolitan
	36	Sharp Corner, part of Kuola, Orelope, Aalafin, Oluode and Oke-Alaro	Mega Emolad
	37	Iyana Adeoyo, Bolomole and Eleruwa	Sun Musico
	38	Orita Challenge, Odo-Ona Elewe, Fodasis and Agbaje	Deletech
	39	Aleshinloye, Alalubosa Estate, Odo-Ona, Gbekuba, Akilapa, Ifelodun, Up Jesus and Agbofeti	Poroku
	64	Mile 110, Challenge, Efunsetan, Molete, G Allen and Queen Cinema	Great Good Concept

Source: Adapted from OYOWMA (2018).

wastes and fees directly from households. The amount paid, per building, varies across neighbourhoods and is influenced by frequency of evacuation. To maintain the existing dumpsites, the private waste contractors are made to pay a fixed dumpsite access charges. The amount to be paid depends on the category of wastes conveyed to the dumpsites. The access charges by OYOWMA for industrial waste is ₦5,000 (16.4

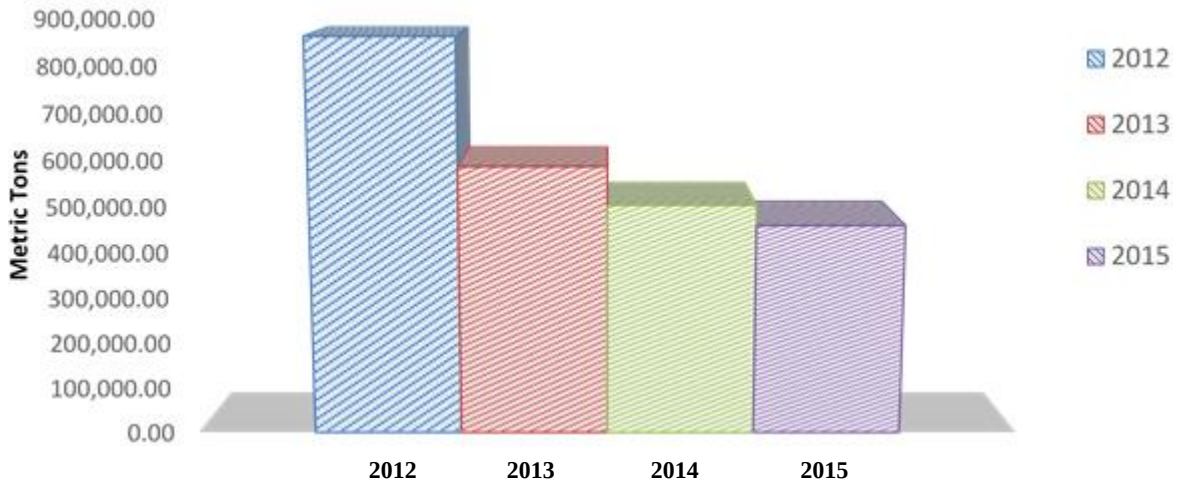

Figure 2. Amount of solid wastes collected and transferred to dumpsites (2012 - 2015).
Source: OYOWMA (2017).

Table 3. Solid wastes transferred by OYOWMA, LGs and PWC (2012 - 2015).

S/N	Year	OYOWMA (MT)	LGs (MT)	PRC (MT)	Total (MT)
1	2012	658,867.85	73,288.20	130,237.65	862,393.70
2	2013	306,941.18	135,460.61	144,035.17	586,436.96
3	2014	265,176.32	90,902.24	147,231.12	503,309.68
4	2015	246,580.16	28,204.07	184,221.21	459,005.44
Total		1,477,565.51	327,855.12	605,725.15	2,411,145.78

Source: OYOWMA (2017).

Table 4. OYOWMA sources of funding for the 2014 budget.

Source	Cost (₦ per year)
State Government	1,248,164,800
Local Governments	198,000,000
Total	1,482,164,800

Source: OYOWMA (2017).

