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A Comparative Analysis of the Operational Characteristics of Informal Waste Collectors: The Case of Ibadan and Abuja, Nigeria

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Abstract: Informal waste collectors (IWCs) have been visible actors in the municipal waste management sector of many cities in Nigeria. Various studies have made attempts to study the operational characteristics of IWCs, however, less emphasis has been made to examine the variations in their operational characteristics across cities in Nigeria. This paper attempts to fill this gap using Ibadan (Oyo State) and Abuja (FCT) as examples. The choice of the two cities was informed by the variation in their access to waste management resources. While Abuja is a federal government-controlled municipality with more resources, Ibadan is a state-controlled municipality with fewer resources. A structured questionnaire was randomly administered to 418 IWCs in both cities. Descriptive and inferential statistics were used in the analysis of the data collected. Abuja IWCs evacuated more waste daily (312 kg) than Ibadan (255 kg). All the sampled Abuja IWCs (100%) used push carts to evacuate wastes while 78.5% of Ibadan IWCs used push carts; Abuja IWCs earned more income (N7,500 daily) compared to Ibadan (N3,000 daily). There was preponderant use of public stationary containers for waste disposal by Abuja IWCs than Ibadan. Few Ibadan IWCs used personal protective equipment (PPE) compared to Abuja. Regression analysis showed that the volume of waste collected by IWCs is influenced by the waste collection fees, method of waste transportation and distance between the collection points and disposal sites. It is therefore recommended that adequate provision of public stationary containers will encourage better waste disposal among the IWCs.

Keywords: Informal waste collectors; operational characteristics; service charge; waste disposal; waste management.

I. Introduction

The rapid growth of the urban population combined with the relative increase in standards of living; and changing consumption patterns have significantly contributed to the increase in the volume and composition of solid wastes generated in most Nigerian cities today [1]. This has invariably created a major challenge for urban managers as many municipalities have to grapple with municipal waste management at the expense of the provision of other public goods and services. As observed by [2] municipal waste collection involves large expenditures and difficult operational problems because it is expensive to operate in terms of investment costs (vehicle fleets), operational costs (fuel and maintenance) and environmental costs (emission, noise and traffic congestions) which ordinarily many municipalities, considering the limited resources at their disposal, may not be able to cope with.

In Nigeria, municipal waste management since independence has been characterized by routine formality and bureaucracy because it is driven largely by the state and local government authorities and agencies as well as formal private waste management companies [3], [4], [5] and [6]. However, the last two decades have witnessed

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the entry of informal waste collectors into the municipal waste management sector in many Nigerian cities and there appears to be a growing acceptance of these informal actors by the urban dwellers [7]. Informal waste collection involves the provision of waste collection services, often in low-income neighbourhoods not served by municipal waste services [8]. IWCs usually use pushcarts, donkey carts, horse carts and motorized vehicles to transport waste and charge a pick-up fee to residents [9]. They are found to be highly effective in waste collection, especially in the high-density residential areas of cities, where municipal waste services are ineffective and are readily available when needed by a significant part of the population [10]. For instance, Male (capital of Maldives), lacks municipal waste service and IWCs provide this service to most of the population in the city [11]. While IWCs are recognised as important for waste management in many cities of the Global South, their activities are generally labour-intensive, low-tech, low-paid, and often managed autonomously or in the family [12].

Many studies have been conducted to examine the operational characteristics of IWCs in some cities in developing countries including Nigeria. [13] averred that the collection of waste by IWCs is carried out in accordance with the spontaneous needs of households and small commercial institutions. Thus, collections are done without any fixed schedule and the service is delivered by itinerant individuals [14]. Since waste collection is done mainly based on the requests of households and small commercial institutions, payments are made for every service the users receive rather than based on monthly arrangements [15]. They usually arrange service fees based on a compromise reached between them and the clients [16]. The collection fees are often negotiated and fixed before the very start of the delivery of the service and adjusted through the course of the service and service fees are usually collected without any kind of receipt [16]. The informal waste collectors have no well-defined territorial space for waste collection, rather, each waste collector has his clients situated as intermingling with others in the same locality [17]. Hence, two adjoining housing units could have different clients for waste collection services. [18] emphasized indiscriminate dumping of refuse by IWCs, resulting from their lack of necessary equipment to haul wastes to official dumpsites or landfills.

