



UNIVERSITI PUTRA MALAYSIA

***ESTIMATION OF ECONOMIC VALUE AND DETERMINANTS OF SOLID
WASTE SOURCE-SEPARATION AMONG URBAN-POOR HOUSEHOLDS
IN LAGOS, NIGERIA***

ADAM SHEHU USMAN

FPAS 2014 14



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By

ADAM SHEHU USMAN

**Thesis submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirement for Doctor of Philosophy**

December 2014

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DEDICATION

This research is dedicated to my beloved parents; Alhaji Adam Idris, Haja Adama Bukhari, and Haja Aisha Buba who have, all I know, sacrificed all that they have to see me through my academic endeavors.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the requirement for the Degree of Doctor of Philosophy

ESTIMATION OF ECONOMIC VALUE AND DETERMINANTS OF SOLID WASTE SOURCE-SEPARATION AMONG URBAN-POOR HOUSEHOLDS IN LAGOS, NIGERIA

By

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December 2014

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The prior near-neglect of solid waste pollution in Lagos accorded its metropolis the status of the dirtiest city in the world. In a drastic policy response to address this environmental issue, Lagos state government privatized solid waste management service. The privatization model positions the government as an industrial regulator, via the Lagos Waste Management Authority (LAWMA). However, improved collection efficiency to avoid littering by the private companies, is noted to account for the fast-filling of existing dumpsites. To avoid associated risks, LAWMA proposes to introduce solid waste source-separation. Meanwhile, there is dearth of knowledge on the compensation amount households are willing to accept in respect to the cost of source-separating waste.

This study sets five objectives to address this issue. Three of the objectives are original to this study. These include the use of design attribute relative importance index (DARII) to determine pre-design relative importance of choice experiment attributes. In addition, unlike existing studies, the dimensions of solid waste pollution concern are assessed to determine the form of concern households could activate in support of solid waste related pro-environmentalism. In the third original contribution, directional causality test was conducted to determine which of the potentially active dimensions of concern could be triggered to support solid waste source-separation. Besides all, this study is the first application of choice experiment to solid waste management in Nigeria.

In achieving the study's objectives, a few methods were combined for robustness purpose. These include the use of DARII, factor analyses, contingent valuation method, choice experiment and path analysis. This study focuses on the urban-poor market segment where non-compliance is reported the most in Lagos. Our results show that the most-preferred subset of service attributes for a source-separation program varies across market segments. In addition, we found three dimensions for solid waste pollution concern. Among these only two are found activated in support of source-separation. The directional causality test result shows that households are willing to practice solid waste source-separation on account of the consequence of

pollution on themselves and other humans as against pollution consequence on the biosphere.

Households' minimum compensation amount was estimated at ₦ 45.50. Further investigation shows that the amount could be less than or greater than ₦ 45.50, depending on the source-separation program configuration implemented. The more the inclusion of service attribute levels desired by households in a configuration, the less is the required compensation for the corresponding welfare loss, and vice-versa.

Based on findings, we suggest LAWMA to observe caution by considering market peculiarities in policy formulation on source-separation program. In addition, cost savings could be made over the planned regulatory 50% monthly waste bill discount proposed by the government to incentivize participation by households. In addition, LAWMA could induce biospheric values to reduce the perception of welfare loss from source-separation. The market scope examined in this study is narrow, thus, future research is suggested to focus on the market segments not captured in this study to allow a state-wide implementation of solid waste source-separation in Lagos.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan untuk ijazah Doktor Falsafah

**ANGGARAN NILAI EKONOMI DAN PENENTU PENGASINGAN SISA
PEPEJAL DARI SUMBER DI KALANGAN GOLONGAN MISKIN URBAN
DI LAGOS, NIGERIA**

Oleh

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Pencemaran daripada pembuangan sisa pepejal yang tidak terurus di negeri Lagos menyebabkan bandaranya dikenalpasti sebagai bandar terkotor di dunia. Di dalam usaha untuk menangani masalah alam sekitar ini, pihak kerajaan Nigeria telah menswastakan perkhidmatan pengurusan sisa pepejal yang sedia ada. Model penswastaan ini meletakkan kerajaan sebagai pengawal selia industry ataupun lebih dikenali sebagai, Pihak Berkuasa Pengurusan Sisa Lagos (LAWMA). Walaubagaimanapun, kutipan sisa pepejal yang efisien oleh syarikat swasta untuk mengelakkan pembuangan merata-rata menyebabkan tapak pelupusan yang sedia ada dipenuhi dengan cepat. Bagi mengelakkan risiko yang berkaitan, LAWMA mencadangkan untuk memperkenalkan pengasingan sisa pepejal di sumber. Sementara itu, terdapat juga kekurangan sumber informasi dalam nilai pampasan yang sanggup diterima oleh seisi rumah berdasarkan kos pengasingan sisa di sumber.

Untuk menangani isu ini, lima objektif telah ditetapkan dalam kajian ini. Tiga daripada lima objektif yang ditetapkan adalah objektif asli kajian ini sendiri. Ini termasuk penggunaan DARII untuk menentukan reka bentuk kepentingan relatif eksperimen pilihan. Di samping itu, berbeza dengan kajian yang sedia ada, dimensi keprihatinan pencemaran dinilai bagi menentukan bentuk keprihatinan yang dapat diaktifkan selari dengan pro-persekitaran berkaitan sisa pepejal. Bagi sumbangan asal ketiga, ujian penyebab berarah telah dijalankan untuk menentukan dimensi keperihatin yang aktif dimana ianya berpotensi untuk mencetuskan sokongan bagi pengasingan sisa pepejal di sumber. Selain itu, kajian ini adalah aplikasi pertama eksperimen pilihan untuk pengurusan sisa pepejal di Nigeria.

