




DETERMINANTS OF RURAL RESIDENTIAL SOLID WASTE COLLECTION SERVICES IN LAGOS STATE

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ABSTRACT

Article History

Received: 25 January 2018

Revised: 15 February 2018

Accepted: 19 February 2018

Published: 23 February 2018

Keywords

Rural solid waste
Management
Regulation
Determinants
policy recommendation
Lagos state.
Household

In the wake of increased investment in and new policies regarding Residential Solid Waste Management (RSWM) in Lagos state and the attendant consequence of inefficiencies currently observed with the system, this study describe the state and determinants of waste management services in rural Lagos State. A well-structured questionnaire, which consist of two sections, was used to elicit demographic and residential solid waste collection information from 200 household heads sampled using the multi-stage sampling in 3 Local Council Development Areas (LCDAs). Data were analysed using both descriptive and Dprobit, an advanced probit logistic model. Results show that the mean and standard deviation for whether a ward/neighborhood has RSW collector was 0.23 and 0.42. Similarly, mean and standard deviation for Private Sector Participation (PSP) operator employing RSWC workers was 0.22 and 0.41. Among demographic and residential solid waste collection characteristics, income, population, PSP charges or rates and distance to dump site are found to be determinants of RSWC services in rural areas of Lagos state. The analysis shows that a one thousand increase in Mean income would increase the possibility of providing waste Transportation services by 0.20 percent and the possibility of employing waste workers by only 0.17 percent. Conversely, a one Kilometre increase in distance to dumpsite would reduce the possibility of PSP operator acquiring a compactor. Government incentivisation of rural residential solid waste collection would go a long way to eliminate poor RSWC in rural areas of Lagos State.

Contribution/Originality: This study is one of very few studies which have investigated the prevalence and determinants Residential Solid Waste Management in rural areas Lagos State. Mean Income and Distance to dump site are among other variables that drive efficiency and up-to-date service delivery among PSP.

1. INTRODUCTION

Residential Solid Waste (RSW) is a problem of new significance worldwide. As a country industrializes and urbanizes, the economy grows and living standards rise, but due to increased consumption, RSW production also increased. In 2012, the total amount of RSW generated in all cities in the world was 1.3 trillion kg (Hoornweg and Bhada-Tata, 2012). Managing this massive amount of waste is a large and important task. Improperly managed waste not only affects the health of local residents, but it can also cause irreversible damage to water resources and the ecological environment.

In Nigeria, there are varied data on waste generation and composition due to poor information management, but notable is the study carried out by Ogwueleke (2009) which give data on nine important Cities. The study (Table 1) shows the rate of waste generation in Lagos is 9, 000 tonnes/day while in Kano, the rate is 3, 849 tonnes/day. Generally, the average rate of generation is estimated as 0.5kg/capital/day. Due to same problem of paucity of data, the total annual quantity of waste from rural areas as against the urban area is not known. Thus there exist no yardstick or statistics for comparing per capita solid waste produced in Nigeria with some developed countries (Japan: 380 kg, European Union: 210-660 kg; OECD (2013)).

Lagos the commercial nerve center of Nigeria is the smallest in size with a land area of 3,600 square km, with an approximated population of about 15 million people. The state presently has a very high population density of over 4,000 persons per square kilometer. It was postulated that over 70% of total industries in Nigeria are based in Lagos State alone. The realities of population explosion, serious urbanization and rapid industrial growth have direct effect on general waste management systems in the state. The volume of waste being generated by this large population and the industrial sector was so enormous and overwhelming to all government agencies involved in the collection, transportation and disposal of solid waste in the state.

In acknowledging this problem, the Lagos government has since issued a series of laws and regulations to standardize RSWM and has also increased investment into RSWM. In 1996/1997, the state government improved access to RSWM by recognizing the activities of the formal private sector when it introduced a pilot PSP scheme in solid waste management in Shomolu and Kosofe Local Government Areas of the state. Over the years many more PSP were licensed to the effect that as at today, Lagos State Government have licensed about 300 PSP operators through the Lagos Waste Management Authority (LAWMA). Proper RSW management consists of three crucial steps: Residential Solid Waste Collection (RSWC); the transportation of RSW to central treatment plants; and RSW treatment and disposal. Without RSWC services, people will litter; without RSW transportation and treatment services, RSW is often burned and buried. In all, the proper collection of RSW is the first and most important part in its management. Different communities have different RSWC services based on their economic and geographical factors. The Lagos State Government through LAWMA engages, coordinates and evaluates the activities of its private sector participants into Municipal Solid Waste Collection. The current practice of collecting, processing and disposing municipal solid wastes is considered to be least efficient. The typical problems are —low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breeding of flies and vermin, and the handling and control of informal waste picking or scavenging activities. Although Lagos State government spend significantly on waste management, they are often unable to keep pace with the scope of the problem. Asides, collection has also been exclusive of rural areas due to perceived inability of rural dwellers to pay for the services, coupled with the fact that most rural areas falls within the lowest range of the government controlled collection fees. Poor solid waste collection in the rural area consists of a major threat to public health and environmental quality, and reduces the quality of life, particularly for the poorer residents in rural areas.

