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Assessment of Solid Waste Disposal in Yenagoa, Bayelsa State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author HOS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CSO, BOO, ASO and LOO managed the analyses of the study. Authors CSO, BOO, ASO and LOO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The problem of municipal waste is a challenge of global proportion occasioned by exponentially increasing population, rapid urbanization, industrialization, inefficient utilization of natural resources, lack of citizen awareness regarding the environmentally adequate disposal of waste, consumption, socioeconomic status (lifestyle), and others. This study aimed to assess solid waste disposal practices in Yenagoa metropolis, Bayelsa State, Nigeria. The study adopted a descriptive and cross-sectional approach where multi-stage sampling was applied to select the sample communities by a simple random sampling method and the cluster areas for data collection by a cluster sampling method. The study revealed that the residents had a good awareness of 229 (95.4%) of waste management practices. About 86.7% of respondents keep their wastes in the bin while 6.3%, 5.0% and 2.1% practiced burning, throwing into the river or along the roads and keeping in the backyard respectively. Waste collection by the sanitation authority was relatively high (70.4%) in some locations in comparison to areas where wastes were never removed

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(22.1%). The residents' attitude towards solid waste disposal was generally good. However, the sanitation level was strongly constrained by limitations on the part of the sanitation authority. The sanitation authority does not cover all areas in the city because of manpower and equipment shortage. Yenagoa is a small city with most areas unplanned and having so many shanties. All wastes in the city are collected without sorting or recycling. The sanitation can be improved if the government would provide at subsidized cost, waste disposal materials such as polythene bags and plastic bins for the residents. More waste collection points should be sited to ease disposal and must be evacuated on a timely basis.

Keywords: Yenagoa; solid waste; sanitation.

1. INTRODUCTION

Waste management is a serious global issue which is considered more challenging in developing countries where a high percentage of waste is currently disposed of by open dumping [1-4]. The environment plays a significant role in the ability of nature to sustain life within its capacity [5]. Solid waste seriously threatens the sustainability of the environment with implications on human health.

Waste left on the streets create unpleasant odours and is breeding ground for vermin and insects (such as cockroaches) causing illnesses. Hazardous materials from randomly and incorrectly dumped waste can seep into and pollute water resources, including groundwater - main drinking-water source. Pollutants reach the human body, via drinking water, vegetables, and animal products, while burning solid waste pollutes the air, causing serious health risks, including respiratory infections, cancer, and other illnesses [6].

Twenty-five million tons of municipal solid wastes are generated annually in Nigeria, and the waste generation rates ranged from 0.66kg/cap/d in urban areas to 0.44 kg/cap/d in rural areas [7]. In Nigeria, wastes are usually dumped on roadsides (Plate 1), available open pits, flowing gully water and drainage channels [8,9]. These indiscriminate disposal practices are prominent in most urban cities where most of the wastes are generated. The waste generated is directly proportional to population, socio-economic status and level of urbanization hence the quantity of waste generated varies from state to state and also increases per year [10-12]. Also, the composition of waste generated per state is a function of the socioeconomic status, industrialization and commercialization.

In Nigeria, the processes involved in the management of waste are storage, collection, transportation and disposal at dumpsites (Fig. 1). Yenagoa is a small city with most areas unplanned and having so many shanties. All wastes are collected together without sorting or recycling and disposed of at a common dumpsite (Plate 2).

A major adverse impact of indiscriminate waste dumping is its attraction of rodents and vector

