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An Assessment of Household Perceptions of Use of ICT and Improved Methods of Waste Management in Owerri, South-East Nigeria

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Abstract*— This study assessed the perception of households in Owerri on the use of ICT and improved methods of municipal waste management. Presently, the challenge of waste management is growing rapidly with increase in Nigeria's population. The popularization of polythene water sachets, shopping bags, bottles, and cutlery is rapidly increasing plastic wastes generated in the country. With very few recycling facilities, the indiscriminate disposal of plastic wastes blocks drains, respiratory issues when burned, and shortening of aquatic animal lifespans. Unfortunately, many Nigerians are yet to appreciate the enormity of these problems. For the study, the entire Owerri metropolis was grouped into 10 distinct areas and structured questionnaires were administered to 1000 households to investigate issues on livelihood activities, mode of waste disposal, willingness to use ICT. It was found that many of the respondents were educated and that more than 40% were graduates and that many households no longer indulge in the practice of throwing wastes into drainages during rains. The result of study when compared with the survey of the practice about five years ago, revealed an improved attitude to waste management by the respondents and a more frequent waste evacuation by the Imo State Waste Management Agency. Most of the households interviewed agreed that waste recycling creates wealth (84.8%) but unfortunately, the opportunity and infrastructure were not available. More than 60% households were not keen to separate their waste at source, this may be attributed to poor motivation and awareness. Hence, an increase in public awareness education was recommended and an on-going work on a platform for all relevant stakeholders in the waste supply chain is being developed. The money the residents agreed to pay weekly for waste disposal will not sustain the service without a substantial government subsidy. Hence, there is need to re-engineer the current waste management in the country using relevant ICT solutions and modern methods such as waste segregation at source to facilitate recycling wastes to useful products and inclusion of the informal sector into the waste supply chain.

Keywords*— *Clean environment; ICT in waste management; sustainable development; waste management; well being

I. INTRODUCTION

Municipal Solid Waste (MSW) operations is still a challenge for developing countries [1]–[4]. Poor waste management results in flooding, water pollution, diseases outbreak and Green House Gases (GHG) emissions, which are serious threats to the environment. In recent times, more than sixty percent of municipal solid waste from developing countries are generated from households [5]–[7]. MSW are heterogeneous in nature, comprising of food waste, wood, plastics, paper, metals, leather, rubber, batteries, paint containers, textiles, construction materials and many others, which would be difficult to segregate for easy recycling [8], [9].

Among the key process steps of waste management is waste collection. Waste collection is expensive and challenging. While high-income countries provide nearly universal waste collection, low-income countries in the Sub-Saharan Africa collect about 44 percent of generated waste [8].

In Nigeria and some developing countries there is inadequate scheme and infrastructure for effective waste management. If waste is not managed properly, it pollutes the environment. Hence, effective waste management has become important to reduce air pollution which directly impacts the environment and subsequently human health.

In some towns in Nigeria, due to the absence of a basic facility of waste collection, citizens are left with no option but to dump their waste on the streets, open spaces, and drains. This is happening because citizens assume that waste thrown on the streets would be picked up by local government

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councils. To ameliorate this situation, state governments have set up Waste Management agencies, for example, Lagos State established Lagos State Waste Management Agency (LAWMA) and Imo State, Imo State Waste Management Agency (ISWAMA). These agencies are saddled with the responsibility of effectively managing the waste of residents in the state and delivering a clean environment through transportation and management of waste disposal sites. However, many households have not been willing to pay for waste disposal services.

Presently, most of the towns do not have structured waste collection and disposal programme [10]–[13]. The challenge of waste management is growing rapidly with increase in the country's population. The popularization of sachet water, polythene shopping bags, food packages, bottles, cups and cutlery are rapidly increasing plastic waste generated in the country, posing a serious threat to municipal solid waste management. With very few recycling facilities in the country, the issue of post-consumer plastic waste has become a major issue of concern because the plastic waste causes floods by clogging drains, respiratory issues, shortening animal lifespans when consumed, and contaminating water bodies when dumped into canals and oceans.

