

Coastal Community Perception on the Use of Human Excreta for Biogas Production

H.I. Ogan^{1*}, S.C. Teme², C.L. Eze³, S.A. Ngah⁴

^{1,2,3,4} *Institute of Geosciences and Space Technology; Rivers State University, Nkpolu-Oroworukwo, PMB 5080, Port Harcourt, Nigeria*
*Corresponding author**

Abstract: Survey research method was adopted for this study. A total of 300 households, from three (3) zones (Azubie/Slaughter, Tourist Beach and Eagle Island Coastal Communities) formed the population of this study. The data collection instrument consisted of structured questionnaire, which contained information on socio-economic and demographic characteristics of the respondents and the acceptance or otherwise of using excreta to generate energy (electricity). The result showed 83% are literate among the Azubie respondents while those at Tourist Beach and Eagle Island were 90% and 81%, respectively. This probably made them receptive to the idea of generating useful energy from their wastes even though most of them were unaware of the biogas technology. On the issue of converting and using the human excreta, the level of awareness by the respondents was quite low. At Azubie, 60.4%, at the Tourist Beach 71.7% and at Eagle Island 60.3% have never heard about it. It could be seen from the above that, more than half of the respondents are unaware of the biogas technology, talk less of considering it as an alternative source of energy. Be that as it may, majority of the respondents welcomed the idea of an innovation that would convert excreta into electricity that they so desperately need. At Azubie, 79.2% accepted this proposition, while 81.7% and 74.6% equally accepted at the Tourist Beach and the Eagle Island coastal communities respectively. Ironically, request for respondents to provide their excreta for the research was met with skepticism and rejection. At Azubie, 62.3% were unwilling, while at the Tourist Beach, 81.7% were not ready. However, 44.4% of respondents at the Eagle Island were willing to provide their excreta for the research. Lastly, there is no significant agreement among the residents to accept the use of the energy produced from the conversion of such wastes.

Keywords: Human Excreta, household biodegradable wastes, coastal communities, anaerobic digestion, electricity generation.

I. INTRODUCTION

The management of wastes streams generated from anthropogenic activities posed very little challenge to humans in the not so distant past. However, with increasing industrialization and urbanization, wastes generated now outstrip disposal rate/mechanism especially in the developing countries, creating severe waste management challenges [1]. Manure from human beings, animals and poultry are easily biodegradable. These wastes have therefore over time, caused environmental degradation, pollution and resource depletion with dire environmental and health consequences [2]. Other materials are industrial waste (saw dust, wastes from food

processing industries); plant wastes (husk, grass, weed etc.), and domestic wastes (vegetables peels, waste food materials) [3]. Human excreta consist of faeces and urine which are waste products of the body metabolism [4] and consist of proteins, carbohydrates and fats. The anaerobic decomposition of human excreta produces methane gas, which can be harnessed by biogas plants to produce energy. Therefore, recycling and reuse of human excreta for biogas generation is an important way to get rid of the health hazards posed by the mismanagement human excreta. Interest in biogas has probably never been as awakened as it is till now, especially with the increasing need for renewable energy sources which has recently gained great importance. Biogas is a renewable and environmentally friendly energy source that will significantly promote sustainable development. When produced from biodegradable wastes sources like human excreta and kitchen wastes, the process converts the unwanted substances into other beneficial substances.

The problem of improperly or unmanaged wastes/residue, is the danger they pose to human existence such as the depletion of natural resources through the non-use of otherwise valuable and much needed resources; the general reduction in the quality and quantity of the physical environment for human sustenance; the defacing and spoilage of the natural beauty/esthetics of the environment and the pollution of surrounding air and water bodies through the generation/introduction of some deleterious matter into the environment. The quest to resolve these issues gave rise to the question: will the residents agree to use the energy from processed excrement? This study is aimed at analyzing people's perception and attitude towards the use of human excreta for the generation of biogas as an alternative fuel for domestic use.

1.1 Hypothesis

Ho: There is no significant agreement among the residents to accept the use of the energy produced from the conversion of such wastes.