Plate 1. Heaps of waste being burned around Tombia in Yenagoa

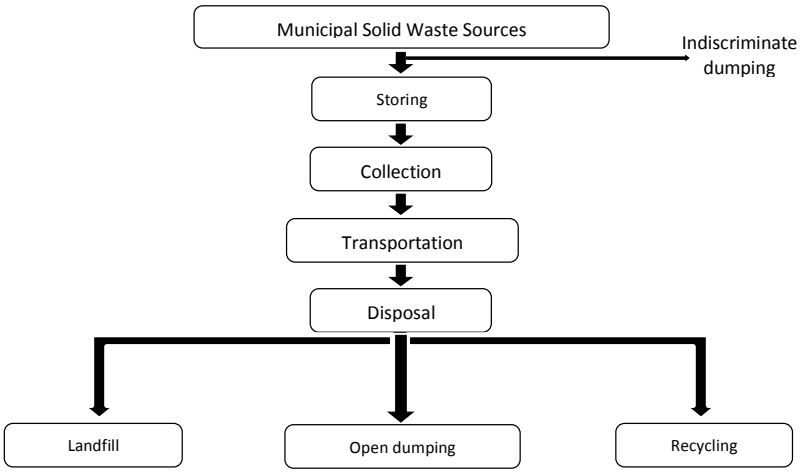

Fig. 1. Municipal solid waste management flowchart for Nigeria

Plate 2. Dumpsite along Amassoma Road, Yenagoa

insects for which it provides food and shelter. Impact on environmental quality takes the form of foul odours and unsightliness. These impacts are not confined merely to the disposal site. On the contrary, they pervade the area surrounding the site and wherever the wastes are generated, spread, or accumulated. Unless an organic waste is appropriately managed, its adverse impact will continue until it has fully decomposed or otherwise stabilized. Uncontrolled or poorly managed intermediate decomposition products can contaminate air, water, and soil resources [13]. Studies have shown that a high percentage of workers who handle refuse, and of individuals who live near or on disposal sites, are infected with gastrointestinal parasites, worms, and related organisms [14]. Although it is certain that vector insects and rodents can transmit various pathogenic agents (amoebic and bacillary dysenteries, typhoid fever, salmonellosis, several parasitoses, cholera, yellow fever, plague, and others), it often is difficult to trace the effects of such transmission to a specific population [13].

The analysis of the key problem affecting the efficient management of municipal waste is critical for evolving a workable solution in an emerging economy like Nigeria. At the core of the issues of solid waste management are the absence of adequate policies, enabling legislation, and an environmentally stimulated and enlightened public. Although there are several legislations regulating waste management practices in Nigeria, such as the law setting up the use of “task force” to ensure collection of solid waste at specified time and location, and the setting aside of one Saturday of every month for general cleaning of the

environment. These laws are considered to be draconian, being offshoots of the military regimes and as such not effective. The aim of this study was to assess solid waste disposal practices in Yenagoa metropolis, the capital city of Bayelsa State, Nigeria and make recommendations that can help in its improvement where necessary.

2. METHODOLOGY

2.1 Study Area

Yenagoa is the capital of Bayelsa State, Nigeria. It is also the headquarter of Yenagoa Local Government Area. It is located on latitude 4°55′29″N longitude 6°15′51″E. Yenagoa is made up of 19 communities namely; Swali, Yenagoa, Ovom, Onopa, Amarata, Ekeki, Okaka, Yenezue-epie, Kpansia, Yenezue-gene, Opolo, Okutukutu, Etegwe, Edepie, Akenpai, Agudama-epie, Akenfa, Yenegue, Igbogene. Yenagoa has a population of about 355,497 people at the 2016 population projection [15].

2.2 Study Design and Sample Size

The study adopted a descriptive and cross-sectional study approach. A minimum sample size was calculated using the formula below for a descriptive and cross-sectional study:

$n = Z^2pq/d^2$

n = sample size

Z = critical value at 95% confidence level usually 1.96

p = prevalence

q = 1-p

d = precision usually 5%

n = 245.8624

2.3 Sample Technique

A two-stage sampling method was applied and it included the following:

- **Stage 1:** Simple random sampling was used to select 10 sample communities out of the 20 communities of Yenagoa by balloting.
- **Stage 2:** A simple random sampling was used to select the cluster areas in the sample communities. Streets were numbered and two streets from each community were randomly selected as the cluster.

2.4 Data Collection

The instruments/tools that were used are questionnaires (Annex 1) made up of:

a. Socio-demographics
b. Assessment of solid waste disposal practices
c. Assessment of the Bayelsa State Environmental Sanitation Authority (BSESA)
d. The questionnaire was structured with open and close-ended questions and was administered by an interviewer.

2.5 Data Analysis

Data collection was analysed using the Statistical Package for Social Sciences (SPSS), version 21. This software was used to determine the frequency and percentages of relevant variables.

2.6 Ethical Consideration

Ethical approval for the study was obtained from the Research and Ethics Committee of the Niger Delta University Teaching Hospital, Okolobiri. Verbal informed consent was obtained from the study participants who were assured of the confidentiality of information given.