Dalam mencapai objektif kajian ini, beberapa kaedah telah digabungkan. Ini termasuk penggunaan reka bentuk sifat indeks relatif kepentingan (DARII), analisis faktor, kaedah penilaian kontinjen, eksperimen pilihan, dan analisis berarah. Kajian ini bertumpu kepada segmen pasaran penduduk miskin urban di mana ketidakpatuhan terhadap undang-undang alam sekitar dilaporkan yang tertinggi di Lagos. Keputusan menunjukkan bahawa subset atribut pilihan yang paling

dipersetujui bagi program ini berbeza-beza di seluruh segmen pemasaran. Di samping itu, kami mengenalpasti tiga dimensi keperihatinan pencemaran sisa pepejal bagi segmen ini. Di antara dimensi ini, hanya dua sahaja yang dikenalpasti sebagai aktif, selari dengan pengasingan sisa di sumber. Hasil ujian penyebab berarah menunjukkan bahawa seisi rumah sanggup mengamalkan pengasingan sisa pepejal di sumber lantaran kesan pencemaran terhadap diri mereka sendiri bukan kerana kesan pencemaran kepada biosfera.

Jumlah pampasan minimum seisi rumah dianggarkan bernilai sebanyak ₦ 45.50. Kajian yang lebih mendalam menunjukkan nilai pampasan boleh menjadi kurang atau lebih daripada ₦ 45.50 berdasarkan konfigurasi reka bentuk program pengasingan sisa di sumber. Semakin banyak tahap atribut perkhidmatan yang dikehendaki oleh seisi rumah dalam sesuatu konfigurasi, semakin kurang jumlah pampasan yang diperlukan untuk kehilangan program kebajikan tertentu, dan sebaliknya.

Berdasarkan keputusan, kami mencadangkan LAWMA untuk membuat pemerhatian dengan berhati-hati di mana ianya dapat mempertimbangkan keganjilan pasaran dalam penggubalan dasar untuk program pengasingan sisa di sumber. Di samping itu, penjimatan kos boleh dibuat dengan memberikan 50% diskaun bil sisa bulanan yang dicadangkan oleh kerajaan bagi menggalakkan dan meningkatkan penyertaan seisi rumah. Selain itu, LAWMA boleh meningkatkan nilai biosfera dengan mengurangkan persepsi kehilangan program kebajikan sebagai kesan daripada pengasingan sisa di sumber. Oleh kerana skop pasaran yang dikaji adalah terhadap kajian di masa hadapan dicadangkan dapat meningkatkan tumpuan terhadap segmen pasaran yang tidak termasuk dalam kajian ini untuk menjadikan pelaksanaan pengasingan sumber sisa pepejal di seluruh negeri Lagos sebuah realiti.

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Finally, behind every successful man is a woman, they say! I acknowledge the undaunted sacrifice and inestimable support of my wife; the apple of my eye, Khashyah Abdulfattah, and my dear children: Abubakar, Aisha, Rumaisa (Ummi), and Sarah, respectively. May Allah reward you all beyond measures, amin.

I certify that a Thesis Examination Committee has met on 9 December 2014 to conduct the final examination of Adam Shehu Usman on his thesis entitled "Estimation of Economic Value and Determinants of Solid Waste Source-Separation among Urban-Poor Households in Lagos, Nigeria" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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LIST OF ABBREVIATIONS

AEM	Averting Expenditure Method
CBA	Cost-Benefit Analysis
CDA	Community Development Area
CE	Choice Experiment
CFA	Confirmatory Factor Analysis
CM	Choice modeling
CR	Contingent Rating
CV	Contingent Valuation
DARII	Design Attribute Relative Importance Index
EFA	Exploratory Factor Analysis
FGN	Federal Government of Nigeria
GHGs	Greenhouse Gases
HPM	Hedonic Price method
ISWM	Integrated Solid Waste Management
KAI	Kick–Against–Indiscipline
LGAs	Local Government Areas
LAWMA	Lagos Waste Management Authority
NOAA	National Oceanic and Atmospheric Administration
OECD	Organization for Economic Cooperation and Development
PC	Paired Comparison
PPP	Private-Public-Partnership
PSP	Private Service Provider
PSPs	Private Service Providers
RP	Revealed Preference
SEM	Structural Equation Modeling
SP	Stated Preference
SW	Solid Waste
SWM	Solid Waste Management
TCM	Travel cost method
TEV	Total Economic Value
TRA	Theory of Reasoned Action
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER 1

INTRODUCTION

1.1 Study Background

One of the environmental problems common to cities around the world is the accumulation of solid waste (SW) ensuing from production and consumption (Miller & Spoolman, 2011). Such accumulation is more than ever, a disaster dilemma in rapidly growing urban centers. When they are allowed to litter; they pollute the air, land and threaten the biodiversity. This is besides the health risks and the aesthetic impairment which, among others, set tourist on the run. Yet, when they are burnt, they do not only pollute the air, but release greenhouse gases (GHGs); the vibrant culprits behind global warming. Nonetheless, when they are buried on land, they do us no good than threaten the lives of important microbes. This is besides the leachate which percolates through the top soil to pollute the water table; our sole source of water supplies. Since this 'physical matter' (SW) cannot be suspended in the air, what happens when we seek as a last resort to dump it in water bodies? Of course, we may not understand how soon, but we get back what we deserve. This could include polluted water and threatened aquatic ecosystem, to mention a few. All these among others, make solid waste a bane to the sustainability of most urban centers.