USD); commercial waste is ₦ 3,500 (11.5 USD) and household waste is ₦ 2,500 (USD 8.2) per truck. The major financier of solid waste management services in Ibadan is the Oyo State Government. Table 4 indicates that, in 2014, the LGs contributed only ₦198 million (15.9%) to funding of municipal solid wastes management. The financial contributions of the PWC could not be easily ascertained owing to a number of issues, which include variation in staff wages, poor management structure and equipment holding and inability of most of the PWCs to quantify operation costs in terms of fuelling, mileage covered per operation, and staff and other logistic requirements.

Owing to limited budget and adequate capacity, OYOWMA could not effectively manage the increasing amount of solid waste generated. For example, OYOWMA's total budget for 2014 was ₦11,844,972. The internally generated revenue for the agency in the years under review was as follows: revenue from the registration of PWC (₦1,355,000), revalidation of old permits and change of title (₦889,000), dumpsites usage charges acquired from PWCs (₦8,663, 472), and fines for contravention of environmental laws (₦937, 500). The annual budget for year 2014 was about ₦12 million. However, the operation cost for the same year was about ₦1.5 billion. The break-up of OYOWMA annual revenue

Table 5. The OYOWMA annual revenue for 2014.

Source of financing	Costs (₦)
Registration of private refuse contractors	1,355,000
Revalidation of old permit and change of title	889,000
Refuse dump usage charges acquired from private refuse contractors	8,663,472
Fines for contravention of environmental laws	937,500
Total	11,844,972

Source: OYOWMA (2017)

Table 6. The OYOWMA operation costs in 2014.

Cost lines	Costs (₦)
Staff costs (Salaries)	42,200,000
Equipment costs	669,000,000
Truck fuel and maintenance	174,164,800
Other costs (clean street initiative, etc.)	596,800,000
Total costs	1,482,164,800

Source: OYOWMA (2017).

Table 7. OYOWMA own trucks for solid waste collection.

S/N	Name of truck	Number of Units
1	Mitsubishi Canters (Ro-Ro) - side loading	10
2	Leyland Skip Eater Compactors - rear loading	3
3	Sterling Goliath Compactors - rear loading	9
4	Leyland Ro-Ro	2
5	Toyota Tipper	1
6	Bedford Tipper	1
	Total	26

Source: OYOWMA (2013).

and operation costs in 2014 are contained in Tables 5 and 6. Further analysis of the revenue revealed that staff costs (salaries) alone was more than ₦42 million, equipment costs (₦669, 000,000), truck fuel and maintenance (₦174,164,800) and other costs, such as the street sweeping initiative (₦596,800,000).

There was a major mismatch among internally generated revenue, budgetary allocation and operation cost. The capacity of the state government to fully finance OYOWMA has been continuously challenged by the Nigerian economic outlook. This is further compounded by the unwillingness of individuals and communities to pay for service rendered by waste managers. Waste management service has always been provided by government as social good, which is not sustainable. This has implications for the efficiency of waste management apparatus manifesting in mountains of uncollected waste dotting the nooks and crannies of the city. The challenge is daunting and seemingly unsurmountable. Thus, the authority finds it extremely difficult to perform its statutory functions, thereby turning the city into a public dustbin susceptible to environmental hazard (Omoleke, 2004; World Bank, 2017).

Given the population of the city, the number and state of the available vehicles coupled with the condition of roads in Ibadan, the operation vehicles owned by OYOWMA, shown in Table 7, were not enough for effective waste collection in the city. However, the available operation vehicles were relatively new, standardized and appropriately designed. The PWCs, which are expected to be a viable alternative to government agencies did not perform better. The operation vehicles of the PWCs were old, unstandardized and inappropriately designed. The PWCs did not perform optimally owing to paucity of funds and inadequate equipment to operate as expected. The private contractors

used all kinds of trucks, not specifically designed for waste collection. The capacity of the vehicles in use was about 5 to 10 tons. Most of the PWCs operated on a small scale and supplemented vehicular needs by hiring vehicles for waste management operations.