This paper focuses on the first and most important step in the process of proper RSW management – RSWC services. It is only when waste is properly collected that it can be transported to factories that can treat the waste properly. The study attempt to describe the determinants of RSWC facilities and RSWC workers at the rural level. To our knowledge, no study have used cross-sectional data to examine the prevalence of RSWC services in rural areas of Lagos State.

The rest of the paper is organized as follows: Section II describes the methodology which explains sampling, data collection, and statistical methods. Section III Reports the results of the determinants of rural RSWC services. Section IV concludes and considers policy implications.

Table-1. Waste Generation in Major Cities of Nigeria

City	Population	Tonnage/month	Density(Kg/m ³)	Kg/capita/Day
Lagos	8,029,200	255,556	294	0.63
Kano	3,248,700	156,676	290	0.56
Ibadan	307,840	135,391	330	0.51
Kaduna	1,458,900	114,433	320	0.58
Port Harcourt	1,053,900	117,825	300	0.60
Makurdi	249,000	24,242	340	0.48
Onitsha	509,500	84,137	310	0.53
Nsukka	100,700	12,000	370	0.44
Abuja	159,900	14,785	280	0.66

Source: Ogwueleke (2009)

2. METHODOLOGY

2.1. Study Area

Lagos State is located in the south-western part of Nigeria. On the North and East it is bounded by Ogun State. In the West it shares boundaries with the Republic of Benin. Behind its southern borders lies the Atlantic Ocean. 22% of its 3,577 km² are lagoons and creeks. It is the commercial nerve center of Nigeria with an approximated population of about 15 million people. The state presently has a very high population density of over 4,000 persons per square kilometer. According to U.N estimation by year 2015, going by 6% growth rate, Lagos will be the 3rd largest mega city in the whole world. In 2003, many of the existing 20 LGAs were split into 56 lower-tier administrative units called Local Council Development Areas LCDAs).

Three LCDAs namely Imota, Ikorodu-North and Igbogbo-Bayeku nested in the old Ikorodu LGA, and possessing all the characteristics of rural area in terms of development form the crust of this study.

2.2. Sampling Procedure and Data Collection

To achieve the objectives of this study, multi-stage sampling procedure was adopted. In the first stage, Imota, Ikorodu-North and Igbogbo-Bayeku LCDAs were purposively selected as they were situated outside metropolitan and bordering Ogun state with all the natural characteristics of rural area. In the second stage, A total of four wards; 1 out of 2 in Imota; 1 out of 2 in Ikorodu-North and 2 out of 4 in Igbogbo-Bayeku; were randomly selected. Fifty households each were selected in each ward using systematic random sampling techniques in the third stage; making the total surveyed households 200 on aggregate.

A well-structured questionnaire with two sections- A and B were administered on household heads. Section A of the questionnaire elicited socio-economic/ biographic information which consists of the age, gender, household size, marital status, Average income of the household head. Section B elicited information on whether or not a ward has waste collectors (PSP) and whether or not households are registered with a PSP operator. The questionnaire also elicited information on whether PSP operator meet scheduled collection time and the amount they charge. These four outcomes variables were used to indicate the extent to which waste collection takes place in the study area. Furthermore, the questionnaire asked whether PSP services were efficient and whether they have enough human resources to render their services. Other information with respect to LCDAs' characteristics such as distance of the LCDAs to state capital, estimated population, number of wards and whether LCDA Chairmen were appointed or elected were sourced from secondary platform.

2.3. Analytical Technique

Descriptive statistics such as mean and standard deviation were used to summarize the data while Dprobit regression model was used to analyze determinants of RSW collection. The Dprobit regression model is stated implicitly as follows:

$$W_i = \alpha + \beta V_i + \gamma P_i + \varepsilon_i \quad (1)$$

Where,

W_i = whether RSW collection services are available (PSP operator). W_i is a binary variable. When a ward has the RSW collection services, W_i is equal to 1; otherwise, it is equal to 0). V_i is a vector of LCDA characteristics, including number of Wards; estimated population; distance from state capital; New Leader (whether the LCDA head was a new leader) and Direct election (whether the LCDA head was elected or appointed). P_i is a dummy variable for controlling State administration effect. The symbol α is constant term, and the symbols β and γ are the coefficients to be estimated. ε_i is the error term.