Unfortunately, many Nigerians do not appreciate this problem and the citizen's role in Waste management. Besides, the financial constraints for solid waste management, another major challenge in waste management is availability of data on where and when waste is generated and how to recycle them for re-use or urgently deal with them before they turn toxic. In order words, there is no existing common platform that brings the various stakeholders in the waste management chain together.

In view of the critical role of households in the success of any waste management ecosystem, the primary objective of this study was to investigate Households' perceptions of the use of ICT and Improved Methods of Municipal Waste Management in Owerri, Southeast Nigeria. This will enable the researchers use data from the study to develop an innovative solution to shift the focus from problem to potentials from Waste (i.e., Waste-to-Wealth).

II. METHODOLOGY

A. *Description of the Study Area*

Owerri is the capital of Imo state in the South-East of Nigeria. Owerri became transformed into an urban city since the creation of Imo state in 1976**.** Owerri and environs has become a vibrant educational centre, hosting the Federal University of Technology Owerri, Imo State University, Imo Polytechnic Umuagwo, Federal Polytechnic Nekede, Alvan Ikoku College of Education and numerous public and private secondary and primary schools. The city is growing rapidly with the establishment of new housing estates, new markets, shopping plazas and a plethora of hotels, bars, restaurants, and nightclubs.

B. *Data Collection and Analysis*

This study was carried out in August 2020. The entire Owerri municipality was grouped into 10 distinct areas for the purpose of eliciting the perception of residence on the integration of ICT for waste management and improved methods of municipal waste management. For this purpose, 1000 questionnaires were randomly distributed among residence of the following estates: Aladinma Estate and Environs, Obinze/Heartland court area, New Owerri/Concorde, Works' layout, Ugwu Orji/Okigwe road, Trans Egbu/Federal housing, Egbeada/Arugo housing estate, World bank/Imo Housing Estate Umuguma, Uzii /Umueche and environs and Amawom/Emmanuel college area.

A structured questionnaire consisting of the following questions was used to record the answers to the questions related to the following issues:

i. Household size of respondents
ii. Livelihood activities
iii. Mode of waste disposal
iv. Waste segregation at source for recycling
v. Willingness to use ICT in waste management and hazard alert notification Apps.
vi. Payment for waste disposal

The data collected from the 10 selected areas were collated and analyzed using Microsoft Excel.

III. RESULTS AND DISCUSSION

A. *Household size, Educational Qualifications and Age of Respondents in Study Area*

The average highest household size in the study area was 5 - 6 persons (34.5 %) while the lowest household size was 1 - 2 persons (15.4 %) (Fig 1). 40 % of households with 5 – 6 persons were found in Obinze, New Owerri and Uzii while on the average, 25 % of the residents of Amawom and Okigwe road were more of 2-person inhabitants.

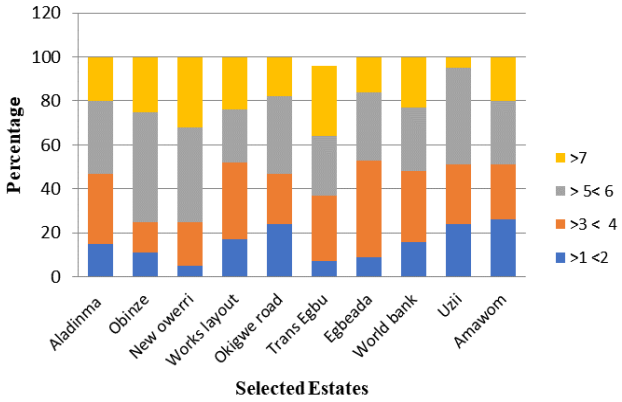

Fig 1: The household size of the respondents in the study area.

The households' size greater than 7 persons were predominant in New Owerri (32%), Trans Egbu (32%), and Obinze (25%). The findings of [14] for Southern Africa low-income towns is evident in this case. Households in these areas have more than 7 members because they have some make-shift settlements especially around Port Harcourt Road

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with large occupants. Trans-Egbu area around Shoprite axis also has similar settlements with attendant large human populations.