However, there have been few research efforts to compare the operational characteristics of these IWCs across cities. Knowledge of operational variations is germane to a deeper understanding of the role of this group of urban actors in municipal waste management and is capable of influencing better policy formulations on waste management by municipalities. This study, therefore, examines the variations in the operational characteristics of IWCs in Ibadan and Abuja, Nigeria. The choice of the two cities was informed by the fact that they exhibit remarkable differences in socio-economic and cultural characteristics. While Abuja, a city in the northern part of Nigeria, is largely cosmopolitan with a large population in the middle- and upper-income level, Ibadan, a city in the southern part of Nigeria, has a relatively homogeneous population with the majority in the low- and middle-income category. Also, while Abuja is a federal government-controlled municipality, Ibadan is being managed by Oyo State Government. This suggests the possibility of a variation in their access to waste management resources.

The impetus for this study was derived from some reasons. First, there is a growing awareness of the role of IWCs in solid waste management

and signs from some states and local governments indicate their readiness to accept and integrate IWCs into their waste management scheme. Second, understanding the variance in the operational characteristics of IWCs will assist concerned stakeholders to evolve appropriate policies for the proper integration of IWCs into the waste management scheme.

II. Materials and Methods

A. Study Areas

The settings of this study are Ibadan, South-Western Nigeria and Abuja, in the North-Central zone of Nigeria.

i. Ibadan: Ibadan, is the largest indigenous city in tropical Africa and the capital of Oyo state. It is located between longitude $7^0 20^1$E and $7^0 40^1$E and latitude $3^0 35^1$ and $4^0 10^1$. It is 145km northeast of Lagos and 345km southwest of Abuja, the federal capital. Since its founding in 1829, the city has had rapid growth both spatially and demographically. Developed land area grew from 3,080 km^2 in 1996 to 468.45km^2 in 2020 [19] while the city's population increased from 3.1 million in 2015 to 4 million in 2021. Ibadan is made up of 11 local government areas (LGAs) with five predominantly urban and six partly rural. The Oyo State Solid Waste Management Authority (OYOWMA) is the statutory body established by the state government to undertake waste collection, processing and disposal in the city. In addition, formal private refuse companies were licensed by the state government to complement the efforts of the OYOWMA [20]. The IWCs are also very active in solid waste management particularly in the largely inaccessible waste-ridden core areas of the city, given their types of equipment. However, given the non-recognition of this group of workers by the state government, their role in waste management is not well documented.

ii. Abuja: Abuja, the Nigerian federal capital city was established in 1976. It was initially developed according to a Master Plan devised in 1979. Following the relocation of the Federal Government establishments, all embassies, and the headquarters of many national and multinational corporations to Abuja during the 1990s, there was rapid expansion which far exceeded what had been anticipated in the Master Plan, and the population of Abuja now exceeds the original design capacity. In 1991 the population of the FCT was 378,671, and this had increased to 1,724,205 by 2001[21]. Current estimates put its population at 3,464,000 [21] while the projected population figures for Abuja indicate that about 5.2 million people will live in the city by 2030 [22]. Unfortunately, the opportunity to develop infrastructure (including that for waste management), in phase with city growth and in line with the Master Plan, was lost, and Abuja now shares many of the same problems as other Nigerian cities. The Abuja Environmental Protection Board (AEPB) is responsible for waste management in the city. While some private waste companies were licensed to complement the waste management activities of AEPB, IWCs were equally active in waste management in Abuja. It is hoped that the findings of this study will allow the government to have a true picture of the contribution of the IWCs to municipal waste management for possible favourable policy towards these important urban actors.

B. Methodology

Primary data was employed for the study. A structured questionnaire was the main instrument used in data collection. Specific questions addressed by the questionnaire include

the volume of waste collected per day, method of transportation and disposal of waste, and waste billing system among other questions.

i. Ibadan: The five urban LGAs were selected for the survey. These are: Ibadan South-West (IBSW), Ibadan South-East (IBSE), Ibadan North-West (IBNW), Ibadan North-East (IBNE), and Ibadan North. Preliminary investigations revealed that the activities of the IWCs were restricted to high-density and few medium-density residential neighborhoods in all the selected LGAs. Three localities where the IWCs predominated from each LGA were randomly selected. The 15 selected localities are shown in Table 1.