To show the marginal effects of every variable, Dprobit, an alternative model to Probit was used. Both models have the same maximum-likelihood estimation property. The Dprobit model reports the marginal effect of a variable, whereas Probit model reports the raw coefficients. Dprobit can also show discrete changes in probability for dummy variables. Thus, the model allows us to show the increased or decreased possibility that a ward/neighborhood has RSW collection services when any one of the characteristics of wards/neighborhood is changed by one unit.

3. RESULTS AND DISCUSSION

3.1. Summary of Characteristics of RSW Collection and Households

The socioeconomics characteristics of respondents and ward/neighborhood characteristics are summarized in Table 2.

Table-2. Summary of RSW Collection and Households Characteristics

Variable	Obs.	Mean	SD	Min.	Max.
Ward has RSW Collectors (yes = 1; no = 0)	200	0.23	0.42	0.0	1.0
PSP operator employ RSWC workers (yes = 1; no = 0)	200	0.22	0.41	0.0	1.0
PSP Operator provide efficient RSWC services (yes = 1; no = 0)	200	0.20	0.40	0.0	1.0
Average income of the Household head (thousand Naira)	200	30	0.3	0.0	8.0
Number of wards/Neighborhood	200	2.2	2.4	2.0	4.0
Total estimated Population	200	21,419	829.0	153.0	.41, 800.0
Distance from state capital (km)	200	45	5.0	39.0	50.0
New leader (1 = yes, 0 = no)	200	0.5	0.5	0.0	1.0
Direct election (1 =yes, 0 = no)	200	0.7	0.5	0.0	1.0
Age (Years)	200	52	8.0	36.0	65.0
Gender (Male=1, 0 otherwise)	200	0.6	0.34	0.0	1.0
PSP Charges (Naira)	200	800	230	450	1100
Household size	200	5.0	3.0	4.0	8.0

Field survey, 2017

The mean for whether a ward/neighborhood has RSW collector was 0.23 and 0.42 was the standard deviation. This indicates very low presence of PSP operator in the study Area. The mean PSP operator employing RSWC workers was 0.22, which indicates that Respondents see number of workers engaged to carry out RSWC is inadequate in area where there are services of PSP operator. The Table further shows that residents perceived services rendered by operatives of PSP were inefficient. The mean of household heads income was ₦30,000 while standard deviation was ₦3,000. The mean number of wards was 2 while the standard deviation was 2.4. According to INEC, there are two wards each in INLCDA and Imota LCDA while there are 3 wards in Igbogbo-Bayeku LCDA. The Population estimated for the three LCDAs are derived based on various publications both on the websites and local newspapers. The mean Total population was 21,419. The mean distance of LCDA to state capital is 45km. This indicates that LCDAs are relatively far from the state capital, considering the small land size of Lagos state. Table 4 further shows that about half of the household heads indicated that the LCDAs leadership is new and brought in through election. By implication, information might have been tainted by political inclination, as election

into LCDAs and LGAs held within the period data was collected. The mean age of household heads was 52 years with standard deviation of 8 years. Furthermore, Table 4 shows male household heads are more than female household heads among the respondents. The mean PSP charges was ₦800, indicating that regulated PSP charges in this area is one of the lowest approved LAWMA. The mean household size was 5, indicating that the households are fairly large and the RSW generation is expected to be high. Dprobit model was used to further analyze Determinants of RSW collection. Individual Characteristics of households/heads were excluded in the ensuing Dprobit model (reason(s)).

3.2. Determinants of RSW Collection Services

The factors influencing RSW collection were examined using equation (1). The results of the Dprobit model are presented in Table 3

Table-3. Determinants of RSW Collection services

Dependent Variables	Dprobit Model	
	Waste Collection Services	
Independent Variables	Waste Transportation (1)	Waste Workers (2)
Average income (thousand Naira)	0.1976 ** (2.473)	0.1671 * (1.675)
Estimated population	0.0000 (1.555)	0.0000 ** (2.136)
Distance from state Capital (km)	-0.0004 (-0.679)	-0.0005 (-0.466)
Number of Wards	-0.0009 (-0.948)	-0.0021 (-1.233)
New leader (1 = yes, 0 = no)	-0.0139 (-0.793)	0.0024 (0.168)
Direct election (1 = yes, 0 = no)	0.0190 (0.853)	-0.0035 (-0.221)
PSP charges/rate	0.964 *** (0.0255)	2.5049 * (1.655)
Distance to dump site	-0.0397 ** (-2.398)	0.952 (0.0937)
State Bureaucracy (dummy)	Yes	Yes
Observations	200	200
Log likelihood = -85.15001, LR statistic = 16.42, Pseudo R ² = 0.0753, Prob > chi ² = 0.0713		

Note: z-Statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$, Each number indicates the marginal effect of a change of +1% in the variable considered.

