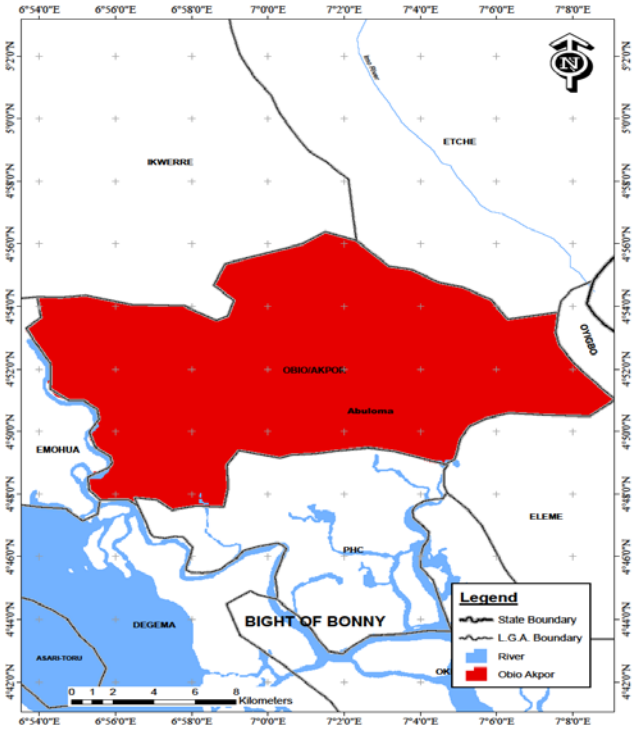

Fig. 1: Map of Study Area

2.0 Review of Relevant Literature

2.1 Waste Collection Patterns in Developing Countries

i. The Case of Uganda

Waste collection system is drawing increasing attention in Uganda as citizens observe that too much waste are left uncollected at various collection points. Studies have shown that households in Uganda generate approximately a tonne of domestic waste annually. In Kampala city alone, the residents of the city and its suburbs generate about 750 tonnes of waste daily. Only 45% - 50% of this waste generated is collected.

Findings also reveal that the problem faced by the council was inadequate and irregular funding. According to the council, daily expenditure on waste collection is between three to four million Uganda shillings. There is also the problem of vandalizing the waste bins provided leading to improper dumping of waste (Makuma et. al, 2016).

ii. Waste collection and Disposal Agencies in Nigeria

The Nigeria constitution (1999) paragraph of fourth schedule denote the function of provision and maintenance of public conveniences, waste and refuse or sewage collection and disposal to the local government (Ikpeze, 2014). In Rivers State, the government has in addition to this provision made further laws such as the 1989 environmental sanitation laws, the Rivers State waste collection and disposal law of 1999 and the Rivers State environmental protection agency law of 1994 .

The sanitation authority is empowered to operate within the Port Harcourt metropolitan area and its environment. The same law, by section 11, has functions as to formulate policies and strategies aimed at promoting environmental hygiene and sanitation, facilitating the collection of waste products at various collection points in the Port Harcourt metropolitan area and its environs (Ikpeze, 2014).

The law also goes further to stipulate for organizing the collection of waste, and street cleaning provision at collection points for final disposal, and identification of dumping sites. According to Ikpeze (2014), the environmental sanitation edict of 1986 also states that:

(a) No person/body shall prevent the authority from inspecting his premises.
(b) Every household/business should have waste bin.
(c) Premises shall be free of overgrown grasses and shrubs.
(d) The above provisions and orders shall be enforced by an agency of government called environmental sanitation authority.

Spatial distribution of waste collection points and disposing of domestic waste is one of the most costly urban services to provide. It absorbs between 20 to 40 percent of municipal revenues in developing countries, employing 3-6 workers per 1,000 populations ((UN-Habitat, 2015).

The summary of literature on Uganda and Nigeria reveals that the waste challenge in developing countries are similar. Hence strategies that may work in Nigeria to manage waste can also be applied in other developing countries which face similar waste challenges.