The average educational qualification of the respondents (44.8%) was first degree certificate, followed by 'O' level certificate (23.9%) and postgraduate (17.4%). The respondents have more degree certificates in Egbeada (69%), New Owerri (65%), Uzii (54%) and Okigwe road (53%). These areas were mostly inhabited by civil servants and staff of tertiary institutions in Owerri city. The Obinze area had more postgraduate degrees (50%) because of staff of FUTO. While Uzii at the heart of Owerri town had the lowest educational qualifications (3%).

On the average, very low percentage of the respondents had no qualification (2.6%) and 2.7% had OND and/or any other certificates. This is expected since most of the estates surveyed are mid to high income dwellers and residents have acquired higher education. Aladinma area had more respondents without any form of qualification compared to other estates and Amawom residence had more respondents with O' Level certificates.

The average age bracket of the respondents was 25-35yrs (42.7%), followed by 36-50yrs (38.1%) (Fig 2). The highest number of respondents under the age bracket of 25-35yrs was recorded in World Bank Estate (57%) and Works' layout (57%), whereas Obinze and Uzii had highest respondents under the age bracket of 51-65years. The lowest number of respondents was of the age bracket of 66yrs and above, which represents 3.8% and the highest of this age bracket occurred in Trans-Egbu area (14%).

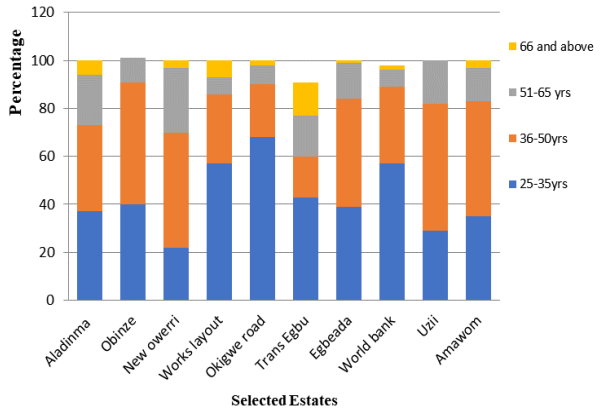

Fig 2. The age bracket of the respondents.

B. The Livelihood Activities of Households

From the interviews, most household heads were businessmen and women (86.2%) and civil servants (37.8%), plotted in Fig 3. The least livelihood activity was the Artisans (11.2%) and they were predominant at Works layout compared to other estates. The residents engaged in business activities and civil service jobs were more in the Obinze, Works layout, Okigwe road and Uzii areas (Fig 3). From the survey, more households from World bank and Egbeada areas were engaged in agricultural related activities than in other areas. The low number of respondents engaged in agricultural activities could be because of the metropolitan nature of the Owerri capital city, residents may not have access to land for cultivation and animal husbandry.

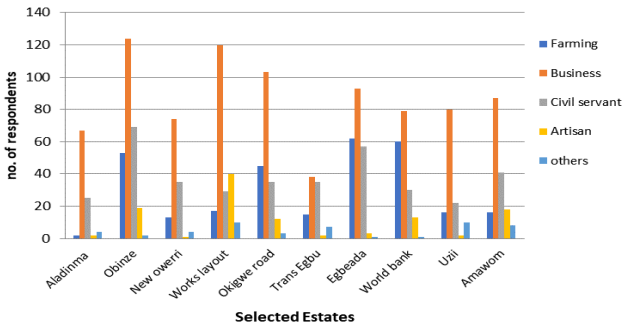

Fig 3. The Livelihood activities of the respondents.

C. Waste Management Practices

The result of the survey on Waste management practices is summarized in Table 1. This represents a slight improvement as compared to the findings of [15] in which case about 66 % of residents practiced open refuse dumping using wheelbarrow. The households across the estates predominantly take their wastes to collection centres which are subsequently evacuated by ISWAMA to final dump sites. Many households no longer indulge in the practice of throwing their waste in the flood, burying waste in residences, or dumping waste in the drainages (Table 1). Probably, the level of education of the individuals has influenced this practice. Waste evacuation by ISWAMA was observed to be more efficient in the Obinze/Heartland court and New Owerri/Concorde areas (Table 1). However, private company waste collection initiatives were observed in Aladinma, Uzii and Amawom areas while waste burning was noted to be highest at Trans-Egbu and Egbeada area.