As shown in Table 3, the empirical estimation of the Dprobit analysis result reveals a log likelihood of -85.15001, pseudo R² of 0.0753 and LR statistic of 16.42, this shows that the model has a good fit. The performance of the individual explanatory variables included in the model indicate that Distance from state capital, Number of Wards in an LCDA, New Leadership of LCDA and Direct Election of LCDA do not significantly influence the RSW collection in the study area.

Out of all the variables included in the model, four turned out to be the main determinants of RSW collection, namely Average Income, Estimated Population, PSP charges/rates and Distance to the dump site. The average income being positively significant ($\beta=0.1976$) means the richer the households, the higher the probability it will enjoy waste collection and transportation services by PSP operator. This is true of the obvious. Most PSP operator strives to secure high-brow community or neighborhood where the high income earner resides and the rates are high. The coefficients shows that when the Mean income increases by one thousand Naira, the possibility of providing waste Transportation services increases by only 0.20 percent (Row 1, Column 1) and the possibility of employing waste workers increases by only 0.17 percent (Row 1, Column 2). This means that PSP operator would provide required facilities and workers in a high income environment where it is perceived that the return to

investment is high. The analysis also shows that PSP operators in rural community with a larger population are more likely to employ waste workers rather than increasing transportation facilities (Row 2, Column 2). Waste transportation vehicles are expensive or capital intensive, with low return to investment in rural areas, a typical business man who is a PSP operator, will opt for a cheaper means of coping with the challenge. The coefficient which shows increase or large population in itself is not sufficient enough to stimulate PSP operator to engage more hands in its waste collection operation in a neighborhood; as coefficient shows zero marginal increase.

Table 3 further shows that the higher the charges the better the waste collection services (Transportation and workers employed) rendered by the PSP operator as more of the required transportation facilities and workers would be provided. A one thousand naira increase in PSP rates/charges would increase the Transportation services by about one percent (Row 7, Column 1) and the possibility of employing waste worker increases by 2.5 percent. This is consistent with preceding outcome and discussion which depict most PSP operators in the rural area as having inclination to avoid capital intensive investment by preferring to employ labour rather than acquiring transportation facilities. The negative sign and significance ($\beta=-2.398$) of Distance to Dumpsite shows that the farther the distance to dump site the fewer transportation facilities the PSP operator will provide (Row 8, Column 1). The marginal effect indicates that a one Kilometre increase in distance to dumpsite would reduce the possibility of PSP operator acquiring a compactor. This is rather surprising, as it is expected that for smartness, to maximize time and render quick and efficient service, the PSP should increase vehicles in his transportation fleet. No plausible explanation can be offered to justify this outcome than that PSP operators in the rural areas do not see reason to improve their transportation facilities. Little wonder their vehicles keep breaking down half way and left over night during RSW collection duty.

4. CONCLUSION

In this paper, we have used both primary and secondary data to describe the determinants of RSWC services in rural Lagos. Multi-sampling technique was used to select the three rural-based LCDAs, from which 200 respondents selected were administered questionnaires, which elicited demographic information and status of RSW collection. The result of the analysis shows that the mean service charge by PSP operator is ₦800, indicating that regulated PSP charges in this area is one of the lowest approved LAWMA rates. The mean of whether a ward/neighborhood has RSW collector (0.23) and the standard deviation 0.42, indicate low presence of PSP operators in the area. This is understood as most PSP operators prefer urban environment where RSW collection rates or payment are higher. Little wonder major roads are sometimes turned to refuse/waste dumps.

Among demographic and residential solid waste collection characteristics, income, population, PSP charges or rates and distance to dump site are found to be determinants of RSWC services in rural areas of Lagos state. The findings here are in tandem with the outcome of the descriptive analysis. Both Descriptive and Dprobit analyses shows that rural RSW collection is bedeviled by low PSP operators' presence and lack of interest in improving transportation facility. This result shows that increase in income will change the scenario positively. It is therefore recommended that government should incentivized rural waste collection services by offering transportation vehicle (Compactor) for sales to be paid on installment rates but with the caveat that it can only be operated in the rural part of Lagos State.

Funding: This study received no specific financial support.

Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

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