

# **A Fundamental Evaluation of the Municipal Solid Waste Management in Ado Ekiti, Nigeria, Using the Rating Index of the Users and Operatives**

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## **Authors' contributions**

*This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The assessment of the management of the municipal solid waste (MSW) in Ado Ekiti being undertaken by Ekiti State Waste Management Board (ESWMB) was done using questionnaires distributed randomly to the users and government operatives of the service. The questionnaire responses were on a five-point scale, similar to the Likert's scale, but not bipolar. The data was collected from the users of the main dumpsters, which are located at Opopogboro, Ajilosun, Atikonkon, Oja Oba and Odo Ado areas of the city. Also, the data from the operatives was collected from the driver and four labourers designated to collect waste from each dumpster. The people's rating index (PRI), which was calculated from the weighted value of the responses to different questions, was used to determine the overall index value whose maximum value is 100. The rating was classified into five categories- bad, fair, fairly good, good, very good and excellent, to enable pragmatic assessment of each issue being assessed. The rating of the users varies from fair to fairly good while the rating of the operatives varies from fair to very good. The general better rating of the operatives compared to the users indicate the reason the state government is oblivious of the poor status of the management of the municipal solid waste (MSW) in Ado Ekiti.

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The findings in this study suggest that the state government needs to hold a stakeholders summit on effective management of MSW in Ado Ekiti. With this, critical issues relating to urgent need for improvement and increased funding from non-governmental organisations and the federal government will be resolved. In conclusion, the approach used in this study, which is not symmetrical and includes the perception of primary stakeholders appears to be pragmatic and suitable for foundational appraisal of the management of a basic MSW system.

**Keywords:** *Municipal solid waste; dumpster; evaluation; management; Ado Ekiti.*

## 1. INTRODUCTION

Municipal solid waste (MSW) comprises solid waste obtained in the community from households, commerce and trade, office buildings, institutions and small sweepings, contents of litter containers and market cleansings. Wastes generated from industrial process, agricultural solid wastes, municipal sewage networks and treatment, construction and demolition are excluded [1-4]. Globally, the management of municipal solid waste (MSW) is very important as its state is an obvious indicator of the management of other municipal services. In recent times, the management of MSW has become a major concern to various governments as the rate of increase in the generation of MSW appears to be more than the level of urbanization, and thus the capacity to manage the volume of waste, especially in low-income economies. Moreover, its adverse effect can be very damaging; resulting in air and water pollution, flooding, and severe health issues, which include respiratory and water-borne illness and dengue fever [4]. The quantity of MSW generated in the world is greatly influenced by population, household wealth, types and pattern of consumption, technology, lifestyles and proliferation of packaging [3,5]. The global waste generation has been projected to increase from 1.2 kg per person per day in 2010 to 1.42 kg per person per day in 2025 although there is variance in the quantity produced in developing and developed countries. For instance, in 2010, waste generation in sub-Saharan Africa varied from 0.09 to 3.0 kg per person per day, with an estimated average of 0.65kg/capita/day while waste generation in the Organisation for Economic Co-operation and Development (OECD) countries varied from 1.1 to 3.7 kg per person per day, with an average of 2.2 kg/capita/day [4]. In 2012, approximately 80-90% of the budget expended on the management of MSW in low- income developing countries was on collection while less than 10% was expended in high-income countries. Despite this, collection rates in high-income countries were higher than

90% [4] while collection rates in low and middle income countries varied from as low as 10% in peri-urban areas to a high of 90% in commercial city centres in 2010 [6].

Integrated solid waste management (ISWM) is being practised in the developed world as it fully utilises the MSW as a useful resource, in this era of environmental sustainability. The use of the 4Rs - reduction, reuse, recycling and recovery is common [7]. The three key system elements of ISWM are: public health, which involves sustaining healthy conditions through an efficient waste collection system; environmental protection particularly during waste treatment and disposal; and resource management through the return of both materials and nutrients to beneficial use through recycling, reuse and recovery. The three governance features of ISWM are: (a) inclusivity; (b) financial sustainability and (c) sound instructions and proactive policies [6].

In Nigeria, there have been various legal frameworks concerning waste management. The foremost was the Federal Environmental Protection Agency Act (FEPA) promulgated in 1988. The Act consists of 42 sections, divided into four parts and includes the powers of the Federal Environmental Protection Agency, National Environmental Standards, Establishment of State and Local Environmental Bodies, and Supplementary and Miscellaneous [8]. FEPA was amended in 1992 (Decree No. 59 of 1992) and in 1999 (Decree No. 14 of 1999) was repealed and replaced with the National Environmental Standards Regulatory and Enforcement Agency (NESREA) Act of 2007. Other legal frameworks to protect and improve environment and safeguard water, air and land of Nigeria have been reported [9,10]. Currently, the MSW management is undertaken by the Environmental Protection Agency (EPA) or the Waste Management Board (WMB) of the various states of Nigeria. It is quite astonishing that despite the adequate legal framework and the pertinent agencies established to deal with the

solid waste produced by residents in the cities, the status of MSW management appears to be inadequate [11].