Table 1. The percentage response of waste management practices in the study area.

Waste management practices	AL	OB	NO	WL	OR	TE	EG	WB	UZII	AM
Collection by private company (%)	47	7	1	3	6	18	0	13	62	43
Collection by ISWAMA (%)	13	92	49	52	22	11	11	25	11	3
Take waste to dumpsite (%)	60	1	47	60	68	52	78	52	36	52
Bury around residence (%)	0	0	6	0	3	7	2	3	2	0
Burn waste (%)	19	0	13	20	17	27	48	23	33	6
Dump in drainage (%)	1	0	8	3	5	1	4	27	3	3
Throw in flood (%)	0	0	0	0	1	0	0	5	0	3
Others (%)	0	0	0	0	0	0	0	0	2	0

AL=Aladinma, OB= Obinze area, NO= New Owerri, WL=Works Layout, OR= Okigwe Road, TE=Trans Egbu, EG= Egbeada, WB= World Bank, AM= Amawom.

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There was presence of waste dumpsites across all the estates surveyed (60.4%) (Table 2). The evacuation of waste is mostly done weekly (39.8%) and at unscheduled times. Monthly waste evacuation was very rare in all the estates. At Obinze, most of the respondents agreed that wastes were evacuated on weekly basis and not on unscheduled periods.

Table 2: Response of households on the presence of Dumpsites and frequency of waste evacuation.

Estates	Presence of waste dumpsite (%)	Frequency of waste evacuation in the study area			
		Daily (%)	Weekly (%)	Monthly (%)	No schedule (%)
AL	69	12	26	2	60
OB	92	2	94	3	0
NO	67	30	19	2	49
WL	74	23	27	2	48
OR	71	25	40	4	29
TE	57	11	47	4	28
EG	36	0	29	7	58
WB	51	6	38	23	33
Uzii	32	28	32	6	34
AM	55	12	46	7	36
Mean	60.4	14.9	39.8	5.4	37.5

AL=Aladinma, OB= Obinze area, NO= New Owerri, WL=Works layout, OR= Okigwe road, TE=Trans Egbu, EG= Egbeada, WB= World Bank, AM= Amawom.

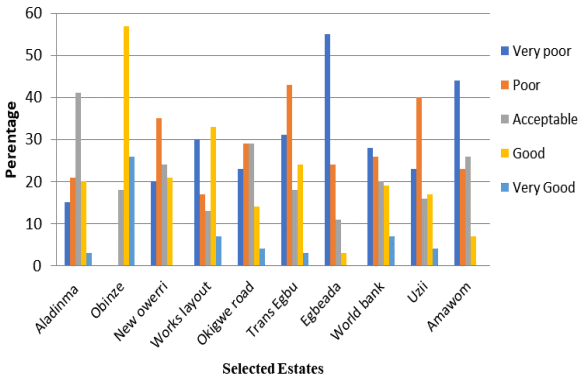

Fig 4: The response of households on the performance of waste evacuation.

The general impression of residents on waste management across the estates was that waste evacuation was poorly carried out (26.9%). However, Obinze/Heartland Court area agreed that waste evacuation in their area was good (Fig 5.0). From the survey, the residents of Egbeada, Amawom, Trans-Egbu and Uzii were of the view that waste evacuation in their areas were poorly managed and needed improvement. In Aladinma area, one of the old estates, the residents predominantly agreed that waste management in the area was acceptable.

D. Sorting of Waste and Funding of Waste Evacuation

There was presence of waste dumpsites across all the estates surveyed (60.4%) (Table 2). The evacuation of waste is mostly done weekly (39.8%) and at unscheduled times. Monthly waste evacuation was very rare in all the estates. At Obinze, most of the respondents agreed that wastes were evacuated on weekly basis and not on unscheduled periods.