Solid waste management is one of the most public revenue-depleting service across urban centers around the globe (Coffey & Coad, 2010). It often accounts for the depletion of up to 20% to 40% of municipal revenue in urban centers. Although a growing economy is desired by all, the increase in waste production, and the related costs and risks that ensue from it, is an inevitable outcome of developmental activities (Misra & Pandey, 2005). In view of this, Georgescu-Roegen (1971) was quick to point that the more sophisticated the output of our production process, the more sophisticated will be the waste generated from such activities. Hence, so long as production and consumption intensifies, partly due to increase in population, advancement in waste management strategies will be required to reduce its impact on nations' economy.

Globally, an estimated 5.2 million people composed of 4 million children die each year on account of waste related diseases. In addition, the amount of waste generated through anthropogenic activities is envisaged to quadruple by year 2025 (Akter, 2000; Akter et al, 1999). Solid waste has been a typical contributor to the impairment of scenic beauty of the environment (Akter, 2000). Nigeria is not an exception in this context (Adeyinka et al, 2005; Titus et al, 2010). According to the Federal Ministry of Housing and Environment, Nigeria generates about 25 million tons of solid waste annually with a per capita waste generation rate of 0.49 kg/cap/day (Nabegu, 2011). Besides, in a recent report on Environmental and Social Management Framework for Public-Private Partnership (henceforth, PPP), the problem of growing solid waste is highlighted among Nigeria's pressing problems (FGN, 2009). Hence, a target sector for PPP. Solid waste pollution is more of urban concern and the household generates the most. A disaggregation of the total waste generation by state across Nigeria shows that Lagos state produces the largest volume of solid waste (Momodu et al, 2011; Nabegu, 2011). This is logical since it is the most industrialized state,

attracting seventy (70%) of the country's total industrial investment. Besides Lagos has the largest population density in Nigeria. Relative to the remaining 36 states in Nigeria, Lagos has the biggest waste management industry in terms of private-sector participation. It has 350 private waste collection companies, while the remaining 36 states altogether, has only 300 private companies (Olugbenga, 2010).

As such, in this study, Lagos is chosen as a fertile research setting with the hope that findings from its leading industry will benefit other states. Several ground-breaking measures are recently employed by the Lagos Waste Management Authority (LAWMA) (Olugbenga, 2008). However, the lingering problem has to do with the fast-filling dumpsites resulting from increased waste collection arising from the operation of the private waste collectors, following the privatization of services in the industry. As such LAWMA proposes to introduce solid waste source-separation. The dilemma however, is that the industry is composed of heterogeneous markets with service attributes and waste bill amounts varying across the high income and low income areas (Adepitan, 2010). Most of the low income areas are urban-slum communities dominated by low-income segments of the state's population. Thus designing improvements in SWM will require understanding the peculiarities of each market. This is because, no solution is ideal for countries or even districts within the same city (Coffey & Coad, 2010; Imam et al., 2008).

Source-separation of waste is rarely practiced in developing countries (Das et al., 2010; Coffey & Coad, 2010). Nonetheless, a plan to introduce one is underway in Lagos state. This has been prompted by the dramatic increase in the cities' volume of waste generation against its known limited landmass. In the face of services privatization in the state, challenges are higher in the low-income areas. Both service subscribers' dissatisfaction and low willingness to pay for services is most observed in the urban-poor settlements of the state (Longe et al., 2009). As such, this study's evaluation of the prospects for source-separation incorporated improvement in SWM service provision will be centered on its feasibility in urban-poor (slum) areas of Lagos. However, solid waste management in Lagos has some associated peculiarities that require being understood in order to comprehend the study's problem statement. These include its geography and population, the solid waste management challenges, heterogeneity in its waste management market, heterogeneity in the regulated collection method as well as waste storage method prior to collection.

1.1.1 Lagos Geography and Population

Lagos state as shown in Figure 1.1, is bordered in the North and East by Ogun State. In the West, it shares boundary with the Republic of Benin. It is bordered in the South by 180 km stretch of the Atlantic Ocean coast. Its land is divided apart by creeks creating islands. The highly dense city of Lagos has an annual population growth rate of 5%. Lagos is the fastest growing megacity in the world (UN-HABITAT, 2006a, 2006b). By 2015, it is anticipated to be among the World's nine hyper-cities which are each envisaged to provide homes for not less than 20 million inhabitants.

The state is the most important economic hub in Nigeria. It hosts about 70% of industries in the country (Rasaki, 1988). Despite the small size of the city by landmass, it has rapidly attracted huge population influx. Its population, which stood

at 500,000 in the late 1960s, increased to 3 million in 1975 (Aderogba & Afelumo, 2012). The population further increased to 5.6 million in 1988 and by 2006, its population has grown to about 18 million. According to *the New York Times*, Lagos' population has exceeded 21 million in 2012 (Campbell, 2012), surpassing Cairo as Africa's largest city.