3. RESULTS

Table 1 shows the socio-demographics of residents. Majority of the respondents were male (57.5%). The highest educational qualification for most of the respondent was technical/secondary education (52.5%). The majority (95.4%) also were aware of solid waste management practices.

Table 2 shows solid waste disposal methods as burning 6.3%, keeping at backyard 2.1%, throwing into the river/along the road 5% and keeping in the bin 86.7%. From this table, it was observed that majority of the respondents carry out waste disposal by first keeping their wastes in a waste bin before final disposal.

Table 3 shows collectors of wastes from disposal location. This table showed that the sanitation authority is most involved in the waste collection than any other firm.

Table 4 shows the time interval for collection of the wastes at disposal location. This table showed that the time interval for waste collection is mostly once in a week (33.3%).

Table 5 shows the frequency of use of government provided facilities. This table showed that 95% of respondents do not use government provided facilities whereas only 4.6% did.

Table 6 shows the level of satisfaction with the waste collection process by residents. This table showed that the waste collection process was unsatisfactory with 56.7%.

Table 7 showed the possible reasons for not having satisfactory waste collection process. Majority of the respondent identified limited waste collection sites as a reason for their dissatisfaction.

Table 1. Socio-demographics of residents

Socio-demographics	Frequency	Percentage (%)
Sex		
Male	138	57.5
Female	102	42.5
Total	240	100
Waste management awareness		
Yes	229	95.4
No	11	4.6
Total	240	100
Educational level		
Primary	20	8.3
Technical/Secondary	126	52.5
Polytechnic/University	94	39.2
Total	240	100

Table 2. Solid waste disposal methods

Solid waste disposal method	Frequency	Percentage (%)
Burning	15	6.3
Keeping at backyard	5	2.1
Throwing into the river/along the road	12	5.0
Keeping in the bin	208	86.7
Total	240	100

Table 3. Collectors of wastes from disposal location

Waste collector	Frequency	Percentage (%)
Sanitation officers/authority	167	70.4
Contractors	14	5.8
Garbage collectors	4	1.7
Nobody	53	22.1
Total	240	100

Table 4. Time interval for collection of the wastes at disposal location

Time interval	Frequency	Percentage (%)
Daily	54	22.5
Once in 1 week	80	33.3
Twice in 1 week	57	23.8
None	49	20.4
Total	240	100

Table 5. Use of Government provided facility

Use of Government provided facility	Frequency	Percentage (%)
Yes	11	4.6
No	229	95.4
Total	240	100

Table 6. Satisfaction with the waste collection process

Satisfactory waste collection	Frequency	Percentage (%)
Yes	104	43.3
No	136	56.7
Total	240	100

Table 7. Possible reasons for not having a satisfactory waste collection process

Reason for non-satisfactory waste collection	Frequency	Percentage (%)
Limited waste collection sites	135	56.3
Reduced solid waste collection facilities	86	35.8
No idea	2	0.8
Not applicable	17	7.1
Total	240	100

Table 8 shows the challenges faced by the Bayelsa State Environmental Sanitation Authority (BSESA). The responses showed inadequacy of personnel, working tools and vehicles, and poor funding of the agency as challenges.

Table 8. Challenges of the Bayelsa State environmental sanitation authority

Challenges	Response
Adequate provision of working tools	No
Adequacy of working personnel	No
Adequacy of funding	No
Sufficiency of operational vehicles	No

4. DISCUSSION

This study looked at solid waste management in Yenagoa and the effectiveness of the Bayelsa State Environmental Sanitation Authority (BSESA). A total of 250 questionnaires were given out to obtain information on solid waste management practices and determine the effectiveness of the Bayelsa State Environmental Sanitation Authority from the residents and the staff of the Bayelsa State Environmental Sanitation Authority.

The residents of Yenagoa were largely aware of solid waste management practices as evidenced by a positive response of 95.4%. A similar study conducted in Ogun State, Nigeria indicated awareness of waste management practices even though they had negative waste management practices [16]. Studies revealed that participation in solid waste management activities depends on the level of awareness, gender, educational level and household income [17-20].