DISCUSSION

Constitutionally and within the tenets of the local government reform of 1985 waste management is a primary function of the local government in Nigeria. OYOWMA, in 2015 alone, was responsible for more than half of the waste collected in the city with only 26 trucks, as indicated in Table 5. The roles of LGs and the private contractors in solid waste collection and transportation were not significant. In Ibadan, as noted by World Bank (2017), the LGs were responsible for about 6% of the waste collected, while more than 50% of the waste collected was done by OYOWMA. The private contractors were able to cater for about 40% of the total waste collection. The private sector has been involved in solid waste collection in Ibadan for more than three decades. The amount of solid wastes collected and transferred to the existing dumpsites by both the private and public sectors between 2102 and 2015 was 2,411,145.78 metric tonnes. However, the public sector was responsible for the collection and transfer of 1,805,420.63 metric tonnes. The private sector was able to transfer 605,725.15 metric tonnes only within the same period. With the government's drive towards public-private collaboration, there is a lot to be done by PWCs in waste management in the city.

Egunjobi (2008) claims that the greatest challenge to waste management is lack of congruence between the rate of generation and collection of wastes. The rate of urbanization has given rise to the immense and ever-increasing amount of solid wastes generated. The wastes have long outstripped the capacity of nature to assimilate them and of city authorities to collect and dispose of the waste generated safely and efficiently (Agbola, 2001). This necessitated the involvement of private waste contractors to complement the efforts of the public agency. However, the PWCs have been inundated with several challenges. The most significant of these challenges is paucity of funds. It is also noted that the private contractors are not able to access the finance they need to improve the quality and efficiency of their operations (World Bank, 2017). The uncollected waste causes different social economic menaces, like diseases, city eyesore, clogging of drains, pollution, and disruption of infrastructural systems and normal community life (World Bank, 2006).

Ideally, with public-private partnership, the collection of residential solid wastes should be effective, efficient, and predictable. However, this is not the case in Ibadan; waste management in the city is inadequate. What has developed is a combination of private and public initiatives that ultimately culminate in collection of waste from one neighbourhood and depose of it somewhere else within the neighbourhood or at open dumpsites (Wahab and Sridhar, 2014; Odewumi et al., 2016).

Residential solid wastes transportation is capital-intensive, especially in the area of equipment and vehicle procurement and running cost. Normally, one truck can handle waste collection for 7,000 inhabitants under public operation or 10,000 inhabitants under private operation. Therefore, for a city as big as Ibadan, at least 400 - 570 collection trucks would be needed. In 1995 when the exchange rate was fixed at ₦22 to US$1, a skip vehicle, according to Agbola (2001), cost approximately ₦15 million. Today, the official exchange rate is ₦305 to US$1. In Nigeria, city authorities are hard pressed to obtain enough capital to finance a sustainable residential solid waste management system. In 2014, for instance, while the total budget of OYOWMA was N12 million, the operations cost for the same year was N1.5 billion. The private contractors use or hire trucks that are not specifically designed for residential solid waste collection and transportation.

Wastes cannot be managed by merely disposing of them into the environment. About 75% of the solid wastes collected in most Nigerian cities are disposed of in open dumpsites erroneously called sanitation landfills (Agbola, 2009; Kasim and Arobo, 2016). Open dumpsites are rampant, and a misnomer as an alternative to sanitary landfills. Sanitary landfill, as perceived by Heeramun (1995), implies a controlled operation employing an engineering method in which waste is deposited in excavated land or in strip mines, compacted to the smallest practical volume and covered with a layer of soil at the end of each day's operation. Currently, all the landfill sites managed by OYOWMA could best be described as open dumpsites. In addition, the locations of these dumpsites are sub-optimal. The four dumpsites in Ibadan were initially located in the suburb areas of Ibadan. Currently, these dumpsites are surrounded by sprawl neighbourhoods owing to ineffective physical planning structure and poor enforcement of development control. Informal waste scavengers and material recovery at the dumpsites are allowed (Wahab and Ola, 2016).

Solid waste management suffers a setback due to unwholesome waste disposal habits of the citizens as well as inadequate funding and poor enforcement of sanitation laws (Sangodoyin, 1993). Typical negative impacts of poor waste management include blockage of waterways and the drainage system leading to flooding as well as health hazards from human contact with untreated waste (Agbola, 2001; Agbola et al., 2012; OYSG, 2013; Ojolowo and Wahab, 2017).