The survey also tested the households on waste segregation at source and the benefits, the result is shown in Table 3. 64.8% households do not have separate bins. Only 26% of the 35.2% households that have separate waste bins, sort their wastes. The reason for their unwillingness to separate waste could be because there is no motivation to do it. Public education on waste management is observed is low and hence, observed reluctance of the respondents this is in line with the observation of [16].

Many households interviewed agreed that waste recycling creates wealth (84.8%) and provides employment however the opportunity and infrastructure were not available (Table 3).

Table 3: Response of households on the idea of sorting and funding of waste evacuation in the study area.

S/N	Questions raised	Average percentage frequency of respondents in the study area
1	Agreed that waste cycling creates employment.	84.8
2	Households that have separate waste bins.	35.2
3	Households that separate their waste.	26.0
4	Respondents' willingness to pay for waste disposal.	72.9

The government agency in charge of Waste evacuation has been doing it free of charge from residential areas for many years, with the increasing population and dwindling finances it is becoming a big challenge to evacuate frequently from dumpsites on streets. For sustainability of the process, households need to pay some money for the service. From the study, many households are willing to pay for waste disposal (72.9%). Most of the households across the study area agreed to spend N50 weekly for waste disposal (36%) followed by N100 (28%). Most of the households did not accept payment of N500 weekly for waste disposal (6%).

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Unfortunately, this amount of money per resident will not sustain the cost of the service since adequate infrastructure is not yet on ground.

E. Perception of Respondents on use of ICT

The result on the perception of respondents on the use of ICT for waste management is presented on Table 4. From the survey, majority of the respondents accepted the use of ICT as a means of improving waste management in their estates. The respondents are willing to use phone numbers to contact waste collectors to evacuate their waste (71.4%). They agreed that Information and Communication Technology (ICT) can provide innovative solutions for waste management. The respondents are willing to exchange their waste to vendors for monetary gains in all the estates surveyed (70%). However, majority of the respondents are not willing to take their waste to recycling centres (26.3%). The use of Mobile Application that will enable households notify vendors and/or waste collectors on areas with huge waste burden, were accepted by majority of respondents (75.2%).

Table 4. Perception of Respondents on use of ICT for Waste Management.

S/N	Questions raised	Average percentage frequency of households willing to use ICT in the study area
1	Willingness to have phone numbers to contact waste collectors.	71.4
2	Willingness to contact vendors who can exchange money for segregated waste.	70.0
3	Willingness to take their waste to recycling collection centre.	26.3
4	Willingness to have a Mobile Application for acquiring information on waste management.	75.2
5	Citizen's willingness to play a role in their environmental protection.	94.0
6	Willingness of households to use phone numbers and call for hazardous incidents e.g. fire, security, road accidents etc.	82.0

IV. CONCLUSION

This paper investigated the perceptions of the residents of Owerri on the use of ICT and modern methodologies of waste management. Findings revealed that there is a positive correlation between the level of education and good waste management practice among the study population, despite a majority being businessmen and women. Analysis shows that residents complied with waste disposal directives from ISWAMA, leading to a more efficient waste collection and evacuation, with lower overhead for the agency.

Generally, the subjects understood the imperatives of waste-to-wealth through better waste handling practices, such as waste segregation and recycling but are not able to practise it because of lack of opportunity and motivation, poor infrastructure and policy framework. Hence, there is need to re-engineer the current waste management approaches in the country using relevant ICT solutions backed by a sustainable reward system for good waste management habit. Also, the use of modern methods such as waste segregation at source whereby households use colour-coded bins for different types of waste to facilitate recycling is a good opportunity.

Since the people are at the centre of waste generation and management, providing incentive for good waste handling habit will go a long way to ameliorating the menace of indiscriminate, unpatriotic waste dumping in the city. It is recommended that Government departments in charge of waste and environment should do more to increase public awareness on proper waste management and citizens' roles. The use of ICT is very good for increasing awareness and public participation hence this research is working on developing an ICT solution for this process. The proposed solution will bring together all relevant stakeholders in waste management supply chain to a platform for fruitful interactions.

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