II. STUDY LOCATION

The study location falls between Latitude 4°45'N and Latitude 4°55'N, and Longitude 6°55'E and Longitude 7°05'E in Rivers State (Figure 1). The study area which are parts of Port Harcourt and Obio/Akpor Local Governments Areas of

Rivers State are predominantly estuaries, connected to several crisscrossing rivers and creeks, which empty into the Atlantic Ocean [5]. According to [6], an extensive study of water quality throughout Rivers State, found that over 85% of the samples contained total coliform counts above 40 coliform per 100ml, indicating faecal contamination. The population of the Port Harcourt metropolitan area (Greater Port Harcourt) according to the 2006 census was put at 1,196,788 persons made up of 610,784 males and 586,004 females [7]. The Port Harcourt metropolitan area includes essentially three Local Government areas (LGAs) namely; Port Harcourt, Obio/Akpor and Eleme LGAs. The House types in Port Harcourt City range from the posh to the standard houses owned by the rich, to the single room, communal living, shanties and batchers owned by the urban poor. While some of the latter category of households use shared water closet systems on the inside and majority use the VIP latrine systems, built on the water and connected to land with very narrow gangways. Feces are thus passed directly into the rivers from the VIP toilet systems, thus polluting the environment as well as wasting valuable energy generating resource.



Fig. 1: Map of Port Harcourt Metropolis Showing Study Locations

III. METHODS

The survey research method was adopted for this study. According to Okwandu [8], surveys are oriented towards ascertaining and establishing the status quo, facts, or pieces of information at the time of the research and subjecting such facts to further analyses; making inferences and drawing conclusions. Accidental sampling technique (a non-probability method) was equally adopted for this study, due to the convenience it offers when conducting a field exercise. It involves meeting people at random within the areas chosen for the study. In all, 300 households from the three (3) Waterfront Communities at Azuabie/Slaughter, Tourist Beach and Eagle Island which effectively covered the Local Government Areas of our focus, formed the population of this study. The data collection instrument consisted of structured

questionnaire, which contained information on socio-economic and demographic characteristics of the respondents and the acceptance or otherwise of using excreta to generate Fuel for domestic uses. Chi-square test were employed for the statistical analysis. Software chi-square calculator [9] for a contingency table that has up to five rows and five columns was used.

IV. RESULTS

Table 1. Gender and Questionnaire Returned

| Community | Male (%) | Female(%) | Total(%) |
|-----------|------------|------------|------------|
| Azuabie | 28 (50)* | 40 (50)* | 68 (100)* |
| Tourist | 33 (50)* | 39 (50)* | 72 (100)* |
| Eagle | 41 (50)* | 38 (50)* | 79 (100)* |
| Total | 102 (150)* | 117 (150)* | 219 (300)* |

Figures in parentheses – Number of questionnaires administered by gender

Table 1 shows the total number of questionnaires administered as well as those correctly completed and returned. At Azuabie water front community 28% of the returned questionnaires were from males while 40% were from females. At the Tourist Beach water front community, males were 33% while females were 39% and at the Eagle Island water front community, males were 41% while females were 38%. In all the three coastal communities, the totals of 73% of the questionnaire were returned.