2.2 Methods of Collection

The method of refuse collection practiced within the study area includes; the communal collection, door-to-door collection, curb side collection and block collection.

i. Communal Collection: Where the communal storage unit is used, citizens deposit their waste in the storage units, which are available on a 24 hours basis. When units are full, the collection services provider empties them. For portable container, an empty one is left behind while the full one is hauled to the disposal site.

ii. Door to Door Collection: collection services may involve collection workers going into the premises to collect refuse from permanently located units. This is the door-to-door collection system.

iii. Curbside Collection: This will require informing the people to throw their refuse at the curbside (road on a collection day and at a specific time to help collection at designated time. Municipal inspectors are appointed to issue penalties to those who forget their bin for too long.

iv. Block Collection: This involves the use of collection vehicles, which have designated route that they follow according to plan. A bed may be rang to inform the inhabitants of that collector are available to collect garbage for disposal. To design an acceptable and functional system of this block collection, the citizens participation is needed and their understanding too. This is because people have to be around when the vehicles comes to pick refuse. While the curbside and door-to-door collection requires good network system (road) (European Environment Agency, EEA, 2002).

2.3 Appropriate Distance between Waste Collection Points

The spatial distribution of waste collection points stand as the pillar for waste management and control in the cities and as such, appropriate distances must be observed. Collection and transportation are also important aspects, which are also very costly because of the labour intensity of the work and massive use of the trucks and fuel consuming machineries in the

collection process. It is responsible for 70-80% of total waste management cost (Karadimas et al, 2007). The waste collection and transportation methods also depends on the spatial distribution of waste sites, hence the need for proper road networks (Khajuria et al, 2010).

3.1 Methodology: The Research Design

Exploration of these objectives requires an approach that not only describes relationships between the stated variables, but also the experiences of people and their perceptions on the assessed variables (Creswell, 2015), thus, a mixed methods approach was used for the study of selected locations that facilitated the realization of the objectives of the research. This is a multi-site mixed methods study the employs the Convergence Triangulation Design.

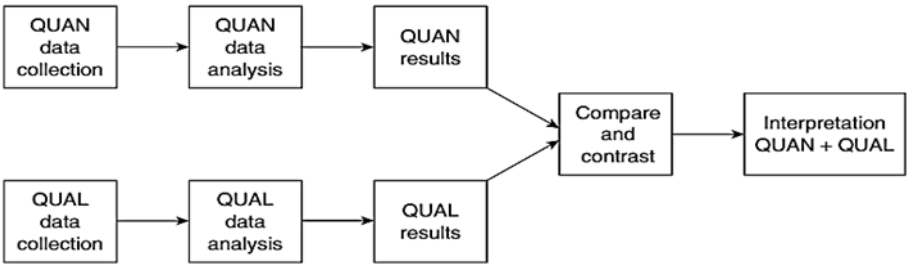

Fig. 1: Triangulation Design: Convergence Model

3.2 The convergence model represents the traditional model of a mixed methods triangulation design (Creswell, 2007). In this model, the researcher collects and analyzes quantitative and qualitative data separately on the same phenomenon and then the different results are converged (by comparing and contrasting the different results) during the interpretation. Researchers use this model when they want to compare results or to validate, confirm, or corroborate quantitative results with qualitative findings. The purpose of this model is to end up with valid and well-substantiated conclusions about a single phenomenon. For instance, researchers can converge their quantitative survey results with their qualitative focus group findings to better understand their theme of study.

It incorporates an exploratory, cross-sectional survey of all neighbourhoods within the study area. It involves the use of structured and semi-structured interviews of selected participants. The approach enables the researcher to explore differences within and between cases, with the goal to replicate findings across cases at the core of the process, which was the case in this study.

Equally, the mixed methods approach was used in the study because of the opportunity to integrate quantitative and qualitative data in a manner that allows triangulation of data for reinforcement and validation. Moreover, the study analysed data, integrated findings and drew inferences using both quantitative and qualitative approaches as suggested by Tashakkori & Creswell (2007). It also combined the strengths of both sets of data to systematically understand the research problems (Creswell, 2015).

3.3 Analysis of data

The Statistical Package for Social Studies (SPSS) was used to analyse the quantitative data obtained in this study and presented in the form of tables, charts and graphs. Open-ended questions, government reports, and policy documents were analyzed using content analysis.