There are different methods of sustainable residential solid waste disposal methods. The use of organic recycling (the biogas option) should also be considered in Ibadan. Through recycling, foreign exchange is saved,

natural resources are conserved, industrialization is promoted and wasted disposal cost is minimized (Cointreau-Levine, 1994). The current attraction of recycling in waste management operations is necessitated by the high cost of industrial raw materials and high level of poverty and unemployment. Poverty has motivated government refuse collection workers, private workers and scavengers to operate various sorting and recycling systems. With recycling opportunities, scavengers are motivated to search for materials which are reusable, such as plastics, metal scraps, steel rods, bottles, cartons, cardboards, used papers from waste dumps and dustbins in residential areas (Wahab and Ola, 2016). Agbola (2001) observes that waste recycling can no longer be treated lightly in view of its many inherent advantages needed to be tapped. The present harsh economic condition, coupled with the high rate of unemployment in the country, provides justification for mainstreaming informal waste recycling enterprises. Through residential solid waste recycling, foreign exchange will be saved, natural resources will be conserved, industrialization will be promoted and waste, storage, collection, transportation and disposal costs will be is minimized.

The informal sector has been actively involved in recovering recyclable materials from generated residential solid wastes. Items recovered are either reused or used to mend other materials or sold directly to retailers and merchants of relevant industries. Such items include paper, polythene, wood, metal scraps, bottles, saw dust, ashes, rubber, bones and plastics. The so-called "*scavengers*" sort and recover valuable materials from the waste along their way. There are about 200 informal waste pickers (*scavengers*) recognised by OYOWMA across the four dumpsites. The informal actors recover significant amounts of waste and sustain a market in recyclable materials (World Bank, 2017).

The informal sector has not only grown in Nigeria but it has also emerged in new guises and unexpected places, such as residential waste collection and disposal sites. Supporting informal waste enterprises and improving informal jobs in residential solid waste management are now recognized as key pathways to promoting sustainable urban growth and reducing urban poverty. The policy dilemma appears to be how to contain the adverse environmental impacts of many of the activities of the urban informal sector without disrupting livelihoods and causing social distress; how to promote environmental awareness and guarantee the right to the city, while at the same time protecting the vulnerable groups in the informal sector from harm and exploitation (Nwaka, 2005).

Mainstreaming the informal waste sector is not automatic and does not depend solely on the informal waste enterprises themselves. The opportunities for development of this sector and for it to fulfil its roles in the transitional economies and provide employment opportunities for the less educated and formally unemployed must be supported by creating an enabling environment which takes into account their particular characteristics. The contributions of the informal waste sector to human livelihood show that the poverty circle can be escaped from and a faster rate of urban economic growth and development can be achieved. Thus, enhancing the productivity of informal waste businesses/activities and making them competitive is crucial, as they absorb the job-seeking citizens, most specially the youth. Also, community participation in solid waste management is always required because solid waste management is a continuous maintenance system, involving for example storing the garbage in a specific bag or bin, bringing it to an agreed collection point, and separating the contents of the waste (John, 2015). This is an effective way of providing solution to "Not in My Backyard Syndrome". Community participation in solid waste management is perceived by Egunjobi (2008) and Wahab and Ola (2016) as important as any other urban service.

Conclusion

The responsibility for residential solid waste management in Ibadan lies with the public and private sectors, but the public sector still remains the dominant actor. The role of the private sector in residential solid waste management has not been significant. With public-private partnership, the collection, transportation and disposal of residential solid waste should be efficient but this is not the case in Ibadan where refuse collected from one area is deposited somewhere else within the city or at open dumpsites. Despite various efforts aimed at managing wastes in Ibadan, the residential solid waste problem still remains one of the most conspicuous and repugnant aspects of environmental problems in the city. The major challenges facing PPP in residential solid waste are limited budget and equipment; improper locations of solid waste containers; the capital-intensive nature of solid waste transportation; and inadequate capacity to handle the increasing amount of residential solid waste generated. While the locations of the open dumpsites serving the Ibadan metropolis are sub-optimal, informal waste pickers have been recognised by OYOWMA across these dumpsites. High levels of poverty, harsh economic condition and unemployment have motivated waste scavengers to embark on waste sorting and recycling. Informal waste businesses will not only play significant roles in employment creation, but they will also reduce crime and government expenditure on security and legal services.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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