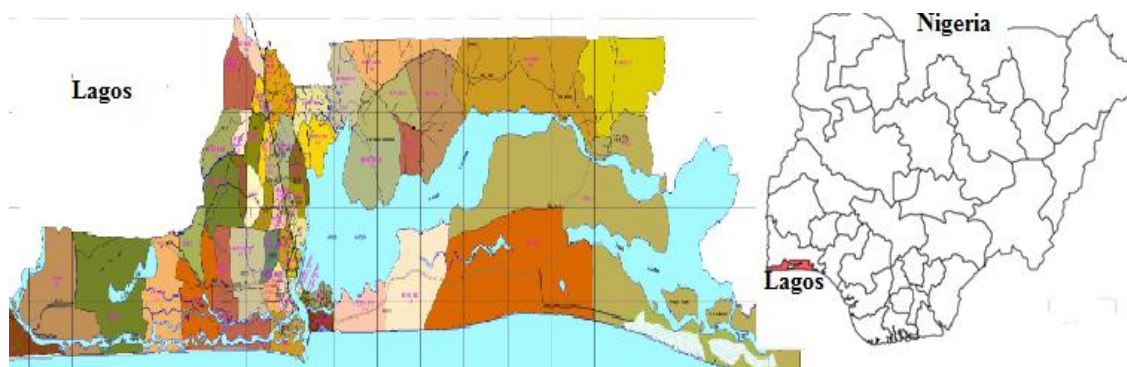


Figure 1.1 Map of Lagos

1.1.2 Municipal Solid Waste Management Challenges

Due to its rare density, Lagos state as shown in Table 1.1, generates the largest volume of solid waste (Nabegu, 2011; Momodu et al., 2011). This led to unsightly city surroundings which made Lagos to be dubbed the dirtiest city in the world (Oyeniya, 2011; Rasaki, 1988). This was also largely due to the inability of Local Government Councils to cope with growing budgetary requirements of collecting the increasing volume of generated waste in their domains. Currently, daily solid waste generation in the state amounts to 10,000 metric tons (Olugbenga, 2010). This is not surprising as it is the fastest growing megacity in the world (UN- HABITAT, 2006/7).

Table 1.1 SW Generation (kg/yr x 1000) in Selected Cities

Cities	1982	1985	1990	2000
Lagos	625,399	681,394	786,079	998,081
Ibadan	350,823	382,224	440,956	559,882
Kano	319,935	348,580	402,133	535,186
Kaduna	257,879	280,925	324,084	431,314
Onitsha	242,240	263,929	300,477	386,593
Port-Harcourt	210,934	229,821	265,129	236,853
Aba	131,190	143,712	169,719	236,703
Gusau	44,488	48,471	57,243	79,835

Source: Nabegu (2011) and Momodu et al., (2011)

Although data on waste generation is scarcely available, recent data provided by Lagos Waste Management Authority (henceforth, LAWMA) reveals the relative importance of waste from households and industry. Figure 1.2 shows the proportional disaggregation of accumulated solid waste by household and industry, deposited at dump sites in Lagos in the first quarter (January to March) of 2009.

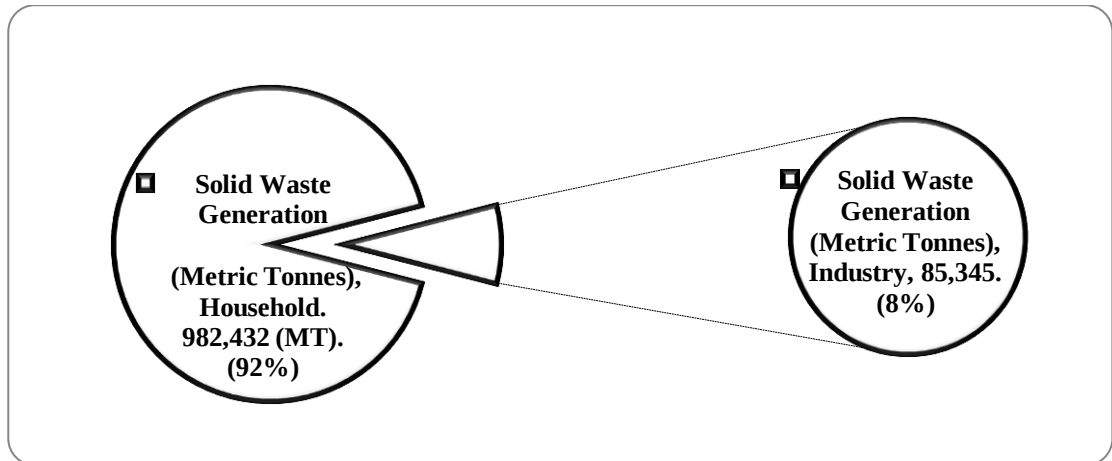


Figure 1.2 Solid Waste Generation in Lagos state (Metric Tonnes)

Source: Author's computation using data from LAWMA, retrieved on 15th August, 2011 via http://www.lawma.gov.ng/lawma_prs.html

It is apparent that the household is responsible for the major share of SW generated (Figure 1.2). The volume of uncollected waste increased beyond the budgetary abilities of the local government authorities who are primarily responsible for its collection. To reduce the health risks, environmental pollution and scenery impairment resulting from the increasing volume of uncollected waste, the state government was prompted to privatize service provision in the industry. The greatest challenge, however, is that, as waste collection increased due to the operation of the newly licensed 350 companies, LAWMA laments that landfill sites receiving solid waste are fast-filling (Odueme, 2012). As it appears, pollution reduction through improved collection aided by the operation of the licensed waste collection companies, without spectacular diversion measures had made another consequential environmental problem more apparent. This is in the form of increase landfill area requirement. The land fill sites in Lagos receive about 700 truck-load of solid waste daily (Adepitan, 2010).