Table 1: Selected IWCs

LGAs	Localities	No of IWCs	50% sample
Ibadan South-West	Oke-Ado	32	16
	Idi-Arere	46	23
	Agbokojo	35	18
	Sub-Total	**113**	**57**
Ibadan North-East	Bashorun	28	14
	Iwo Road	36	18
	Oke-Adu	39	19
	Sub-Total	**103**	**51**
Ibadan South-East	Oniyere	30	15
	Labo	37	19
	Oke Oluokun	43	21
	Sub-Total	**110**	**55**
Ibadan North-West	Oke – Seni	36	18
	Olopomewa	28	14
	Opo-yeosa	32	16
	Sub-Total	**96**	**48**
Ibadan North	Ode-Oolo	36	18
	Oke-Itunu	28	14
	Yemetu	36	18
	Sub-Total	**100**	**50**
Bwari	Dutse	47	23
	Kubwa	35	18
	Dawakin	44	22
	Sub-Total	**126**	**63**
Gwagwalada	AnguwarHausawa	32	16
	Akyakyata	38	19
	Anguwar Sarki	45	23
	Sub-Total	**115**	**58**
Kuje	Kuchiyako	23	12
	Pasali	31	16
	Low-cost estate	19	9
	Sub-Total	**73**	**37**
	Grand-Total	**836**	**418**

Source: Author's Analysis, 2020.

ii. Abuja: Abuja is made up of six LGAs – Abaji, AMAC, Bwari, Gwagwalada, Kuje, and Kwali with the IWCs operating in Bwari, Gwagwalada and Kuje. Three localities where the IWCs predominated from each LGA were randomly selected. Thus, making a total of fifteen and nine (9) localities in Ibadan and Abuja respectively (Table 1).

Using the snowball approach, a total of 522 and 314 IWCs were identified in Ibadan and Abuja

respectively between January and March 2018. Fifty per cent (261 and 157) IWCs were randomly selected in Ibadan and Abuja respectively, making a total of 418 IWCs (Table 1). The 50% samples fall within the purview of [23] postulation that a 30% sample size for a homogeneous population of less than 1,000 is suitable for a survey at a 95% confidence level, assuming a +/-5% error margin. Questionnaires were administered to the sampled IWCs and all the questionnaires were satisfactorily filled and returned. The data generated from the field survey were analyzed using descriptive (frequencies and percentages) and inferential statistics (Chi-Square and linear regression analyses). Chi-Square statistic was used to measure the variations in the IWCs' operation in the two cities. It is expressed as follows.

$$\boldsymbol{x^2} = \frac{\sum(\boldsymbol{O_i}-\boldsymbol{E_i})^2}{\boldsymbol{E_i}} \quad (1)$$

Where:

$\boldsymbol{x^2}$ = Chi-Square

$\boldsymbol{O_i}$ = observed value (actual value)

$\boldsymbol{E_i}$ = expected value.

The Chi-Square test results are presented in Table 3. Note that the Chi-Square values for all the variables tested are contained in the first column, while the second column contains the Pearson Chi-Square values, otherwise referred to as P Values. If the P-Value is less than 0.05 (which is the alpha level associated with a 95% confidence level), then the relationship between the variables is significant but if the P-Value is more than 0.05, the relationship is not significant. Multiple Linear Regression of the form $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$……..+ e was used to determine the effects of the operational characteristics on the volume of waste collected by the IWCs.

III. Results and Discussion

A. Days of Operation of IWCs

Analysis of data reveals that 43.1% of the Ibadan IWCs and 14.8% of the Abuja IWCs worked every day (Fig. 1). Compared to Abuja, the higher percentage of Ibadan IWCs working every day might have been influenced by the near absence of municipal waste collection services in the high-density residential neighborhoods of Ibadan and the consequent high patronage rate of the IWCs by the residents. Those who did not work every day, (9.0% and 11.2% in Ibadan and Abuja respectively), worked only on Saturday (6.3% and 8.7% in Ibadan and Abuja respectively) and Sunday (2.7% and 2.5% in Ibadan and Abuja respectively). The reasons for the choice of the weekend according to the respondents are:

- Because clients are always at home at the weekend, they tend to generate more waste and, therefore, require the services of IWCs (4.1% and 6.0% in Ibadan and Abuja respectively);
- The IWCs whose primary occupations were not waste collection (2.3% and 1.6% in Ibadan and Abuja respectively) usually dedicate Monday to Friday for their primary occupation and used Saturday and Sunday for waste collection;
- Clients usually do general cleaning of home and their environment at weekends (1.6% and 3.6% in Ibadan and Abuja respectively);
- One per cent (1.0%) of the Ibadan IWCs were students who had to go to school between Monday and Friday and, therefore, had only Saturday and Sunday to work. None of the Abuja IWCs was a student.