4.1 Permanent and Non-Permanent Residents

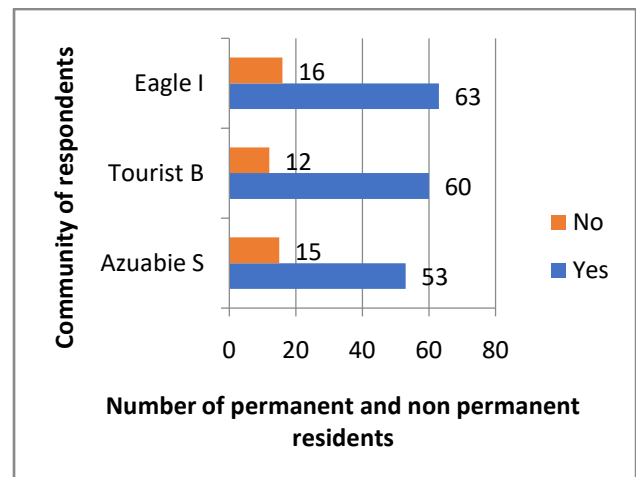


Fig. 2: Permanent and Non-Permanent Residents

Figure 2 shows the distribution of the permanent and non-permanent residents in the studied communities. Out of the 79 respondents that correctly completed and returned their questionnaire, 63 of them were permanent dwellers, while 16 of these respondents were not permanent dwellers in Eagle Island community. At the Tourist Beach, 60 out of 72 were permanent dwellers while 12 were not and at Azuabie, 53 out of 68 were permanent dwellers while 15 were not.

4.2 Ownership of Houses

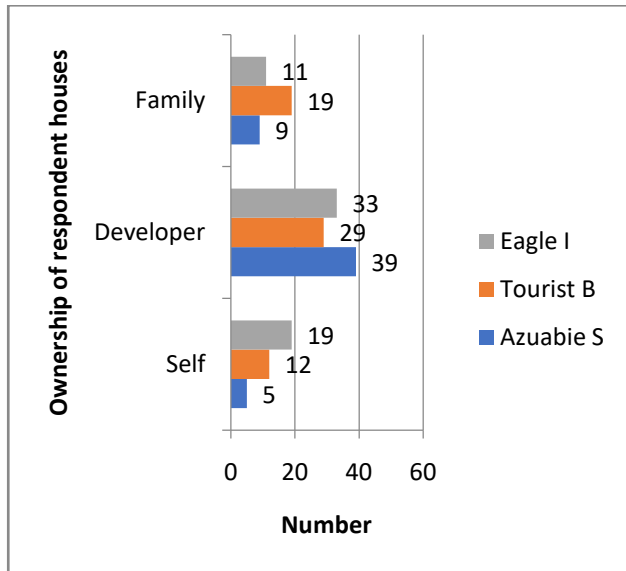


Fig. 3: Ownership of Houses

As shown on figure 3, 9.4% of the respondents from Azuabie community live in their own houses, 73.6% lived in houses owned by private developers and 17% lived in houses belonging to the family members. At the Tourist Beach, 20% are owner occupiers, 48.3% lived in houses belonging to private developers and 31.7% lived in family houses. At the Eagle Island, 30.2% dwell in their own houses, 52.4% dwell in houses belonging to private developers and 17.5% dwell in family houses.

4.3 Respondents Level of Education

Table 2: Respondents Level of Education

| Cmnty ** | Illiterate | Pry Sch ** | Sec Sch** | High Sch** | Univ ersity | Total (%) |
|-----------|------------|------------|------------|------------|-------------|-----------|
| Azuabi e | 17.0 (9)* | 35.8 (19)* | 18.9 (10)* | 7.5 (4)* | 20.8 (11)* | 100 (53)* |
| Tourist B | 10.0 (6)* | 26.7 (16)* | 23.3 (14)* | 28.3 (17)* | 11.7 (7)* | 100 (60)* |
| Eagle I | 19.0 (12)* | 20.6 (13)* | 28.6 (18)* | 22.2 (14)* | 9.5 (6)* | 100 (63)* |
| Total | 27 | 48 | 42 | 35 | 24 | 176 |

* Figures in parentheses - Number of respondents
 ** Cmnty – Community; Pry Sch – Primary School, Sec Sch – Secondary School, High Sch – Higher School.

From table 2 the level of education among the respondents are given thus: illiteracy levels were relatively low at 17% at Azuabie, 10% at Tourist Beach and 19% at Eagle Island water front communities. Primary school education varied among the respondents from 35.8% at the Eagle Island to 26.7% at the Tourist Beach and 20.6 % at the Azuabie water front communities. The level of secondary education among the respondents at the Azuabie, Tourist Beach and Eagle Island water front communities were 18.9%, 23.3%, and 28.6%,

respectively. Higher school attainment such as A Level and Ordinary Diploma at the Azuabie, Tourist Beach and Eagle Island water front communities were 7.5%, 28.3% and 22.2%, respectively. Those who attained University education in Azuabie, Tourist Beach and Eagle Island were 20.8%, 11.7% and 9.5%, respectively.