On the methods of solid waste disposal practiced among residents, responses captured in Table 2 revealed that 86.7% practiced keeping their wastes in a waste bin before finally disposing off at a designated temporary location while 6.3%, 5.0% and 2.1% practiced burning, throwing into the river or along the roads and keeping in the backyard respectively. A similar study by Nkwocha et al. [21] revealed that the method of solid waste disposal range from direct dumping (43.6%), open burning (23.0%), dustbins (32.4%) composting and dumping in drains accounted for (1.0%). Waste disposal and management, in many places and cities in Nigeria is still indiscriminate as wastes are dumped on roadsides in drainage channels and gully erosion sites, this is quite apart from the small efforts made by families to clean up their immediate surroundings, and the fact that practically all states have regulations which set apart at least one day of the month for ‘general clean up' and have laws creating offences from noncompliance with those regulations [22]. Residents may adopt dumping of wastes along roadsides or throw into river and drainage pathways owing to the distance of disposal sites from places of residence [9].

Table 3 showed that though waste collection by the sanitation authority is relatively high at 70.4%, there were 22.1% of responses suggesting that in some areas, nobody comes to remove their wastes. The high collection rate by the sanitation authority in this study is not unconnected to the fact that Yenagoa is a small city where residents living close to the seat of power within the Yenagoa metropolis have their waste collected and disposed of more frequently.

The responses for waste collection by nobody was noticed to have come from residents who reside relatively distant from the metropolis who reported the challenges of the distance of and unavailability of solid wastes collection and disposal locations.

Furthermore, Table 4 revealed another limitation to efficient solid waste disposal which was the time interval for waste collection at the disposal sites. The frequencies of the variables were relatively close with the highest (33.3%) being for once in a week collection and the least (20.4%) being for no collection done at all. Twice in a week collection was (23.8%) while a daily collection was (22.5%). It is apparent that one of the determinants of effective waste disposal is the frequency and time interval at which wastes are evacuated from temporary dump sites to the permanent dump sites. This relative delay in evacuation of solid wastes from the temporary dump sites was noticed to be the major reason for which many of the residents responded that the waste collection was not satisfactory. In the study areas where residents were satisfied with the prompt removal of wastes by the sanitation agency workers from the temporary dump sites to the permanent dumpsites witnessed a great and acceptable level of cleanliness within the metropolis.

Results in Table 5 showed that 95% of respondents do not use government-provided waste collection materials and facilities (such as disposable polythene bags, plastic waste bins, and stationary collection vehicles) whereas only 4.6% make use of government provided facility (especially the disposable polythene bags). Responses from the residents showed that the government rarely provides them with waste collection materials for their purchase and where they ever do; it was at relatively high rates which were usually not affordable to most of the residents. A study has underscored poverty, high population and urbanization growth rates compounded by a weak and underfunded infrastructure, as the main drivers of solid waste problems in Nigeria [23].

Respondents reported that poor access and distribution of waste collection facilities contributed to the unsatisfactory waste collection process. Hence, it was generally observed in this study as shown in Table 6 that the waste collection process was unsatisfactory owing to limited waste collection sites with the available ones being relatively distant from most of the residents (Table 7).

Waste evacuation is handled mostly by the Bayelsa State Environmental Sanitation Authority. The effectiveness of their services is dependent on a number of factors including personnel, funding and working equipment. From Table 8 100% of the respondents from the Bayelsa State Environmental Sanitation Authority admitted that lack of working materials largely affected their ability to carry out their functions effectively which thus posed a serious challenge. They also revealed that there was no single waste collection operational vehicle available for the sanitation authority to work with. A research study carried out on current waste management activities in Benin metropolis showed that the agency was deficient in their duties due to lack of adequate manpower, equipment, and proper waste disposal outfit [24].

These findings revealed the unsatisfactory solid waste management practices among residents of Yenagoa. Solid waste heaps at some open dump sites create an unsightly environment, impact bad odour to the atmospheric air being breathed. This may lower the quality of life for individuals within the vicinity of the dump sites and can potentially reduce local property values. Delay in the removal of wastes at dump sites can predispose to disease by creating harbour areas for some disease vectors to thrive as is the case with multimammate rats which cause lassa fever.

The sanitation of the city can be improved if the government would provide at subsidized cost, waste disposal materials such as polythene bags and plastic bins for the residents. More waste collection points should be sited to ease disposal and must be evacuated on a timely basis.