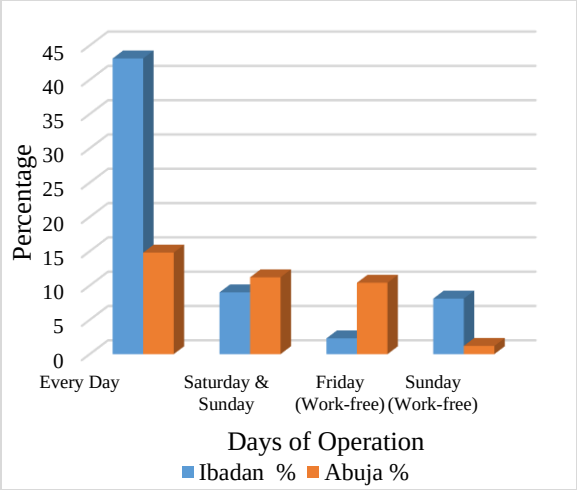

Figure 1: Days of Operation and Days of Rest of Informal Waste Collectors

Source: Authors' Analysis, 2020.

Moreover, 2.3% of the IWCs in Ibadan and 10.4% in Abuja who were Muslims did not operate on Fridays only, because of Juma'at service and the fact that Friday being a holy day must meet them clean. Contrarily, 8.1% in Ibadan and 1.2% in Abuja who were Christians did not operate on Sundays. The need to attend church service and rest by this group of IWCs appears to influence their decision not to operate on Sunday only. Using equation 1, the computed chi-square value of 1.495 at P = 0.473 (Table 3) established that differences in the days of operation of the IWCs were not statistically significant. This finding is a slight departure from [24] assertion from her study in Ethiopia that IWCs do not observe any rest.

B. Time of the Day the IWCs Operate

Another critical issue considered in this study is the time when IWCs carry out their activities. Some 29.4% of the Ibadan IWCs and 8.1% of the Abuja IWCs respectively worked in the morning (between 5 am and 12 noon), 0.4% of the Ibadan IWCs and 1.3% of the Abuja IWCs worked in the afternoon (12 pm to 6 pm), while 3.2% of the Ibadan IWCs and 3.8% of the Abuja IWCs worked in the evening (6 pm to 11 pm) (Fig. 2). The computed chi-square value of 7.142 at 0.141 indicates that differences in time of the day of operation by the IWCs were not statistically significant (Table 3). It is pertinent to note that there are various reasons for choosing specific periods to operate by the IWCs. For instance, the IWCs that worked in the morning (29.4% and 6.1% in Ibadan and Abuja respectively) met their clients at home during that period and, therefore, had no cause to work in the afternoon or evening.

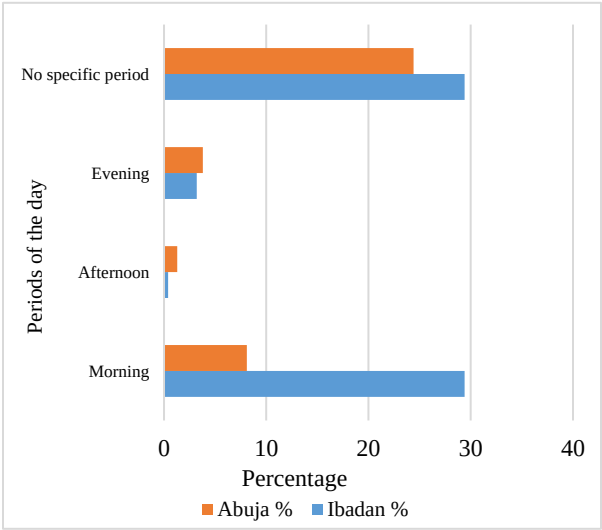

Figure 2: Time of the Day When the Informal Waste Collectors Operate

Source: Authors' Analysis, 2020.