This is clearly a paradox of solid waste management service provision. That is, in the absence of integrated solid waste management (ISWM), an attempt to solve one solid waste related problem (littered uncollected waste) obviously leads to another related environmental problem (increase in landfill area requirement), creating a dilemma. It is most especially a serious problem in large cities such as Lagos because it is a small place by landmass but densely populated. To go around this waste management paradox, LAWMA had embarked on improvement measures by adopting ISWM technique. This include among others, recovery of paper, Nylon (plastic), bottles and the creation of recycling and composting plants. LAWMA's Managing Director, Mr Oresanya emphasizes the indispensable adoption of source-separation, yet to be implemented, to the diversion of waste from landfills (Odueme, 2012; Adeseri & Akoni, 2011). Yet little is known on the prospects for implementing such improvement.

1.1.3 Heterogeneity in Solid Waste Management Market

The marketplaces for virtually all merchandises are in reality, not purely perfect. They contain some homogenous smaller market segments within the bigger markets which are most often heterogeneous (Dibb & Simkin, 2009; Smith, 1956; Wind,

1978). The markets for environmental resources are prototypes of such heterogeneous markets. This holds for solid waste management service where attributes are accorded unequal relevance across heterogeneous market segments (Naz & Naz, 2008). This conforms to expectations by advocates of market segmentation (Jones et al, 2005). Yet, the earlier applied studies had assumed homogenous market across segments. However, in reality, just like other destinations, the solid waste management service market in Lagos has two major segments including the affluent and poor communities with apparent difference in certain service attributes (Adepitan, 2010; Oresanya, 2008). The two most important factors that distinguish each market segment are the economic groupings of respective localities as well as the level of infrastructure availability. In a related rating of communities across Lagos, 42 areas are dubbed slum areas as shown in Figure 1.3.

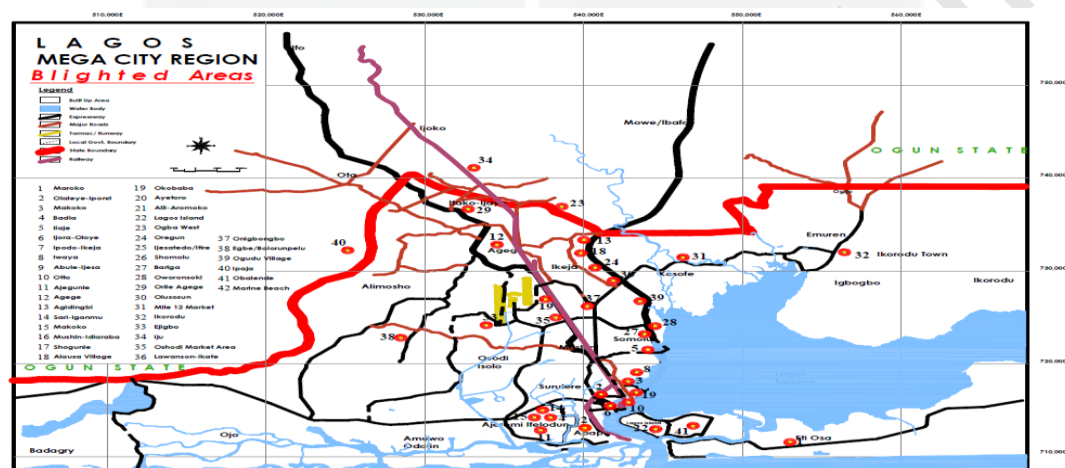


Figure 1.3 Slum Communities in Lagos

Source: SNC-Lavalin (1995, cited in Agbola & Agunbiade, 2009)

These 42 communities were identified based on a research conducted by the United Nations Development Program (UNDP) (SNC-Lavalin, 1995 cited in Agbola & Agunbiade, 2009). Solid waste management service attributes in this poor stratum of Lagos is not the same as those of the affluent communities.

In view of these district-specific peculiarities, it is impracticable to have a unique waste management model even within a city (Coffey and Coad, 2010). Thus, it is expected that the demand structure in each of these broad categorizations differ. This leads to the creation of sub-markets. This is evidenced by differences in services attribute and waste bill, including bridging¹ payment to PSPs in Lagos. Regulated monthly waste bill amount in Lagos is contingent upon the type of housing units inhabited by households (Adepitan, 2010). The charges are ₦ 1, 000 for Duplex, ₦ 750 for Bungalow, ₦ 500 for Flats, ₦ 200 for Shops, and ₦ 100 for single-room apartments. Meanwhile, the urban slum areas are dominated by households

¹ Bridging amount refers to a sum of money paid to PSP operators. It is usually a proportion of reported losses arising from tenements' default. The aim of this mechanism is to mitigate operators' losses arising from tenements' non-payment of monthly waste bill. The stipulated amount by LAWMA is to the tune of 60% of the deficit exposure of PSP operators per month. Note that 1USD = ₦ 160.

occupying single-room apartments. This creates an enclave of people sharing common characteristics; low-income earners who are mostly the occupants of single-room apartments in Lagos. The second apparent diverse attribute across market segments is the mode of solid waste collection. Although LAWMA primarily requires PSPs to collect solid waste from door to door. However, the unavailability of infrastructure such as accessible roads necessitates the use of pre-collection mode in slum areas dominated by the urban poor.