There have been many reports on the management of solid waste in Nigeria. Many of the reports have been on the characteristics of the MSW [12,13]. Few have been on the perception of the producers of MSW on its effective management [14,15]. The researchers have focused mainly on urban areas, where the problems associated with inadequate waste management are predominant. This is not surprising as there has been a rapid rural-urban migration in Nigeria since independence. According to the data provided by the World Bank, the urban population as a percentage of the total population in Nigeria increased from 15% in 1960 to 49% in 2017 [16]. This has been caused by the focus of the federal and state governments on the development of urban areas. Consequently, rural dwellers continuously migrate to the urban areas for better job opportunities and improved infrastructural facilities, thus resulting in high standard of living [17,18]. In Sub-Saharan Africa, the average per capita wealth increased by 13% in South Africa between 1995-2005 while Nigeria, the other dominant economy decreased by 15% during this period [19]. However, an average growth rate of 5.7% in gross domestic product (GDP) was recorded in Nigeria between 2006 and 2016, before the economy went into recession in 2016, with a growth rate of -1.5% owing to the crash in the price of crude oil [20]. Although the economy has now come out of recession, with an average growth rate of 1.0%, financial resources are still inadequate to provide basic infrastructure, including those for the management of MSW. This has been supported with various research findings that reported lack of funds as one of the major hindrances to the effective operations of the Environmental Protection Agency of various states despite the fact that the average waste generation in Nigeria is approximately 0.5kg/capita/day [5-21].

In Nigeria, the collection of MSW in the urban areas is undertaken by the state governments, registered private operatives and the informal sector. The operations of the latter have been growing in influence, especially in Lagos, where many streets in the poor residential areas are impassable for waste-collection trucks. The relatively small percentage of recycling is usually done by the informal sector [14,15]. The MSW is usually disposed of to open dumps as there are

no sanitary landfills in Nigeria [22]. No wonder, there have been reported cases of groundwater contamination owing to the disposal of municipal solid waste in open dumps, which have resulted in health problems among the residents living in the vicinity of such dumps [23-31].

A MSW management system comprises three groups of stakeholders: the service provider, such as the various state governments in Nigeria; the service users; and enabling environment provided by the national and state governments. Regular assessment of MSW management system is required to determine existing inadequacies and proffer solutions to enable sustainable planning and operation of the system. In the process, valuable data is also obtained which enhances accuracy of the continuous analysis of the system. Often, in the developing countries, arbitrary solutions, which may be applicable in the developed world but untenable in developing countries as they do not consider ambient conditions, are proffered. This is the reason why the status of MSW management in many cities in the developing world continues to be poor. Obviously, the best pragmatic way to primarily assess a MSW system in a developing country such as Nigeria whose existing MSW infrastructure is undeveloped and reliable waste data is non-existent for meaningful analysis, is through the analysis of the current perceptions of all the primary stakeholders. This may appear basic, but it is required for a solid foundation on which efficient framework of MSW will be built upon. Consequently, this study was undertaken to assess the management of MSW in Ado Ekiti, Nigeria using the user's perceived ratings of the current situation. Unlike in previous investigations [14,15], the ratings of the operatives employed by the state government to collect the solid waste from the various public dumpsters for disposal have also been used in the assessment. This is very important as the perception of the operatives, who are employed by the state government are solely sought in making governmental decisions on the management of solid waste in the state. In addition, a rating index, which is not bipolar or symmetrical but whose values vary directly as the goodness of the rating of the assessor was formulated and used for the assessment. The rating index used in this study is similar to the resident's satisfaction index used by Afon [14], however, the rating classification and response questions are different. This was done to avoid inaccuracies in the calculation of severity index

obtained with a bipolar rating classification and a rating index of 0, 1, 2, 3, 4, using a 5-point Likert's scale as done by [32] and criticized by [33]. Furthermore, realistic questionnaire structure was adapted to enhance the accuracy of the data being provided by the respondents.

## 1.1 Study Area

The area of study is Ado Ekiti, the capital of Ekiti State, which is one of the 36 states in Nigeria. It is located in southwestern Nigeria and lies between latitude 7°25' and 7°47' north of the equator, and between longitude 5°5' and 5°30' east of the Greenwich Meridian. The population of Ado Ekiti from the last census in 2006 was 313,690 (NPC [34]) and the projected population of Ado Ekiti, in 2017, when the study was undertaken would be 441,157 using a growth rate of 3.148%. The management of MSW in Ado Ekiti is done by Ekiti State Waste Management Board (ESWMB), which is owned by the state government. Approximately 23m<sup>3</sup> metal dumpsters (waste skips) are placed at strategic locations by the main roads in the city for the collection of MSW (Fig. 1).

The dumpsters at the main market area (Oja Oba and Atikonkon) are supposed to be emptied daily while the dumpsters in the residential areas are supposed to be emptied within 2 days using 'roll-on and roll-off' trucks with hydraulic facilities for eventual disposal at the open dumpsites located at Ilokun, Ikere Road and Federal Polytechnic Road. Unforeseen breakdown of some of the trucks, however, often prevents this and thus creates an overflow of the MSW placed in the dumpsters. In reality, the people that dump their MSW into the dumpsters are usually those that live in the vicinity. These are usually residents, traders and artisans that live and work/trade within a convenient walking distance of the dumpsters. Far-away residents that have vehicles also dump their MSW into the dumpsters. Other residents either burn or dump their MSW into unauthorised places. Recently, the management of ESWMB created a mobile taskforce that enforces the use of the dumpsters and prohibits illegal disposal of MSW. The taskforce has achieved a bit of success since its creation. In the past one year, few registered private companies have also been involved in the collection of MSW in areas that are not served by the dumpsters.