5. CONCLUSION

It was observed that residents of Yenagoa are largely aware of solid waste disposal. The residents were found to commonly practice solid waste disposal by first keeping wastes in their waste bins before disposing at designated temporary dump sites. However, other methods practiced included open burning, throwing into the river or along the roads and keeping in the backyards. Waste collection and disposal were found to be inefficient and it was observed that the residents attributed the inefficiency to limited government designated waste dump sites, none availability and affordability of waste collection/disposal materials (polythene bags, waste bins). The Bayelsa State Environmental Sanitation Authority was ineffective in the discharge of their duties due to poor funding, personnel shortfall and inadequacy of working equipment and materials. The government should provide waste collection points, subsidize cost of waste disposal materials and properly

fund the sanitation authority to carry out their duties, to minimize the problem of solid waste disposal in the city.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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ANNEXE 1 (QUESTIONNAIRES)

SECTION A: FOR RESIDENTS

DEMOGRAPHICS

1. Address of Respondent: ……

2. Sex:
Male ☐ 01
Female ☐ 02

3. Marital status:
Single ☐ 01 Married ☐ 02 Divorced ☐ 03

4. What is your education level?
Nursery/Primary ☐ 01 Polytechnic/University ☐ 03
Technical/Secondary ☐ 02 Others ☐ 04

5. What type of living unit?
Single room ☐ 01 Flat/Bungalow ☐ 03
Self-contained ☐ 02 Batcher ☐ 04

6. How long have you been living here?
Less than 12 months ☐ 01
More than 12 months ☐ 02

7. How many persons are in your household?
9 Less than 4 ☐ 01
4 – 7 ☐ 02
8 and above ☐ 03

8. On the average, how much do you earn annually?
Less than 70,000 ☐ 01 81,000 – 90,000 ☐ 03
71,000 – 80,000 ☐ 02 100, 000 and above ☐ 04

ENVIRONMENTAL CONDITION AND SERVICES

9. Do you know about solid waste disposal before now
YES ☐ 01
NO ☐ 02

10. How do you feel about the cleanliness in your local environment
Good ☐ 01 Bad ☐ 03
Very good ☐ 02 Miserable ☐ 04

11. What kind of wastes do you find in your local environment
Plastics ☐ 01 Polythene bags ☐ 03
Food items ☐ 02 Open dump sites ☐ 04

12. Which common methods of solid waste disposal are practiced in your area
Burning ☐ 01 Throw into water bodies ☐ 03
Burying ☐ 02 Dustbin ☐ 04

13. How do you carry out solid waste disposal in your household/around you
Burn them ☐ 01 Throw into the river ☐ 04
Bury them ☐ 02 Throw on street ☐ 05
Keep in the backyard ☐ 03 Keep in the dustbin ☐ 06

14. Does your house have a waste bin?

YES ☐ 01
NO ☐ 02

15. If yes to question 14 above, what kind of waste bin?

Metal bin ☐ 01 Cartons ☐ 04
Plastic bin ☐ 02 Broken buckets ☐ 05
Waterproof bags ☐ 03

16. At what time interval do you dispose of your rubbish?

Once in 2 weeks ☐ 01 Daily ☐
Once in 1 week ☐ 02 If any other, please specify ……..
Twice in 1 week ☐ 03 …….

17. Who disposes of your rubbish?

Self ☐ 01 Siblings ☐ 04
Housemaid ☐ 02 Children ☐ 05
Hired labourer ☐ 03

18. If by neighbours, children, self or housemaid, are there places provided where you can dispose your rubbishes?

YES ☐ 01
NO ☐ 02

19. If by neighbour, children, self, housemaid or hired labourer, where do you think or know the rubbishes are disposed of?

The communal storage unit ☐ 01 Roadside/street side ☐ 04
Collection vehicle ☐ 02 Gutter ☐ 05
Waterfront ☐ 03 Others (specify)……..……

20. Give an approximate distance to the location where you throw away your rubbish

Below 100 meters [near] ☐ 01
101 – 200 meters [far] ☐ 02
201 – 300 meters [very close] ☐ 03

21. Who collects the rubbish from the disposal location?

Sanitation officer/authority ☐ 01 Nobody ☐ 03
Contractors ☐ 02 Others (specify) Scavengers
……

22. At what day interval do they collect the rubbish

Daily ☐ 01
Once in 1 week ☐ 02
Twice in 1 weeks ☐ 03

23. Do you use government-provided waste collection facilities?

YES ☐ 01
NO ☐ 02

24. If NO, why

Unavailability ☐ 01 too expensive 04 ☐
Ignorance ☐ 02 Others (please specify)……...
Far distance from the place of residence ☐ 03 ……