4.4 Respondents’ Awareness of Excreta for Biogas (Fuel)

Table 3. Respondents’ Awareness of Excreta for Biogas (Fuel)

| Communities | Yes (%) | No (%) | Total (%) |
|-------------|-------------|--------------|------------|
| Azuabie S | 39.6 (21)* | 60.4 (32)* | 100 (53)* |
| Tourist B | 28.3 (17)* | 71.7 (43)* | 100 (60)* |
| Eagle I | 39.7 (25)* | 60.3 (38)* | 100 (63)* |
| Total | 107.6 (63)* | 192.4 (113)* | 300 (176)* |

* Figures in parentheses - Number of respondents

Table 3 represents the respondents’ level of awareness that Biogas (Fuel) could be generated from their excreta in combination with other household biodegradable waste streams for cooking, heating and the generation of electricity. At Azuabie, 39.6% stated “yes” while 60.4% stated “no”; at the Tourist Beach, 28.3% stated “yes” while 71.7% stated “no” and at the Eagle Island, 39.7% stated “yes” while 60.3% stated “no”.

4.5 Acceptance of a System of Excreta Collection for Biogas

Table 4. Acceptance of a System of Excreta Collection for Biogas

| Communities | Accept (%) | Not accept (%) | Undecided (%) | Total (%) |
|-------------|-------------|----------------|---------------|-----------|
| Azuabie S | 79.2 (42)* | 9.4 (5) | 11.3 (6) | 100 (53) |
| Tourist B | 81.7 (49) | 5.0 (3) | 13.3 (8) | 100 (60) |
| Eagle I | 74.6 (47) | 15.9 (10) | 9.5 (6) | 100 (63) |
| Total | 235.5 (138) | 30.3 (18) | 34.2 (20) | 300 (176) |

* Figures in parentheses - Number of respondents

From table 4, we could ascertain the respondents’ level of acceptance or otherwise to use an excreta disposal system with the capacity to harness and convert “wastes” into useful gas for household uses, including electricity as 79.2% accepted, 9.4% did not accept, while 11.3% of the respondents were undecided at Abuabie. At the Tourist Beach, 81.7% accepted, 5.0% did not accept while 13.3% were undecided. At Eagle Island, 74.6% accepted, 15.9% did not accept while 9.5% were undecided.

4.6 Respondents’ Willingness to Provide Excreta for the Research

Table 5. Respondents’ Willingness to Provide Excreta for Research

| Communi ties | As soon as possible (%) | Need a week(%) | Need a month(%) | Not ready(%) | Total (%) |
|--------------|-------------------------|----------------|-----------------|--------------|-----------|
| Azuabie S | 11.3 (6)* | 17.0 (9) | 9.4 (5) | 62.3 (33) | 100 (53) |
| Tourist B | 3.3 (2) | 8.3 (5) | 6.7 (4) | 81.7 (49) | 100 (60) |
| Eagle I | 44.4 (28) | 11.1 (7) | 30.2 (19) | 14.3 (9) | 100 (63) |
| Total | 59.1 (36) | 36.4 (21) | 46.3 (28) | 158.2 (91) | 300 (176) |

* Figures in parentheses - Number of respondents

Table 5 shows the reaction of the respondents when asked whether their excreta could be collected for the generation of Biogas (Fuel). At Azuabie, 11.3% indicated “as soon as possible”, 17% indicated “need a week”, 9.4% indicated “need a month” while 62.3% indicated “not ready”. At the Tourist Beach, 3.3% indicated “as soon as possible”, 8.3% indicated “need a week” 6.7% indicated “need a month” while 81.7% indicated “not ready”. At the Eagle Island, 44.4% indicated “as soon as possible”, 11.1% indicated “need a week”, 30.2% indicated “need a month” while 14.3% indicated “not ready”