3. RESULTS

3.1 Presentation of findings

Table 1: Staff strength of the Rivers State Waste Management Agency (RIWAMA).

Staff Cadre	Frequency
Senior	10
Junior	70
Total	80

Source: Field survey, 2021

The result on table one shows that the agency is grossly understaffed to be able to effectively execute the enormous tasked placed upon it to ensure that the study area is rid of waste.

3.2 Rating Of Waste Collection And Disposal By The Public In Study Area

The below fig shows the level of satisfaction or otherwise waste collection and disposal methods in the study area. The answer given from the respondents indicate the 39 percent were dissatisfied, with the condition of domestic waste disposal in the area, 34 percent were satisfied, 22 percent were very dissatisfied while 6 percent were very satisfied with the services provided by the agency (RIWAMA) in charge of the waste collection points and disposal in the study area.

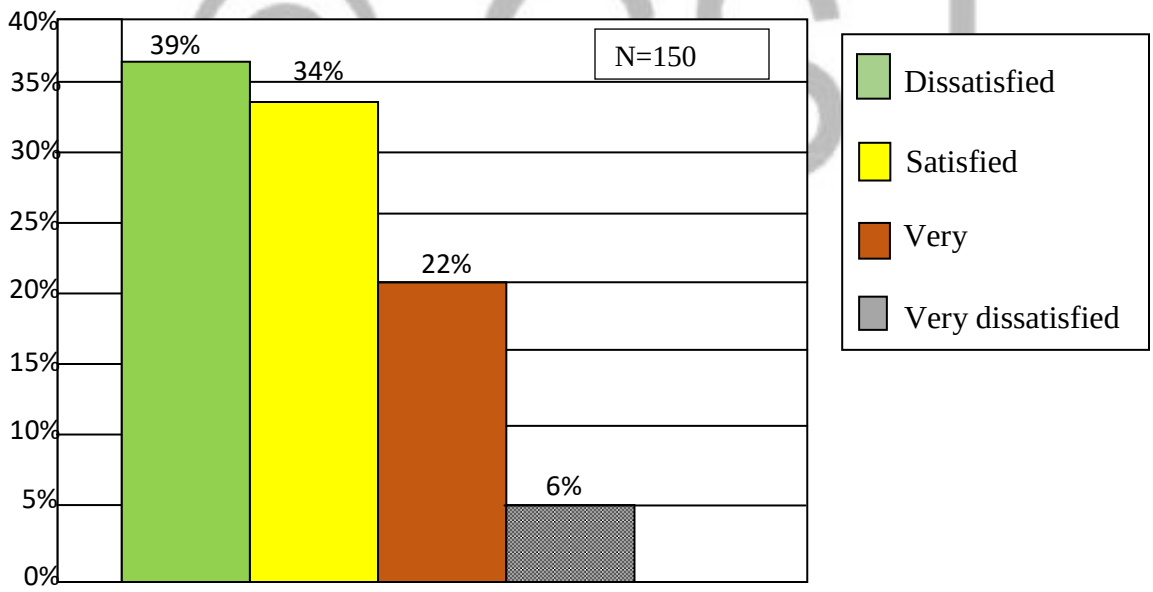

Fig 2: Rating of waste collection and disposal by the public in Study Area

Source: Field survey, 2021

3.3 The Appropriate Time for the Disposal of Households Waste

The table below shows or indicates the appropriate time for the household waste disposal in various locations within the study area. Out of the 150 persons sampled, 40 percent said they prefer to dispose their waste after 6: pm in the evening, 36 percent said 9: pm while the

remaining 24 percent said they prefer 6: am in the morning. This is an indication that much effort need to be put into collecting waste early in the night so that the waste heap in avoided.

Table 2: Appropriate Time for Waste Disposal

Time	No	Percentage
6:pm	60	40%
9:pm	54	36%
6:am	36	24
Total	150	100

Source: Field Survey, 2021

3.4 Rating of the Activity of Scavengers towards Waste Collection and Disposal in the Study Area

Figure 2 shows the level of satisfactions of residents on the activity of the effects of the activities of scavengers towards waste collection and disposal in the study area. Responses indicate that majority of the population are not in favour of their activities. This is because 38 percent were dissatisfied with the activities of scavengers, while 22 percent were very dissatisfied.