Availability of customers as indicated by 0.4% and 1.3% of the Ibadan and Abuja IWCs respectively and the need to engage in other socio-economic activities (3.2% and 3.8% in Ibadan and Abuja respectively) also influenced the IWCs to work in the afternoon or evening. This finding amplifies the earlier study by [25] in South Africa where IWCs characteristically targeted certain periods of the day to operate because of the need to attract high patronage and income.

C. Months of Operation of IWCs

Furthermore, not all the IWCs operated all year round. About 9.4% in Ibadan and 15.7% in Abuja did not operate every month of the year. The inability of these IWCs to operate every month of the year may be attributed to their need to attend to other socio-economic responsibilities especially those whose primary occupations were not waste collection. Religious leaning of the waste collectors is also one of the causative factors. For instance, the Hausas among the IWCs do not normally work during the month of Ramadan (fasting month) as they mostly observe fasting in their hometowns. Similarly, the Igbos among them spent the Christmas period (December and January) in their home towns and, therefore, did not operate in that period. However, going by the data presented above, Ibadan had a higher percentage of IWCs working every month of the year than Abuja. The possibility of higher waste generation due to the higher population of Ibadan and larger high-density neighbourhoods may be responsible for this. It further indicates that the Abuja IWCs may not be having substantial returns due to the limitations imposed by the geographical extent of their operational area. This finding contradicts the [26] study in Belo Horizonte (Brazil) where she observed that IWCs did work all year round.

D. Operational Tools of IWCs

The tools used in the waste evacuation, transportation and disposal by the IWCs were simple. Push cart or wheelbarrow; shovel and iron/wooden rod were the dominant tools. In addition, some IWCs used personal protective equipment (PPE) such as hand gloves, boots, nose masks, eye-protecting glasses and helmets. About 4.9% of the Ibadan IWCs and 8.3% of the Abuja IWCs used hand gloves and boots; 2.6% in Ibadan and 5.2% in Abuja used gloves, boots and nose covering; 1.1% in Ibadan and 4.8% in Abuja used gloves, boots, nose covering and eye glasses; 0.8% in Abuja and none in Ibadan used gloves, boots, nose covering, eyeglasses and helmet. Less usage of PPE among the Ibadan IWCs may be a result of a low level of awareness of the benefits of using personal protective equipment. Many studies have reported similar observations in the operational tools of IWCs [27] and [25].

E. Volume of Waste Evacuated and Transported

On average, an IWC in Ibadan evacuated about 255 kg of waste per day while an IWC in Abuja evacuated about 312 kg (Fig. 3). About 78.6% of Ibadan IWCs employed push carts while 21.4% employed wheelbarrows to transport the evacuated wastes. All the Abuja IWCs used push carts for evacuating and transporting the wastes to the disposal points.

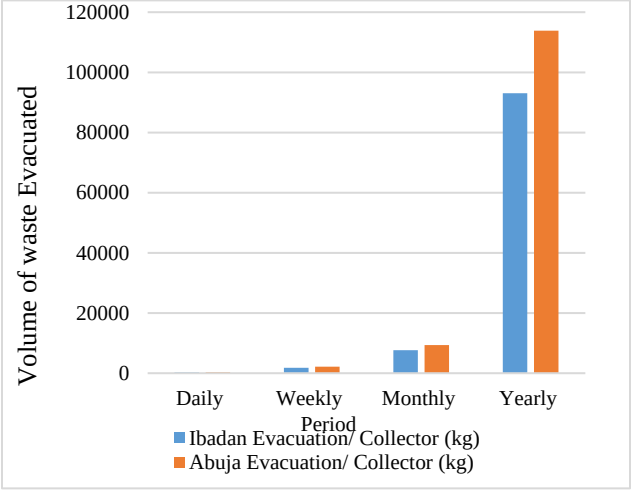

Figure 3: Volume of Waste Evacuated by the Informal Collectors

Source: Authors' field survey, 2018

The predominant use of push carts in Abuja may be due to the IWCs' attempts to evacuate a larger volume of waste in a day because push carts can

Table 2(a): Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.721	.505	.401	18.6314

Dependent Variable: the average amount of waste evacuated per week
Predictors: daily operation, mode of transportation, disposal points, collection fees

Table 2(b): ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	511.475	5	102.496	50.164	.000[b]
	Residual	2062.431	205	72.222		
	Total	2573.962	210			

Table 2(c): Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.968	572		6.181	.000
	Daily operation	8.582-01	.533	.012	.196	.845
	Waste collection fees	2.271-01	.275	.203	3.119	.002
	Mode of waste transportation	4.563E-01	.302	.347	5.382	.000
	Waste disposal points	- 2.822	.382	-.043	-.668	.505

accommodate a larger volume of waste than q wheelbarrow. It also indicates that more waste is generated in Abuja than in Ibadan.