1.1.4 Heterogeneity in Solid Waste Collection Practices

1.1.4.1 Pre-Collection

Pre-collection service entails waste collection from tenements using either carts or light-weight trucks prior to final transportation. In Lagos, that is done using motorized tricycle truck which has the advantage of accessing roads in urban slum areas which are often narrow with no asphalt or bituminous treatments. This makes such areas inaccessible to heavy compactor trucks. As such pre-collection service is usually provided by operators in such areas to transport the waste to heavy trucks which are used for the final transportation at the tar roads. Figures 1.4 and 1.5 show related pictures obtained from field work.



Figure 1.4 Pre-collection Service Provision in Low-Income Communities of Lagos

Source; Authors' Field Material



Figure 1.5 Pre-collection truck in a low-income area of Lagos

Source; Authors' Field Material

1.1.4.1 Door -To-Door Collection

Door-to-door mode of collection is a collection type that entails the PSPs going from house-to-house to collect generated waste. The waste is usually emptied directly into the heavy truck that does the final transportation to either the transfer loading stations or landfill sites. This form of solid waste collection is provided to tenements in affluent areas. This is because houses in those areas are accessible to trucks via tar roads unlike what is obtainable in low-income areas.

1.1.5 Waste Containerization

In order to ease the collection of waste and cleanliness of surroundings, LAWMA introduces waste containerization. This requires the storage of waste in a wheeler bin prior to collection. Interview responses by PSPs were found to be mixed about households' usage of such bins in high income areas. Meanwhile, non-compliance was found higher in low income areas. This does not imply that they do not store waste before collection, rather they store them in sacks and discarded plastic containers as evident in Figure 1.4.

1.2 Problem Statement

Solid waste prevention prior to generation as well as management after its generation constitutes the two broad ways in dealing with solid waste (Spoolman and Miller, 2011; Coffey & Coad, 2010). Previously, the overwhelming concern of dealing with municipal solid waste in Lagos was majorly concerned with the latter approach (Taiwo, 2009; Kofoworola, 2007). This earlier traditional method was based on the simple model of collection and disposal. However, the need to deal with growing solid waste around the world had necessitated the use of a more comprehensive method which incorporates both aforementioned approaches dubbed integrated solid waste management- ISWM (UNEP, 2009a, 2009b; Taiwo, 2009; Olugbenga, 2010; Kiely, 2007; Tonglet et al., 2004; Barr et al., 2001) This approach accents more on the diversion of waste from landfill sites. This is majorly done through reduce, re-use and recycling as shown in Figure 1.6. The most sophisticated approach requires

strategies to prevent the waste from being generated in the first place. This is achieved through waste reduction and prevention mechanisms.



Figure 1.6 Solid Waste Management Priorities in Lagos

The adoption of the traditional collection-disposal method had subjected cities to put up with the paradox of solid waste. By this paradox, we meant a scenario where increase in a city's waste collection in an attempt to avoid its aesthetic, health and biodiversity-threatening impacts increases land area requirement for land filling. This is a problem in urban centers with limited landmass, increasing population and wealth but with traditional solid waste management which accents only on collection and dumping of waste (Aluko, 2010; Aluko, 2012). This is crucial particularly for Lagos where land use is considered very competitive due to its high population density (Olayiwola et al., 2005). Breaking this paradox is necessary for achieving decoupling link between waste generation, population and other economic drivers. Although we cannot have 100% recycling, ISWM could help reduce the environmental impact of mixed solid waste production (Contreau-Levine and Coad, 2000).

Environmental problems most especially, SWM is a serious issue of concern in Lagos state (Rasaki, 1998; Aluko, 2010). The Lagos state government had taken important steps since the fairly recent past, to curb the intensity of aesthetic impairment, pressure on natural resources, as well as potential health impacts from improper SWM (LAWMA, 2008). However, the same improvement measures have created a new scenario where increased waste collection to avoid littering is accounting for the fast-filling of existing dumpsites. This will increase landfill area requirement into the future. To avoid this, recent studies examining solid waste issues in Lagos conclude that diversion through waste separation and recycling is important to solve such problem (Aderogba and Afelumo, 2011; Taiwo, 2009; Kofoworola, 2007). Waste diversion is crucial as future demands for solid waste collection services are expected to rise due to projected increase in population (Coffey and Coad, 2010).

Lagos has an ambitious recycling target. It achieved 18% recycling rate in 2011. The accomplished recycling was disaggregated into 10% composting, 7% plastic recycling and 1% paper recycling. Lagos plans to gradually increase its annual rate of recycling from this 18% accomplished in 2011 to 30% in 2014/15. As a long term

plan, it envisages to achieve up to 60% recycling rate by 2020². LAWMA presently serves two major types of settlements, characterized by differences in socio-economic status. These include the low income and high income communities (Adepitan, 2010). These could be dubbed distinct markets due to apparent differences in service provisions to these user groups. Hence, the market for SWM service in Lagos is not homogenous. However, there are impressions that compliance to environmental regulations is less observed in urban-poor neighborhoods of Lagos which constitutes one of the market segments (Longe et al., 2009; Adepitan, 2010). Thus, examining the feasibility of implementing source-separation in the less compliant market segment is expected to provide insight on the practical plausibility of introducing source-separation in the entire market segments. However unlike the generation of mixed solid waste, source-separation requires households' commitment of some 'inconvenience costs' embodying buying and maintaining more than one waste storage container as well as time and effort inputs required for sorting generated waste (PwC, 2010).