4.7 Hypothesis 1

Table 8. Contingency Table

| | Agree | Disagree | Undecided | Row Totals |
|----------------|-------------------|-------------------|------------------|-------------------|
| Azuabi e | 31 (33.12) [0.14] | 17 (14.45) [0.45] | 5 (5.42) [0.03] | 53 |
| Tourist B | 39 (37.50) [0.06] | 18 (16.36) [0.16] | 3 (6.14) [1.60] | 60 |
| Eagle I | 40 (39.38) [0.01] | 13 (17.18) [1.02] | 10 (6.44) [1.96] | 63 |
| Colum n Totals | 110 | 48 | 18 | 176 (Grand Total) |

The contingency table above provides the following information: the observed cell totals, (the expected cell totals) and [the chi-square statistic for each cell]. The chi-square statistic is 5.435. The *p*-value is .245499. The result is *not* significant at *p*< .05.

V. DISCUSSIONS

Level of education plays a significant role in actualizing any innovation and in all the three coastal communities studied low illiteracy level was recorded among the respondents. Only 17% are illiterate among the Azuabie respondents while those at Tourist Beach and Eagle Island were 10% and 19%, respectively. This probably made them receptive to the idea of generating useful energy (biogas) from their wastes even though most of them were unaware of the biogas concept/technology.

On the issue of converting and using the human excreta and household food wastes for biogas production, the level of awareness by the respondents was quite low. At Azuabie, 60.4%, the Tourist Beach 71.7% and at Eagle Island 60.3% were also not aware. A study carried out in Kano among five communities reported that only 48% were aware of biogas while 52% were unaware [10]. It could be seen from the above that, more than half of the respondents are unaware of the biogas concept, talk less of considering it as an alternative source of energy. [10] however advocated more enlightenment, possibly to create awareness and generate interest among the population of the environment friendly alternative source of energy that is also cost effective in the medium and long terms.

Be that as it may, majority of the respondents welcomed the idea of an innovation that would convert excreta into useful fuel/gas. At Azuabie, 79.2% accepted this proposition. At the Tourist Beach 81.7% accepted while 74.6% accepted at the Eagle Island. Interestingly, request for respondents to provide their excreta for such research was met with skepticism and rejection. At Azuabie, 62.3% were unwilling to provide their excreta; at the Tourist Beach, 81.7% were not ready. On the other hand, 44.4% of respondents at the Eagle Island were willing to provide their excreta for the research. Lastly, there is no significant agreement among the residents to accept the use of the energy produced from the conversion of such wastes.

VI. CONCLUSION AND RECOMMENDATIONS

It can be said with all confidence that biogas plants, based on human excreta and other household biodegradable wastes offer benefits in terms of human health, resource conservation and the regeneration of the physical environments. The results of this study showed that though societal awareness of the biogas concept/technology is low, its subsequently being accepted among the research universe will not pose a very serious challenge. The reason being the almost non-existent public power supply in the area, coupled the high costs of the alternatives such as power generating sets, premium motor spirit (PMS), diesel, cooking gas, fire woods etc. It was observed that females were more enthusiastic and participated more than the males. This could be adduced to the fact that they spend more time at home and in the vicinity and thus suffer more of the air pollution, very hot/stuffy dwellings as well as the pains and inconveniences caused by frequent illnesses occasioned by the current excreta and other household wastes disposal methods.

It is therefore recommended that a massive and sustained re-orientation of the residents/communities in the Research Universe (Niger Delta) be carried out to enable them view human excreta as a beneficial resource, rather than the age long traditional view of it as good for nothing. This will result in a paradigm shift that will improve the standard of living, at least in the areas of good health and environmental regeneration. It is also recommended that there should be

legislation requiring urban and regional planning departments to no longer approve building plans without proper excreta and household biodegradable wastes management.

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