This may be attributed to the higher socio-economic status of Abuja residents. This partly explains why the Abuja IWCs evacuated larger wastes than the Ibadan IWCs. Using equation 1, the computed chi-square value of 234.422 at P = 0.000 established that differences in the mode of transporting wastes by the IWCs are statistically significant (Table 3).

It is important to find out how operational characteristics influence the volume of waste collected by the IWCs. To determine this, the volume of waste collected was regressed against the day of operation, service charge, waste transportation means and waste disposal points distanceThe multiple regression $R^2 = 0.505$ significant at 0.001 indicates that these four variables explain about 51% of the variation in the operational characteristics as they influence the volume of waste collected. The emerging regression equation is given as $Y = 2.968 + 0.858x_1 + 0.227x_{2+} 0.456x_{3-} 0.282x_4$. Except for the day of operation, all the other variables relate in a positive direction to the volume of waste collected (Tables 2 a, b, c). This shows that the volume of waste collected is a function of service charge, method of waste transportation and disposal point distance.

F. Waste Disposal

There was a predominant use of public stationary containers by the IWCs in both cities with 53.4% and 21.2% in Ibadan and Abuja respectively disposing of their evacuated wastes in public

stationary containers. The fact that the majority of the IWCs in both cities disposed of their wastes in public containers is an indication of the environmental health consciousness of the IWCs and the availability of stationary containers at some strategic points in the cities. It was, however, observed during fieldwork that some of the containers did not get the prompt attention of the evacuating agency, especially in Ibadan. The wastes, therefore, usually spilled on the streets and the surrounding area and consequently constituted serious dangers to public health. However, some 10.3% of the Ibadan IWCs and 1.8% of the Abuja IWCs disposed of their waste in illegal dumpsites that characterized the high-density residential neighborhoods in the cities (Fig. 4). The high incidence of indiscriminate dumping is capable of creating public health problems in the cities, especially Ibadan where the problem seems to be more pronounced.

Attempts by some IWCs to make as many trips as possible coupled with the non-provision of waste containers in some neighbourhoods appear to be responsible for this. Also, the nonchalant attitude of some residents towards a clean environment by condoning the activities of these IWCs as well as weak monitoring by the environmental health officers equally contributed to the problem. Using equation 1, the computed chi-square value of 34.316 at P = 0.000 indicates that differences in the waste disposal sites of the IWCs in the two cities is statistically significant (Table 3). [28] reported several unauthorized dumpsites in Pune (India) where IWCs disposed of their wastes. This study slightly contradicts his assertion, which is an indication that the IWCs in Nigeria and the Nigerian urban dwellers appear to be more environmentally conscious than those in India.

G. Average Distance of Waste Disposal Points to Collection Points

Another important factor that influences the IWCs' choice of disposal sites is the distance between the collection points and disposal sites. As shown in Fig. 5, some 33.3% of the Ibadan IWCs travelled a distance of 2 to 3km to dispose of their waste compared to 19.5% of Abuja IWCs that travelled between 4 and 5km. The chi-square test indicates that the difference in the distances travelled between the waste collection points and disposal points by the IWCs in both cities is statistically significant with a chi-square value of 41.915 at P = 0.025 (Table 3). The indiscriminate waste dumping at illegal dumpsites that is more pronounced in Ibadan appears to be responsible for shorter distance coverage by Ibadan IWCs to dispose of their wastes compared to Abuja.

H. Service Charge

Service charge is considered crucial in determining the level of income accruable from informal waste collection It also influences the rate of patronage of IWCs by households and other users. Generally, in both cities, service charges are determined either per collection or per sack.