As such, following welfare theorists, households as rational economic agents will only support its implementation if they are not made worse-off. This could be achieved by designing source-separation in a manner that compensates the losses in their utility. Such disutility is reflected in reduced access to mixed waste disposal which they previously enjoy and the 'inconvenience costs' associated with source-separation. Despite these losses in utility that accrues to households, source-separation is expected to increase societal net utility via reduction in pollution, landfill area requirement, exploration of fresh stock of resources, urban environmental eyesores, heating via discharge of landfill gases, among others (Eshet, et al., 2005, 2006).

Besides, one of the most apparent benefits of this solid waste management policy change is that segregated recyclables have huge market value in Lagos. This is evident by the existence of informal waste-pickers and the maintenance of recycling and compost plants by LAWMA. Since there exist potentials for societal benefits, such benefits could be huge enough to off-set the costs accruing from the policy change (Morrison, 2000). This is in accordance with Kaldor-Hicks potential compensation principle in the face of interpersonal comparison of utility. Despite recognizing the loss in welfare to losers arising from policy change, the principle asserts that a policy could be welfare enhancing if it increases net benefit to the society such that it is possible for the gainers to compensate the losers (Hicks, 1939; Kaldor, 1939).

Assessment of such welfare impact, most especially since source-separation produces non-market benefits, requires computations via economic valuation of non-market benefits (Carson & Mitchell, 1989). In addition, designing informed policies on services such as source-separation which has many potential non-market service attributes require insights on the marginal rate of substitution (MRS) among service-attributes (Agimass & Mekonnen, 2011). This is expected to guide decision-makers on the myriad of alternative policy designs of source-separation program and their respective costs. However, the model required to compute MRS among attributes has a recently acknowledged drawback of biasing welfare estimates which could be

² Retrieved on 16th February, 2014 from <http://www.ricardo-aea.com/cms/the-world-of-waste-in-lagos-africa-s-most-populous-city/#.UwAgI2KSxXc>

avoided if the modeled service-attributes exert high preference among affected agents (Alemu et al, 2013). If the welfare loss from source-separation is known, it will serve as an input in cost-benefit analysis required to evaluate the feasibility of implementing the program. This could be achieved by comparing aggregated welfare loss (to be computed in this study) to welfare gains to waste-pickers, LAWMA or other policy-designated managers of source-separated recyclables.

Another recently acknowledged important welfare-related issues somewhat outside the realm economics are non-economic motivators of pro-environmental activities. This is commonly expressed in the context of environmental concern (Ojea & Loureiro, 2007; Stern et al., 1993; Stern & Dietz, 1994; Whittaker et al., 2005). Environmental concern is understood to have distinct dimensions and all dimensions are believed to simultaneously exist in all humans, motivating them to obtain utility from pro-environmental activities even at some costs. It is therefore worth understanding the link between this concern and welfare loss assessment perceived for source-separation which is also a pro-environmental activity. This link is not least expected by advocates of economic value assessment for non-market goods (Mitchell & Carson, 1981). However, due the inconclusiveness a previous study by Van Liere and Dunlap (1980) suggests specific focus on concerns specific to peculiar environmental issues.

Meanwhile, Stern and Dietz (1994) and Thompson & Barton (1994) noted that different dimensions of concern could be activated for different pro-environmental behaviors. Thus, in the case of solid waste pollution concern, it is important to know what dimensions exist, and which of the dimensions is activated to support solid waste related pro-environmentalism. This issue is important as existing economic valuation studies have established that solid waste pollution concern influences economic value ascription of individuals (Afroz, et al., 2009; Afroz & Masud, 2011; Jamelske & Kipperberg, 2006; Jin et al, 2006; Othman, 2003, 2007; Pek & Jamal, 2011). However, a great deal of information is lost as all these studies conceptualize concern as (Yes-No) discrete concept, ignoring its distinct dimensions. Thus, none could say which dimension of its structure is activated in support of improvement in solid waste management. Meanwhile, information on such is important to inform policy on which dimension to focus when designing awareness campaign programs, for instance.

1.3 Research Questions

The issues underscored in this study's problem statement, warrant the following research questions.

- I. What are the most important service-attributes of solid waste source-separation program desired by the urban-poor in Lagos?
- II. What are the dimensions of urban-poor households' attitudinal concern that could be activated in support of solid waste source-separation?
- III. What is urban-poor households' average willingness to accept compensation for providing source-separated waste?
- IV. What is urban-poor households' marginal rate of substitution among the service attributes of solid waste source-separated program.