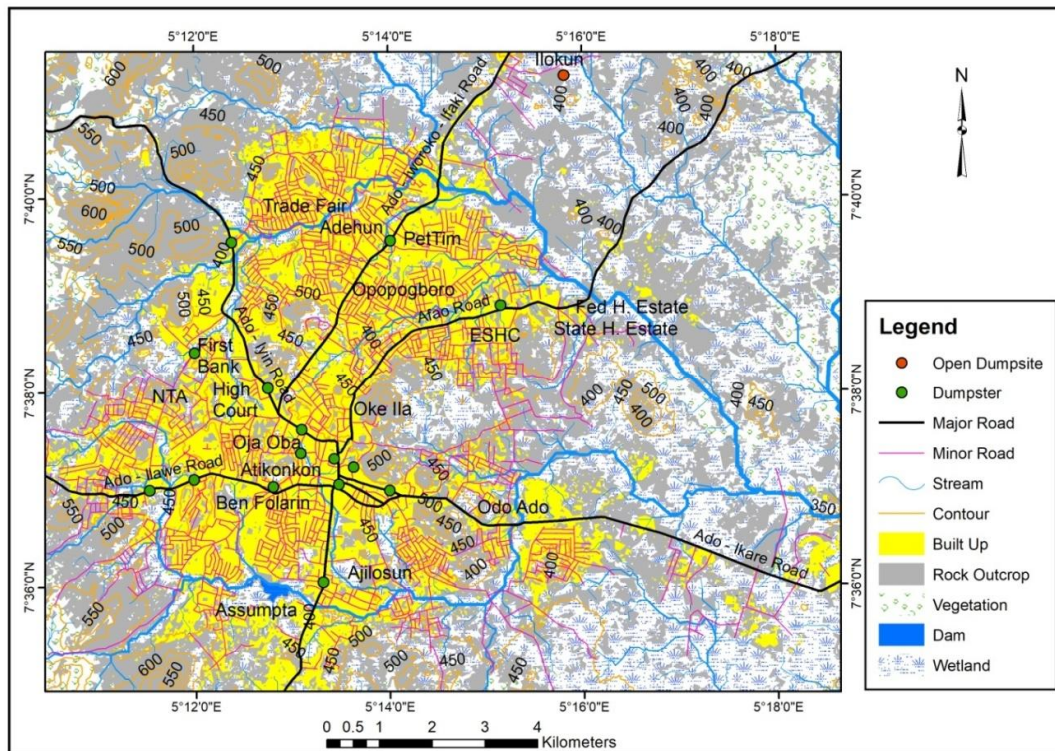


Fig. 1. Location of dumpsters and dumpsite

## 2. METHODS

The data used in this study was obtained from users of dumpsters and operatives of ESWMB through direct administration of questionnaires and structured interviews. One hundred and fifty (150) questionnaires were distributed randomly to users of each of the waste dumpster located at Opopogboro, Ajilosun, Atikonkon, Oja Oba and Odo Ado areas of Ado Ekiti. The majority of the users live/work within 150m of the location of the dumpsters. Twenty five (25) questionnaires were distributed to the users of each dumpster while five questionnaires were distributed to the operatives of each dumpster. The operatives comprise a driver and four labourers. In order to obtain a comprehensive assessment of the management of the MSW in Ado Ekiti, holistic questions were asked in the questionnaire. They include the ratings of the following: (i) the availability of the dumpster within the neighbourhood; (ii) the adequacy or the location of the waste collection dumpster being used; (iii) the capacity of the dumpster; (iv) the appropriateness of the dumpster to the waste being dumped into them; (v) the hygiene of the dumpster's location; (vi) the performance of ESWMB in the collection of waste placed in the dumpsters in Ado Ekiti; (vii) the capacity of the truck being used to collect and dump the waste at the waste dumpsite. (viii) people's attitude towards indiscriminate refuse disposal; (ix) the appropriateness of using Ilokun village, as a main disposal site for the waste collected at Ado Ekiti; (x) how often waste is collected.