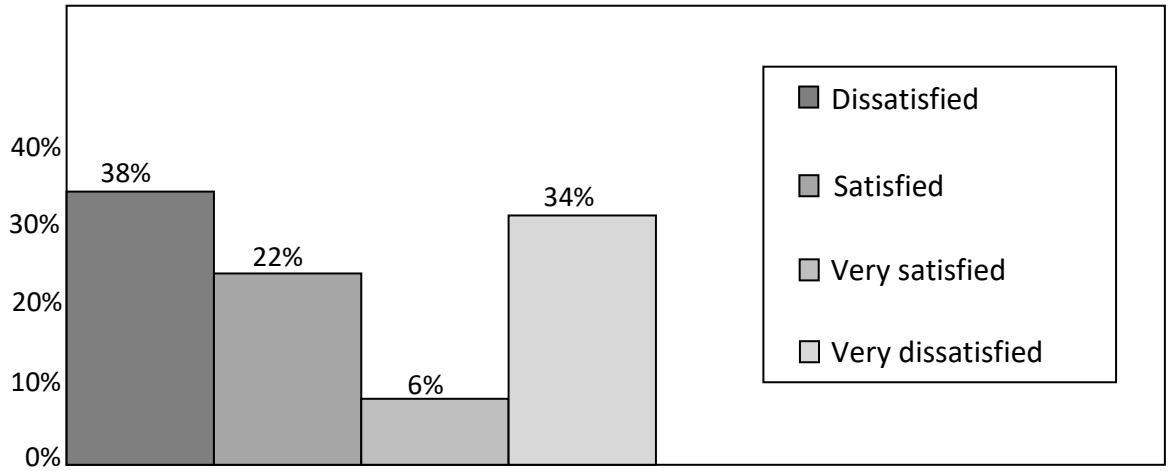

Fig 3: Rating of Activities of Scavengers beset

Source: Field survey, 2021.

3.5 Discussion of findings

i. Problem of Waste Collecting Points

In most parts of the study area, waste collections has been plagued with numerous. As a result, waste collection points have been seen as a threat to environmental sanitation. Furthermore, these challenges manifest themselves in the form of “inadequate equipment, inadequate funding, and inadequate provision for designated dump site (receptacle), poor planning and lack of accessibility. Conclusively, these challenges become the major constraints to effective waste management within the study area. This finding goes on to buttress the early findings of scholar scholars such as Egunjobi (1971) and Adedibu (1971) that agreed that lack of clear court policy

on waste management and absence of sound framework for waste collection are the major constraints for the effective management of waste.

ii. Poor Staffing of the Agency Charged with Waste Management

Most of the technical aspects of the duties of Rivers State Waste Management Agency (RIWAMA) are not executed and this implies that a lot has to be done in order to facilitate efficient and sufficient fulfillment of the duties of the agency (RIWAMA).

The findings show that the Rivers State Waste Management Agency (RIWAMA) the necessary work force to supervise the workers on various locations in order to render good services. When the waste have been evaluated from the various collection points, left over particles of the waste collected are usually found on streets causing environmental pollution. Furthermore, due to inadequate staffing in the Rivers State Waste Management Agency (RIWAMA), insufficient services will always be rendered, and the agency do not have a monitoring team that could regulate and supervise the services of these contracting companies (contractors).

iii. Inadequate Equipment

Another critical area of concern is inadequacy of equipment to render effective services. From the findings, it was discovered that the services rendered are through the contractors, which do not have have the necessary equipment such as trucks and cranes in order to render good services. Most of the vehicles used for waste collection are also in poor condition and they are usually broken down on the roads due to poor maintenance culture of the contracting companies, and all these become the major challenges of waste management within the study area.

iv. Ways of Waste Disposal in the Study Area

Findings reveal that waste are usually disposed in various ways within the study area, some usually disposed households waste by packing them in polythene bags, others pack them in metal waste bins, some with plastic waste bins, and other with cartons and baskets before taking them to waste collection points. The challenge is that the diverse ways of storing waste pose a problem to management, hence the need to educate residents on the accepted method of storage especially for household waste.