For instance, a fully loaded medium-size sack costs N50 in Ibadan and N100 in Abuja. This is multiplied by the number of sacks available for collection to determine the amount a client will pay. A cart can evacuate a maximum of fifteen sacks at a time. This shows that a fully loaded cart could realize about N750 in Ibadan and N1500 in Abuja

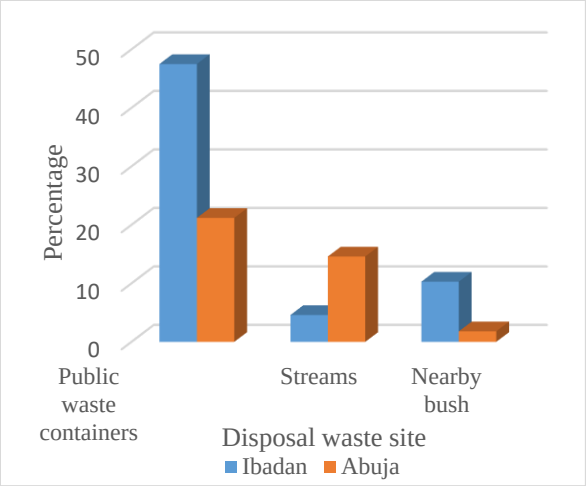

Figure 4: Waste Disposal Points of Informal Waste Collectors
Source: Authors' Analysis, 2020.

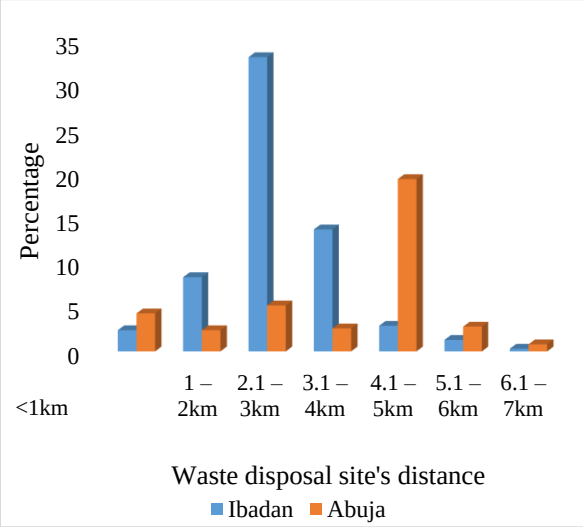

Figure 5: Average Distance of Waste Disposal Points to Collection Points
Source: Authors' Analysis, 2020.

. In the absence of a sack, the amount to be paid is determined through bargaining. The survey revealed that a collector in Ibadan could make an average of four trips per day while in Abuja a collector made five trips in a day. Thus, a collector in Ibadan made an average of N3000 daily (About 200% above the national minimum wage) while an Abuja IWC made an average of N7500 daily (About 650% above the national minimum wage). The computed chi-square value of 72.715 at 0.030 indicates that differences in service charges by the IWCs are statistically significant (Table 2). The above results confirm the findings from the earlier studies on IWCs' earnings from different cities in developing countries. For instance, [29] reported that average earnings in the informal waste collection sector in Pune (in India) are 110% higher than the legal minimum wage. In Lima (Peru), earnings from informal waste collection service are 125% higher than the national minimum wage [30]. In Cluj (Romania), [31] found that the earnings from informal waste collection are 170% higher than the legal minimum wage, while in Lusaka (Zambia), the earnings from the informal waste collection are 240% higher than the national minimum wage [32].

I. Waste Sorting and Recycling

One of the observable practices of the informal waste collectors is sorting and salvaging recyclable and usable items before disposing of the waste. From the survey, 28.4% of the Ibadan IWCs and 29.4% of the Abuja IWCs engaged in waste sorting.

Some 22.2% of the Ibadan IWCs and 16.8% of the Abuja IWCs sold their recovered materials to waste recyclers (Fig. 6). Using equation 1,the chi-square test indicated that no statistically significant difference exists in the sorting of wastes by the IWCs as the computed chi-square value is 2.599 at P = 0.273 (Table 3). The fact that a higher number of Abuja IWCs sold their sorted wastes compared to Ibadan suggests that less recyclable waste is generated in Ibadan. Also, awareness of waste sorting and recovery appears to be higher amongst Abuja IWCs.

The Abuja IWCs also appear to have more access to markets for recyclable wastes than the Ibadan IWCs.