The questionnaires were structured similar to the Likert's scale of satisfaction but were not conventional and polarised as the 5-point Likert's scale questions of "Strongly disagreed, Disagreed, Neutral, Agree and Strongly Agree" may be subjected to distortion since the Neutral option may be easily opted for and thus misrepresent the true perception of the respondents. In the Nigerian context, people are likely to avoid the use of "Strongly" as it is not normally used in mundane expressions. Preliminary survey showed that the respondents were likely to be more accurate in assessment if scale questions of "Bad, Fair, Good, Very Good, Excellent" were used in the questionnaire as these terms are the common rating terms being used in the Nigerian educational system and thus in mundane communication. The people's rating index used in this study is given as:

$$PRI = \frac{\sum_{i=1}^n (a_i x_i)}{5 \sum_{i=1}^n x_i} (100\%)$$

where:

PRI= people's rating index

a = rating value given to each expression of rating; bad = 1; fair = 2; good = 3; very good = 4; excellent = 5

x = frequency of response

The classification of PRI is as shown in Table 1:

**Table 1. Classification of PRI**

| Range of PRI     | Classification |
|------------------|----------------|
| 0.00≤PRI≤16.67   | Bad            |
| 16.67≤PRI≤33.33  | Fair           |
| 33.33≤PRI≤50.00  | Fairly good    |
| 50.00≤PRI≤66.67  | Good           |
| 66.67≤PRI≤83.33  | Very good      |
| 83.33≤PRI≤100.00 | Excellent      |

## 3. RESULTS AND DISCUSSION

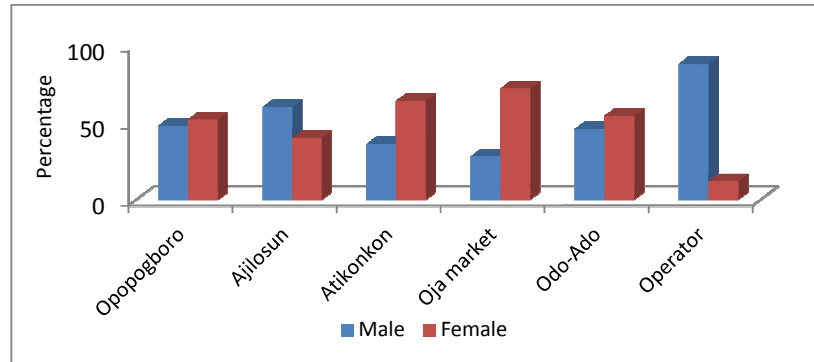
The gender status of the operatives and respondents at various areas of survey is shown in Figure 2. Females were more than the males at most of the study locations, especially at the market and residential areas with adjoining shops. They were 72% at Oja Oba, which is the market and 64% at Atikonkon, 52% at Opopogboro, and 54.2% at Odo Ado. Males (60%) were however more than females at Ajilosun. It is not surprising that 88% of the operatives were male owing to the rigorous nature of the job. The educational background of the respondents is shown in Figure 3. All the respondents have at least, primary education, which means that they are able to read and write. The respondents with secondary education were the majority at Opopogboro, Ajilosun, Atikonkon and Odo Ado with 64%, 56%, 52% and 45.8% respectively. In the case of the operatives, 48% have primary education, 40% have secondary education and 12% have technical college/college of education.

The responses of the users of the dumpsters and the operatives are shown in Tables 2-11. The PRI for the users and operatives is shown on the last row of each table. The PRI for Ado Ekiti is the mean of the values obtained for all the locations of the dumpsters in Ado Ekiti. As can be seen in Table 2, the users rated the availability of a dumpster in their neighbourhood as fair while the operatives' rating was very good.

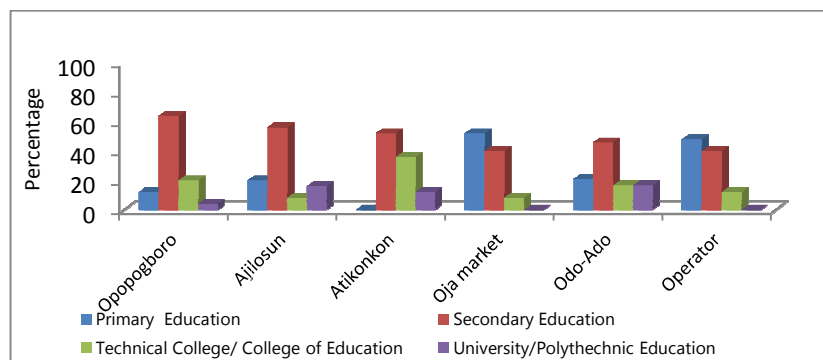
This is not surprising as the operatives are staff of Ekiti State Government and do not live in the neighbourhood of the site of the dumpsters. Similarly, the users rated the adequacy of the location of the dumpsters (Table 3) as fairly good while the operatives believed that the location is very good. There is however a slight discrepancy between the ratings of the users and the operatives concerning the capacity of the dumpster (Table 4) being used. While the users' rating was fairly good, the rating of the operatives was good, although the difference in the PRI of their assessment was just 5.2.