25. Is the waste collection process satisfactory?

YES ☐ 01
NO ☐ 02

26. If NO, what do you think is the cause?

Inadequate waste collection sites	☐ 01	Few waste collection facilities	☐ 03
It is too rigid	☐ 02	No idea	☐ 04

27. What is your advice as regards waste management in Yenagoa?

Provide more waste collection sites	☐ 01
Provision of affordable waste collection facilities	☐ 02
Improve their services by collecting the waste daily	☐ 03
Prompt payment of sanitation workers salary	☐ 04
None	☐ 05

SECTION B: FOR BAYELSA STATE ENVIRONMENTAL SANITATION AUTHORITY

1. Location ……

2. What was the authority authorized to do?
……..…..

3. How many persons work here?

Below 50	☐ 01	101 – 150	☐ 03
50 – 100	☐ 02	150 above	☐ 04

4. In the waste management of Bayelsa State, are you directly or indirectly involved?

Directly	☐ 01
Indirectly	☐ 02
No involvement	☐ 03

5. If directly involved, how?
……

6. If by contracting, how many are involved? ……

7. How do they operate?

Zones	☐ 01
Streets	☐ 02
Compounds	☐ 03

8. What firms are operationalized and to what zones, streets or compounds?
……

9. Which type of waste disposal facility do you have?

Landfills/borrow pits	☐ 01
Open dumps	☐ 02

Others (specify) ……

10. Where are these disposal facilities located?
……

Does any other private or NGO firm have a disposal facility?

YES	☐ 01
NO	☐ 02

11. If YES, which and where?
……

12. Do you use your waste disposal facility alone?

YES	☐ 01
NO	☐ 02

13. If NO, does any other firm that wants to dispose waste in your disposal facility pay or they take permission alone?

They pay ☐ 01
They take permission ☐ 02

14. If they pay, how much and for what duration?
……

15. If they take permission, what steps are taken?
……..

16. If NO in question 13 above, where do you think the private firms dispose of their waste?
……

17. What do the contract firms do?

Collect waste from street/gutter/roads ☐ 01
Collect garbage from within premises ☐ 02
Collect garbage from house to house ☐ 03
Others (specify) ……

18. How do the firms collect the waste from the residents?

Door to door ☐ 01
Curbside/Frontage ☐ 02
From communal storage ☐ 03
Block collections ☐ 04
Others (specify) ……

19. How often do you think they collect these wastes? ……...

20. Do you like their performance in the collection and disposal process?

YES ☐ 01
NO ☐ 02

21. Does your authority have any future plans or management system when it comes to waste collection in Yenagoa?

YES ☐ 01
NO ☐ 02

22. If YES, what plans and if NO why? ……..

23. How is your authority funded?

Self ☐ 01
NGOs ☐ 02
State or Local Government ☐ 03
Federal Government ☐ 04
Tax/Revenue Collection (Sanitation fees) ☐ 05

24. Is there any existing policy on waste management in Bayelsa State?

YES ☐ 01
NO ☐ 02

25. Is your authority expected to formulate a policy on waste management for the state?

YES ☐ 01
NO ☐ 02

26. If YES on question 26 above, when was it expected?
……

27. If No on question 26 above, who then?
Federal Government ☐ 01
State/Local Government ☐ 02

28. Does this policy have an effect as regards your performance on waste management in Yenagoa?
YES ☐ 01
NO ☐ 02

29. Is there any position for training and retraining?
YES ☐ 01
NO ☐ 02

30. What are some of the materials/equipment required for your work?
Operational vehicles ☐ 01
Waste bags ☐ 02
Others (specify)…… 03

31. Are these materials/equipment provided to the authority adequately?
YES ☐ 01
NO ☐ 02

32. If NO, does this pose a challenge to your work?
YES ☐ 01
NO ☐ 02

33. How many operational vehicles do you have?
More than 10 ☐ 01
Less than 10 ☐ 02

34. Are they sufficient for your work?
YES ☐ 01
NO ☐ 02

35. Do you receive your remuneration (salary) regularly?
YES ☐ 01
NO ☐ 02

36. If NO, does this pose a challenge to the execution of your duty?
YES ☐ 01
NO ☐ 02

Peer-review history:
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