Table 3: Results of Chi-Square Tests (Ibadan Vs Abuja)

Variables	Chi-square Values	P Values
Days of Operation of IWCs	1.495	0.473
Time of the Day When the IWCs Operate	7.142	0.141
Waste Disposal Points of IWCs	34.316	0.000*
Distance of Waste Disposal Points to Collection Points	41.915	0.025*
Service Charge	72.715	0.030*
Waste Sorting	2.599	0.273
Operational tools	234.422	0.000*

*. = Significant at 0.05 level (2-tailed test)
Source: Computed by the Authors

The practice of waste sorting is engaged in by the IWCs to earn additional income, which is why a majority of the IWCs sold the recyclable materials sorted out from the waste. It is important to note that none of the IWCs engaged in waste recycling, probably because they did not have the skills and capital to do so. This result agrees with [33] conclusions from her study in Mbeubeuss (Senegal) where several IWCs sorted wastes to reclaim usable materials before disposal.

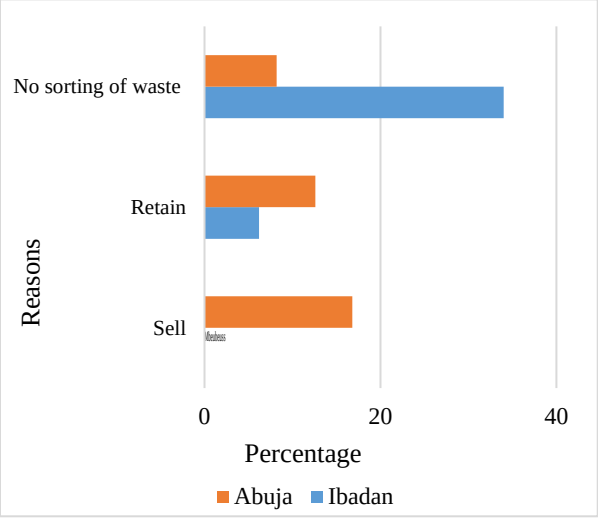

Figure 6: Reasons for Waste Sorting by the Informal Waste Collectors
Source: Authors' Analysis, 2020.

IV. Conclusion

Informal waste collection is crucial to the sustainability of urban environments. Understanding the variations in the mode of operation of the informal waste collectors among cities enables the urban managers and decision-makers to have a proper perspective on informal waste collection. Consequently, such knowledge will guide them in making appropriate decisions on waste management. The foregoing comparison of the operational characteristics of the Ibadan and Abuja informal waste collectors has revealed the differences and similarities in their operations. While all Abuja IWCs used push carts to evacuate wastes, a certain percentage of Ibadan IWCs used wheelbarrows for waste evacuation. A higher number of the Abuja IWCs deposited their wastes in public stationary waste containers and collected higher waste collection fees than the Ibadan IWCs. A higher number of Ibadan IWCs had no specific day, and time of operation compared to Abuja IWCs. This flexibility in the operational approach undoubtedly makes IWCs more suitable for waste collection in the cities, especially the high-density neighbourhoods.

The Abuja IWCs evacuated a higher volume of waste than the Ibadan IWCs. The result of regression analysis revealed that service charge,

method of waste transportation and waste disposal point distance play a positive role in the volume of waste evacuated by the IWCs. Also, as revealed by this paper, the official views of informal waste collectors as aggravators of the environmental health problem of cities through indiscriminate dumping of waste may not be true. The predominant use of public waste containers by a large number of informal waste collectors in both cities indicates their environmental health consciousness and, therefore, not deliberately degrading the environment. Indiscriminate dumping occurred where public stationary containers or other public disposal facilities were lacking. However, there seems to be more provision of waste containers by the Abuja municipality than Ibadan going by the higher number of Abuja IWCs disposing of their wastes in public waste containers. This calls for attention by the Oyo State Government to ensure the provision of adequate waste containers not only for use by IWCs but to reduce the littering problem in the city.

Waste sorting and recovery, help in reducing the volume of waste for disposal and serves as additional income for IWCS. The practice of waste sorting among waste collectors was more pronounced in Abuja than in Ibadan. While it could be argued that more recyclable or useable wastes are generated in Abuja than in Ibadan, low awareness of the benefits of waste sorting among the Ibadan IWCs may be responsible for this. Thus, there is a need for increased awareness of the significance of waste sorting before disposal among waste collectors. The relevant agencies of government and NGOs should ensure this. For this to be accomplished, both the Federal Capital Territory Administration and the Oyo States government need to first recognize the activities of IWCs and accept them as partners in the waste management scheme of the cities. Efforts should also be made to accord them the necessary training and operational equipment for optimal performance.

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