Similarly, the users rated the appropriateness (Table 5) of the dumpster to the waste being dumped in them as just fair. The users were more realistic as an inadequate capacity and disposal of putrescible solid waste into the dumpsters would result in spillage of the waste, which would result in offensive odour and unsightly scenery. This is supported in the rating value of 42.5 by users and 38.0 by the operatives concerning the hygiene at the location of the dumpsters (Table 6). These low values indicate that there were usually overflow of waste at the location of the dumpsters. The operatives rated

the frequency of collection of waste (Table 7) as very good; however, the users rated it as fairly good. This is expected as the operatives would rate their performance high despite their obvious shortcomings. The operatives rated the capacity of the truck used for collecting the waste (Table 8) as barely fairly good. This is a very pragmatic assessment as inadequate vehicles are often utilised when the designated trucks breakdown. The ratings of the users were quite similar as people would witness the breakdown and inappropriate vehicles being used by the operatives to collect the waste from the dumpsters. Similarly, the operatives rated the behaviour of people towards indiscriminate dumping (Table 9) as barely fair, just few PRI points better than poor while the users rated it as fair. It appears that the operatives are being realistic of the situation as they often pick scattered waste, which negatively impact their efficiency. The users and the operatives both rated the appropriateness of using Ilokun village (Table 10), as an open refuse dump as barely fairly good. This is expected as Ilokun village is a residential settlement that would be exposed to pollution of surface water and groundwater owing to these inappropriate activities.



**Fig. 2. Gender status of the respondents**



**Fig. 3. Educational attainment of the respondents**

**Table 2. How would you rate the availability of a dumpster in your neighbourhood?**

| S/N<br>(i) | Rating<br>Value ( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|---------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                           | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                         | 6           | 6               | 10          | 10              | 1           | 1               | 7           | 7               | 10          | 10              | 34          | 34              |             |                 |
| 2          | 2                         | 10          | 20              | 7           | 14              | 3           | 6               | 9           | 18              | 9           | 18              | 38          | 76              | 2           | 4               |
| 3          | 3                         | 6           | 18              | 4           | 12              | 12          | 36              | 4           | 12              | 6           | 18              | 32          | 96              | 3           | 9               |
| 4          | 4                         | 3           | 12              | 3           | 12              | 8           | 32              | 2           | 8               |             |                 | 16          | 64              | 5           | 20              |
| 5          | 5                         |             |                 | 1           | 5               | 1           | 5               | 2           | 10              |             |                 | 4           | 20              | 8           | 40              |
| 6          | 6                         |             |                 |             |                 |             |                 | 1           | 6               |             |                 | 1           | 6               | 7           | 42              |
| PRI        |                           |             | 37.3            |             | 35.3            |             | 53.3            |             | 40.7            |             | 30.7            |             | 39.5            |             | 76.7            |

PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$

**Table 3. How would you rate the adequacy of the location of the waste collection dumpster being used?**

| S/N<br>(i) | Rating<br>Value<br>( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|------------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                              | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                            | 6           | 6               | 7           | 7               | 3           | 3               | 7           | 7               | 10          | 10              | 33          | 33              |             |                 |
| 2          | 2                            | 5           | 10              | 4           | 8               | 3           | 6               | 8           | 16              | 4           | 8               | 24          | 48              |             |                 |
| 3          | 3                            | 4           | 12              | 6           | 18              | 4           | 12              | 6           | 18              | 9           | 27              | 29          | 87              | 5           | 15              |
| 4          | 4                            | 8           | 32              | 7           | 28              | 8           | 32              | 4           | 16              | 2           | 8               | 29          | 116             | 12          | 48              |
| 5          | 5                            | 2           | 10              | 1           | 5               | 6           | 30              |             |                 |             |                 | 9           | 45              | 5           | 25              |
| 6          | 6                            |             |                 |             |                 | 1           | 6               |             |                 |             |                 | 1           | 6               | 3           | 18              |
| PRI        |                              |             | 46.7            |             | 44.0            |             | 59.33           |             | 38.0            |             | 35.3            |             | 44.7            |             | 70.7            |

PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$

**Table 4. How would you rate the capacity of the dumpster? i.e. Is it big enough?**

| S/N<br>(i) | Rating<br>Value ( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|---------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                           | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                         | 2           | 2               | 5           | 5               | 3           | 3               | 5           | 5               | 7           | 7               | 22          | 22              |             |                 |
| 2          | 2                         | 15          | 30              | 1           | 2               | 5           | 10              | 7           | 14              | 6           | 12              | 34          | 68              | 9           | 18              |
| 3          | 3                         | 2           | 6               | 5           | 15              | 6           | 18              | 7           | 21              | 6           | 18              | 26          | 78              | 7           | 21              |
| 4          | 4                         | 5           | 20              | 11          | 44              | 3           | 12              | 4           | 16              | 4           | 16              | 27          | 108             | 5           | 20              |
| 5          | 5                         | 1           | 5               | 1           | 5               | 6           | 30              | 2           | 10              | 1           | 5               | 11          | 55              | 3           | 15              |
| 6          | 6                         |             |                 | 2           | 12              | 2           | 12              |             |                 | 1           | 6               | 5           | 30              | 1           | 6               |
| <b>PRI</b> |                           |             | 42.0            |             | 55.3            |             | 56.7            |             | 44.0            |             | 42.7            |             | 48.1            |             | 53.3            |

PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$

**Table 5. How would you rate the appropriateness of the dumpster to the waste being dumped into them?**

| S/N<br>(i) | Rating<br>Value ( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|---------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                           | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                         | 9           | 9               | 8           | 8               | 1           | 1               | 12          | 12              | 16          | 16              | 45          | 45              | 2           | 2               |
| 2          | 2                         | 6           | 12              | 7           | 14              | 5           | 10              | 2           | 4               | 4           | 8               | 25          | 50              | 5           | 10              |
| 3          | 3                         | 3           | 9               | 6           | 18              | 10          | 30              | 3           | 9               | 3           | 9               | 25          | 75              | 6           | 18              |
| 4          | 4                         | 6           | 24              | 1           | 4               | 8           | 32              | 6           | 24              | 1           | 4               | 22          | 88              | 8           | 32              |
| 5          | 5                         | 1           | 5               | 1           | 5               | 1           | 5               | 2           | 10              | 1           | 5               | 6           | 30              | 4           | 20              |
| 6          | 6                         |             |                 | 2           | 12              |             |                 |             |                 |             |                 | 2           | 12              |             |                 |
| <b>PRI</b> |                           |             | 39.3            |             | 40.7            |             | 52.0            |             | 39.3            |             | 28.0            |             | 39.9            |             | 54.7            |

PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$

**Table 6. How would you rate the hygiene of where the dumpsters are kept?**

| S/N<br>(i) | Rating<br>Value ( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|---------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                           | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                         | 12          | 12              | 9           | 9               | 2           | 2               | 8           | 8               | 17          | 17              | 48          | 48              | 5           | 5               |
| 2          | 2                         | 4           | 8               | 4           | 8               | 3           | 6               | 6           | 12              | 2           | 4               | 19          | 38              | 11          | 22              |
| 3          | 3                         | 4           | 12              | 2           | 6               | 5           | 15              | 5           | 15              | 5           | 15              | 21          | 63              | 7           | 21              |
| 4          | 4                         | 5           | 20              | 5           | 20              | 9           | 36              | 3           | 12              |             |                 | 22          | 88              | 1           | 4               |
| 5          | 5                         |             |                 | 2           | 10              | 4           | 20              | 2           | 10              |             |                 | 8           | 40              | 1           | 5               |
| 6          | 6                         |             |                 | 3           | 18              | 2           | 12              | 1           | 6               | 1           | 6               | 7           | 42              |             |                 |
| <b>PRI</b> |                           |             | 34.7            |             | 47.3            |             | 60.7            |             | 42.0            |             | 28.0            |             | 42.5            |             | 38.0            |

*PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$* **Table 7. How would you rate how often waste is collected?**

| S/N<br>(i) | Rating<br>Value ( $a_i$ ) | Opopogboro  |                 | Ajilosun    |                 | Atikonkon   |                 | Oja Oba     |                 | Odo-Ado     |                 | Ado Ekiti   |                 | Operatives  |                 |
|------------|---------------------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
|            |                           | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) | F ( $x_i$ ) | P ( $a_i x_i$ ) |
| 1          | 1                         | 5           | 5               | 1           | 1               | 1           | 1               | 2           | 2               | 6           | 6               | 15          | 15              | 1           | 1               |
| 2          | 2                         | 7           | 14              | 5           | 10              | 1           | 2               | 12          | 24              | 7           | 14              | 32          | 64              | 2           | 4               |
| 3          | 3                         | 9           | 27              | 11          | 33              | 8           | 24              | 6           | 18              | 9           | 27              | 43          | 129             | 2           | 6               |
| 4          | 4                         | 3           | 12              | 5           | 20              | 7           | 28              | 4           | 16              | 2           | 8               | 21          | 84              | 8           | 32              |
| 5          | 5                         | 1           | 5               | 3           | 15              | 7           | 35              | 1           | 5               | 1           |                 | 13          | 65              | 11          | 55              |
| 6          | 6                         |             |                 |             |                 | 1           | 6               |             |                 |             |                 | 1           | 6               | 1           | 6               |
| <b>PRI</b> |                           |             | 42.0            |             | 52.7            |             | 64.0            |             | 43.3            |             | 36.7            |             | 48.4            |             | 69.3            |

*PRI- People's Rating Index; F- Frequency; P- Product of  $a_i$  and  $x_i$*

**Table 8. How would you rate the capacity of the truck being used to collect the waste for disposal?**

| S/N<br>(i) | Rating<br>Value<br>(a <sub>i</sub> ) | Opopogboro          |                                    | Ajilosun            |                                    | Atikonkon           |                                    | Oja Oba             |                                    | Odo-Ado             |                                    | Ado Ekiti           |                                    | Operatives          |                                    |
|------------|--------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|
|            |                                      | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) |
| 1          | 1                                    | 5                   | 5                                  | 11                  | 11                                 | 3                   | 3                                  | 5                   | 5                                  | 6                   | 6                                  | 30                  | 30                                 | 5                   | 5                                  |
| 2          | 2                                    | 5                   | 10                                 | 1                   | 2                                  | 5                   | 10                                 | 3                   | 6                                  | 6                   | 12                                 | 20                  | 40                                 | 10                  | 20                                 |
| 3          | 3                                    | 8                   | 24                                 | 5                   | 15                                 | 5                   | 15                                 | 7                   | 21                                 | 9                   | 27                                 | 34                  | 102                                | 6                   | 18                                 |
| 4          | 4                                    | 4                   | 16                                 | 6                   | 24                                 | 3                   | 12                                 | 7                   | 28                                 | 4                   | 16                                 | 24                  | 96                                 | 3                   | 12                                 |
| 5          | 5                                    | 3                   | 15                                 | 1                   | 5                                  | 5                   | 25                                 | 2                   | 10                                 |                     |                                    | 11                  | 55                                 | 1                   | 5                                  |
| 6          | 6                                    |                     |                                    | 1                   | 6                                  | 4                   | 24                                 | 1                   | 6                                  |                     |                                    | 6                   | 36                                 |                     |                                    |
| <b>PRI</b> |                                      |                     | 46.7                               |                     | 42.0                               |                     | 59.3                               |                     | 50.7                               |                     | 40.7                               |                     | 47.9                               |                     | 40.0                               |