- V. What dimension of urban-poor households' attitudinal concern for solid waste pollution is activated in support of source-separation

1.4 Study Objective

The general objective of this study is to assess the prospects for implementing solid waste source-separation in urban-poor areas of Lagos. This is in the context of estimating households' required willingness to accept compensation for the attributed inconvenience cost. To achieve this, the specific objectives outlined for this study are;

1. To determine the most relevant set of households' choice-influencing service attributes for solid waste source-separating program.
2. To explore the dimensions of attitudinal concern for solid waste pollution among the urban-poor in Lagos.
3. To estimate urban-poor households' average willingness to accept compensation for providing source-separated waste.
4. To determine households' marginal rate of substitution among the service attributes of solid waste source-separated program.
5. To determine the dimension of households' attitudinal concern for solid waste pollution that is activated in support of solid waste source-separation

1.5 Significance of the Study

This study uniquely combines five methods to achieve robust results. Each of the specific objectives set out in this study is analyzed using distinct technique. The first objective was achieved by using SPSS software to compute design-attribute relative importance index. The second objective was achieved by using both SPSS and AMOS software to respectively conduct exploratory and confirmatory factor analyses. The third objective was achieved by using Nlogit software to conduct a contingent valuation study for economic value ascription in respect of solid waste source-separation. The fourth objective was achieved by using both Ngene software and Nlogit software to respectively conduct experimental design as well as choice experiment analysis. Meanwhile, the fifth objective was achieved by using AMOS software to conduct path analysis. The outcome from the above combination of methods yielded robust results with unique contributions to stakeholders.

This study is envisaged to contribute to literature, policy and to guide stakeholders in Lagos SWM industry. Firstly, existing micro level literature on economic valuation of non-market costs/benefits associated to SWM are based on a restrictive assumption of homogenous market (Othman, 2002; Jin et al., 2006; Jamelske & Kipperberg, 2006; Othman, 2007; Afroz et al., 2009; Afroz & Masud, 2011; Pek & Othman, 2011; (Basili et al., 2006; Blaine et al., 2005; Huhtala, 1999; Palatnik et al., 2005; Tiller et al., 1997). This assumes that variables investigated are not nested around any other variable. Such assumption is already waning in the circle of marketing experts who have now favored the relevance of the realization of market heterogeneity in capturing wider spectrum of consumers (Burton, 2002; Pires & Stanton, 2000). Only this approach might be applicable to the diverse realities of Lagos environment (Imam et al., 2008; Omofonmwan & Osa-Edoh, 2008; Coffey & Coad, 2010). The present study furthers research on economic valuation by using

data structure clustered around distinct solid waste management market segment. This way, more reliable information on the chosen market segment is achieved.

Secondly, LAWMA's franchisees which are private waste collectors called the private sector participants (PSPs) are encouraged to participate and invest in SWM service across the city. As part of the strategies to ensure effective service delivery and to pave way for PSPs, the informal private operators are continuously being banned from operating in the sector (Akiyode & Sojinu, 2006; Longe et al., 2009). Despite this heightened desire for PSPs' involvement by the government, there is no market research on both the service attributes preferences and households' minimum willingness to accept to provide source-separated waste in Lagos. If this is not studied prior to the implementation of source-separation, the industry might run the risk of reduced revenue from households' unwillingness to provided separated waste. This might create another wave of indiscriminate dumping of waste in Lagos. This study therefore, generates vital information, not only relevant to the industrial regulator (LAWMA), but also, the existing and potential investors in the industry. When the information on households' WTA compensation provided by this study is compared to the benefits of source-separation via cost-benefit analysis, informed policy will be enhanced.

Thirdly, the outcome of this research is expected guide regulators on the necessary intervention needed to evolve pro-environmental attitude among members of urban population towards solid waste pollution. This is achieved through the examination of the dimensions of solid waste pollution concern held by households. Having known such dimensions each is then assessed for its predictive strength in motivating solid waste pro-environmental behavioral intention in the context of source-separation. This is important as it does not only provide better explanation on why households ascribe the value they claim but signals the relevant non-economic motivation that requires intervention via awareness and campaign programs. Here, the first contribution could help explain any divergence between expected and estimated amount of compensation. Meanwhile, the second contribution will guide LAWMA on what intervention to focus in its routine awareness campaign programs conducted by its advocacy unit.

1.6 Organization of the Thesis

This study is structured into five chapters. Chapter 1 provides an overview of solid waste management globally, narrowed to some details on Nigeria, and eventually, the case study of Lagos. These include discussions on the population and peculiarities of the solid waste management market in Lagos. In addition, the main policy challenge confronting solid waste management improvement in Lagos is underscored under the problem statement which the study seeks to address. This is followed by the study's objective which outlines the specific aims of the research in addressing the research problem. Finally, the contributions of the research are discussed under the significance of the study.

Chapter 2 presents the literature review on the methods adopted in the study. These entail models of behavioral intention in economics and psychology. In the case of the former, the stated preference (SP) methods using contingent valuation (CV) as well as choice experiment (CE) are reviewed. Meanwhile, in the case of the latter,

attitude-behavior theories are reviewed in relation to economic valuation. These explanations are presented as the relevant empirical and theoretical frameworks for the two broad methods.

In Chapter 3, the study's conceptual framework is presented. Besides, the survey design encompassing the survey method, sampling method, sample size, questionnaire design, data collection and estimation techniques are discussed. In addition, the result for final pre-survey analysis conducted to address the study's first objective is presented. The analysis was done prior to the conduct of the final survey.

Chapter 4 reports estimated results from the models estimated to address the research objectives outlined in chapter 1. In addition the discussions of results and interpretations of findings are also provided. The final chapter, chapter 5, summarizes the findings from the study in a concise conclusion. In addition, implications for policies are also presented. Lastly, the limitations of the study are highlighted, including proposals for future improvements.

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