v. Attitudes of the Resident towards Waste Disposal in the Study Area

Observation has shown that children constitute a majority of household members that dispose household waste. As such, proper attentions is not paid to where waste is disposal in the study area. some children even disposed the waste at the areas that are not approved, such as pedestrian walkways, drainages, bus stops and even on the roads. From the responses of the respondents, adults in various households do not participate in waste disposal and children are not given proper orientations on how to dispose of the waste. In summary, poor attitude of household contributed to indecent and unsafe disposal of waste.

vi. Distance Covered During Waste Disposal

Distance covered during waste disposal was seen as another critical challenge in the proper management of waste. Some of the households travel up to a kilometer or more to dispose their waste. In this case, most people dispose of the waste along the way before they get to the approved receptacles.

vii. Rivers State Waste Management Agency Approve Receptacles

These are otherwise known as temporal dumpsites because wastes are not allowed there permanently. These areas have been approved and authorized by the Rivers State Waste

Management Agency (RIWAMA) and the goal and objectives of the agency is nothing but to have a clean environment.
However, these approved receptacles are located in various neighbourhoods, which constitute a challenge to health because they are allowed to become Garbage Mountains (see plate 1)

Plate 1: Rivers State Management Agency (RIWAMA) approved receptacles.

Below are some locations for the receptacles;

i. Rumuokoro by slaughters receptacle
ii. Federal bus stop receptacle
iii. Rumuokwuta after Ohiamili receptacle
iv. Rumuokwuta by Sobaz filling station receptacle
v. Market junction and
vi. Agip before school gate receptacle

These together makes up six (6) RIWAMA approved receptacles on Ikwerre road in Obio-Akpor local government area.

4.1 Conclusion

The Distribution of waste collection points determines the effectiveness and efficiency in waste management within municipalities. As such, the Rivers State Waste Management Agency (RIWAMA) has made provisions that will help in tackling the shortcoming that are encountered in the administration, management and operation of waste collection points located around the local government area. However, due to numerous challenges such as poor staffing, inadequacy of equipment and poor attitude of residents towards waste disposal, the activities of the agency have been seriously hindered but with a proper waste management framework and policy in place, the waste serves of the agency can be adequately improved.

4.2 Recommendations

Based on the findings of this study, the following recommendations have been proposed. They include;

i. The use of Improved Method of Disposal

For efficient and effective waste disposal, it is recommended that the agency adopt the use multiple methods to adequately deal with different types of waste, such as burying, composting, controlled tipping or sanitary landfills and incineration. These have to be done in order to achieve the objectives such as "reuse, recycle and recover, public hygiene and health, energy generation, sustainable development together with aesthetics.

ii. Improvement in transportation facility

There is an urgent need for improvement of waste collection at different locations; therefore, good transportation facilities such road network is vital. Most of the existing inaccessible roads have to be improved upon, to facilitate waste collection.

iii. Use of Well-Maintained Transportation Facilities

More equipment is needed for efficient waste collection in the area. The use of tippers or unauthorized vehicles should be discouraged as this tends to cause more harm than good. Proper waste collection vehicles should be purchased, vehicles like bulldozer and traitors should also be purchased. Broken down vehicles should also be repaired for effective and efficient services.

iv. Agency Need To Be More Responsible

Rivers State Waste Management Agency (RIWAMA) is responsible for all activities that concern waste management. The body or agency should pay more attention most especially in the area of creating more staff members in order to keep good records to solve problems such as lack of data for further study, movement of each location or collection vehicle plowing standing, loading and leaving time.

v. Scavengers

Activities of so called "scavengers should be limited most especially inside the towns. No scavenger should be allowed to open waste bags at any collection point in order to properly manage the volume of waste generated at a given collection point. The work of scavengers tend to cause more problems than good in the area of waste collection hence it should be discouraged. A new team should be formed by Rivers State Waste Management Agency (RIWAMA) in order to control the illegal activities of the scavengers at various waste collection points.

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