PRI- People's Rating Index; F- Frequency; P- Product of a<sub>i</sub> and x<sub>i</sub>

**Table 9. How would you rate people's attitude towards indiscriminate refuse disposal?**

| S/N<br>(i) | Rating<br>Value<br>(a <sub>i</sub> ) | Opopogboro          |                                    | Ajilosun            |                                    | Atikonkon           |                                    | Oja Oba             |                                    | Odo-Ado             |                                    | Ado Ekiti           |                                    | Operatives          |                                    |
|------------|--------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|
|            |                                      | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) |
| 1          | 1                                    | 8                   | 8                                  | 11                  | 11                                 | 3                   | 3                                  | 8                   | 8                                  | 17                  | 17                                 | 47                  | 47                                 | 1                   | 8                                  |
| 2          | 2                                    | 5                   | 10                                 | 4                   | 8                                  | 5                   | 10                                 | 5                   | 10                                 | 2                   | 4                                  | 21                  | 42                                 | 2                   | 5                                  |
| 3          | 3                                    | 4                   | 12                                 | 3                   | 9                                  | 3                   | 9                                  | 2                   | 6                                  | 3                   | 9                                  | 15                  | 45                                 | 3                   | 4                                  |
| 4          | 4                                    | 7                   | 28                                 | 4                   | 16                                 | 7                   | 28                                 | 10                  | 40                                 | 2                   | 8                                  | 30                  | 120                                | 4                   | 7                                  |
| 5          | 5                                    | 1                   | 5                                  | 2                   | 10                                 | 5                   | 25                                 |                     |                                    | 1                   | 5                                  | 9                   | 45                                 | 5                   | 1                                  |
| 6          | 6                                    |                     |                                    | 1                   | 6                                  | 2                   | 12                                 |                     |                                    |                     |                                    | 3                   | 18                                 | 6                   |                                    |
| <b>PRI</b> |                                      |                     | 42.0                               |                     | 40.0                               |                     | 58.0                               |                     | 42.7                               |                     | 28.7                               |                     | 42.3                               |                     | 27.3                               |

PRI- People's Rating Index; F- Frequency; P- Product of a<sub>i</sub> and x<sub>i</sub>

**Table 10. How would rate the suitability of using Ilokun village, as a main disposal site for the waste collected?**

| S/N<br>(i) | Rating<br>Value<br>(a <sub>i</sub> ) | Opopogboro          |                                    | Ajilosun            |                                    | Atikonkon           |                                    | Oja Oba             |                                    | Odo-Ado             |                                    | Ado Ekiti           |                                    | Operatives          |                                    |
|------------|--------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|
|            |                                      | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) |
| 1          | 1                                    | 8                   | 8                                  | 7                   | 7                                  | 1                   | 1                                  | 9                   | 9                                  | 12                  | 12                                 | 37                  | 37                                 | 4                   | 4                                  |
| 2          | 2                                    | 7                   | 14                                 | 2                   | 4                                  | 4                   | 8                                  | 6                   | 12                                 | 5                   | 10                                 | 24                  | 48                                 | 5                   | 10                                 |
| 3          | 3                                    | 5                   | 15                                 | 7                   | 21                                 | 9                   | 27                                 | 6                   | 18                                 | 3                   | 9                                  | 30                  | 90                                 | 7                   | 21                                 |
| 4          | 4                                    | 2                   | 8                                  | 7                   | 28                                 | 8                   | 32                                 | 2                   | 8                                  | 4                   | 16                                 | 23                  | 92                                 | 8                   | 32                                 |
| 5          | 5                                    | 1                   | 5                                  | 1                   | 5                                  | 2                   | 10                                 | 2                   | 10                                 | 1                   | 5                                  | 7                   | 35                                 | 1                   | 5                                  |
| 6          | 6                                    | 2                   | 12                                 | 1                   | 6                                  | 1                   | 6                                  |                     |                                    |                     |                                    | 4                   | 24                                 |                     |                                    |
| <b>PRI</b> |                                      |                     | 41.3                               |                     | 47.3                               |                     | 56.0                               |                     | 38.0                               |                     | 34.7                               |                     | 43.5                               |                     | 48.0                               |

PRI- People's Rating Index; F- Frequency; P- Product of a<sub>i</sub> and x<sub>i</sub>

**Table 11. How would you rate the performance of ESWMB in the collection of waste from dumpsters?**

| S/N<br>(i) | Rating<br>Value (a <sub>i</sub> ) | Opopogboro          |                                    | Ajilosun            |                                    | Atikonkon           |                                    | Oja Oba             |                                    | Odo-Ado             |                                    | Ado Ekiti           |                                    | Operatives          |                                    |
|------------|-----------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|
|            |                                   | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) | F (x <sub>i</sub> ) | P (a <sub>i</sub> x <sub>i</sub> ) |
| 1          | 1                                 | 4                   | 4                                  | 5                   | 5                                  | 2                   | 2                                  | 3                   | 3                                  | 9                   | 9                                  | 23                  | 23                                 | 1                   | 1                                  |
| 2          | 2                                 | 9                   | 18                                 | 3                   | 6                                  | 2                   | 4                                  | 9                   | 18                                 | 3                   | 6                                  | 26                  | 52                                 | 3                   | 6                                  |
| 3          | 3                                 | 6                   | 18                                 | 8                   | 24                                 | 7                   | 21                                 | 8                   | 24                                 | 8                   | 24                                 | 37                  | 111                                | 1                   | 3                                  |
| 4          | 4                                 | 5                   | 20                                 | 7                   | 28                                 | 5                   | 20                                 | 2                   | 8                                  | 4                   | 16                                 | 23                  | 92                                 | 13                  | 52                                 |
| 5          | 5                                 | 1                   | 5                                  | 2                   | 10                                 | 9                   | 45                                 | 1                   | 5                                  |                     |                                    | 13                  | 65                                 | 7                   | 35                                 |
| 6          | 6                                 |                     | 0                                  |                     | 0                                  |                     | 0                                  | 2                   | 12                                 | 1                   | 6                                  | 3                   | 18                                 |                     |                                    |
| <b>PRI</b> |                                   |                     | 52.0                               |                     | 48.7                               |                     | 61.3                               |                     | 46.7                               |                     | 40.7                               |                     | 48.1                               |                     | 64.7                               |

PRI- People's Rating Index; F- Frequency; P- Product of a<sub>i</sub> and x<sub>i</sub>

The operatives rated the performance of ESWMB (Table 11) as good in comparison to the fairly good expressed by the users. It shows that the operatives are oblivious of the feelings of the people they serve. This is very critical since the perception of the state government on the status of MSW management is that of the operatives, whose General Manager reports regularly to the State Executive Council on the management of MSW in Ado Ekiti. Thus, the good rating of the operatives compared to the primary users of the dumpsters, as found out in this study, would falsely inform the state government on the true status of MSW management in Ado Ekiti. With respect to the users' perception, it is imperative for the government of Ekiti State to enhance the operations of ESWMB through increased funding. Urgent financial assistance is needed to increase the number and size of dumpsters and trucks provided, to employ more qualified personnel and to embark on a massive campaign to educate the residents on appropriate ways of disposing the waste being generated by them. Owing to financial constraints, the state government should seek assistance from international organisations such as WHO and UNDP for assistance in order to prevent epidemic of water-borne disease from improper management of solid waste produced by the residents. Also, additional fund should be sought from the federal government. Registered and informal private sectors should be engaged by the government to assist in MSW management of the city. It is well documented that the informal sector is very vital in the successful management of MSW in the developing world [6,14]. In general, it is obvious that an urgent stakeholders meeting on MSW management in Ado Ekiti is needed in order to resolve the challenging issues observed in this basic study.

It is believed that the rating values of the MSW management by the users in this study is the uppermost value expected as the users of the dumpsters constitute insignificant population of the residents of Ado Ekiti.

#### 4. CONCLUSION

An evaluation of the management of MSW in Ado Ekiti by ESWMB was undertaken using the data obtained from 5-point scaled questionnaires distributed randomly to the users and operatives of the dumpsters at Opopogboro, Ajilosun, Atikonkon, Oja Oba and Odo Ado areas of the city. Rating expressions commonly used in mundane communication in Nigeria were

selected for use in the design of the questionnaire. The operatives, who were employed by the state government rated the availability and location of the dumpsters and their own performance as very good and rated most of the other features of the system as fairly good. However, the users' rating of the management of MSW and people's attitude varies from fair to fairly good. The relatively good perception of the status of MSW management in Ado Ekiti by the government operatives, as found out in this study, would give the state government a false impression of the actual status. With these findings, urgent stakeholders summit should be held to create a fundamental framework for an appropriate MSW management in Ado Ekiti. Urgent financial assistance from non-governmental organisations and federal government should be sought to enhance the implementation of any framework derived from the summit. In addition to solutions derived from the proposed summit, feasibility studies on the implementation of 4Rs - reduction, reuse, recycling and recovery should be done by the state government in order to create wealth from waste and reduce the waste streams to the landfill. An engineered landfill should also be constructed to avoid the surface water and groundwater pollution that will be caused by the current use of the open dumpsite. In general, the procedure used in this study, though may appear simple, indicates a pragmatic assessment of the management of MSW by using both the users and government operatives of the MSW management in Ado Ekiti. It shows that it can be used for the primary assessment of the MSW management in cities in the developing countries where waste data and infrastructure are lacking. Findings from the procedure can also be utilised as scientific evidence to the pertinent authorities involved in MSW management of a municipality for urgent action.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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