An Assessment the Solid Waste Composition and Management in Agbor and its implication on human health

Abstract
The Study assessed solid waste composition and how it is being managed in relation to health implications in Agbor, a nordal town in Delta State Nigeria. Survey design was used and both primary and secondary data were collected through stratified sampling technique. Solid waste management practices of respondents were generated through the use ofSix hundred and twenty five (625) copies of questionnaires in 8 sampling unit. The hospital report on malaria and typhoid were obtained from the medical records of central hospital, Agbor covering 1997-2011, and the solid waste composition was obtained through waste characterization and measurement. The data on solid waste management and composition were from the sanitary records of the Local Government Council, and private waste firm in Agbor called Total Resource Management Limited. The study result shows 34.14% are traders, 22.14% are civil servants, 14.34% are farmers, and 29.38% are business men and women. The waste generated is 1594.11 kilogram. This shows that the total respondent of five thousand generate 1594.11 kilogram of solid waste daily. Baleke area has the highest rate of waste generated which is 223.43 kilogram; followed by Dr. Whyte area which generate 214.46 kilogram of solid waste daily. Edike area generates the harvest amount of solid waste in the entire sampled areas, having 180.34 kilogram of solid waste generated daily. Food items are the greatest amount generated daily, with 1135.21 kilograms per day.85% of malaria cases and 98.6% of typhoid cases in Agbor is consequent on solid waste composition.To enhance effectiveness in solid waste management in Agbor, the Local Government Authority should subsidize the amount of money paid for the services of private waste managers. The promulgation of punishable laws on the indiscriminate dumping of solid waste will help avoid the dumping of waste waterfront, road side and street drains.
Keyword: Solid Waste Management, Malaria, Typhoid, Agbor, Nigeria.

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Introduction

The cornerstone to any successful planning for a waste management programme is the availability of reliable information about the quality and the type of material being generated and an understanding about how much of that material that materials the collection-programme managers can expect to prevent or capture [1]. Most municipalities in developing countries spend a large proportion of their budgets on the collection, transport, and disposal of solid wastes [2]. Solid waste generation has been encouraged by rapid increase in population, changes or improvement in wages, massive expansion of the urban areas and the changing lifestyle or better standard of living as well as improvement in technology [3]

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According to Ajadi and Tunde[4], increase in population and income brings about an increase in the production of goods and services and thus effluents are discharged into the environment. Gidarakos, *et al*.,[1] noted that the effective waste management through municipal solid waste composition studies is important for numerous reasons; including the need to estimate material recovery potential, to identify sources of component generation, to facilitate design of processing equipment, to estimate physical, chemical and thermal properties of the waste and to maintain compliance with national law. The composition of generated waste is extremely a consequence of seasonal, lifestyle, demographic, geographic and legislation impacts. This variability makes defining and measuring the composition of waste more difficult and at the same time more essential.

The solid waste management in most cities of developing countries consumes 20-50% of municipal revenues, yet collection service levels remain low with only 50-70% of residents receiving service and most disposals being unsafe. Poor solid waste management is a threat to public health and reduces the quality of life for urban residents. Moreover, the situation is likely to worsen due to continuing population growth and urbanization in developing countries [5]

According to United Nation International Children Educational Fund [6], waste is any material that is thrown away as unwanted. Adedibu[7] defined solid waste as all non-gaseous, non-liquid waste resulting from a wide range of community, industrial, commercial and agricultural activities. The composition or generation of waste at alarming rate constitutes a huge problem to the governments as well as individuals in large urban area especially in developing countries like Nigeria. This is as a result of residues of products used which are not always destroyed but discarded, and these contribute greatly to land pollution [8].

Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. Waste management can involve solid, gaseous or retroactive substances, with different methods and fields expertise for each [9].The manner of solid waste composition and management in Agbor is a problem which resulted from lack of waste minimization and illegal dumping respectively. Solid waste has occasioned diverse problems in the environment. Uncollected solid waste obstructs storm water runoff, resulting in the formation of stagnant water bodies that become the breeding ground of disease vectors.

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Solid waste dumped near water sources cause a contamination of the water body or the ground water source. This leads to spread of typhoid when the water is consumed. Direct dumping of untreated waste in rivers result in the accumulation of toxic substance in the food chain through plants and animals that feed on it [10].In 2010, an estimated 216 million cases of malaria occurred worldwide and 655,000 people died of which a whooping proportion (91%) was in the African region [11].

According to Kurniawan[12], in addition to global warming, open dumps pose a serious threat to the aquatic environment. One of the greatest environmental concerns associated with solid waste landfilling is the generation of leachate. Depending on rainfall conditions, the colour of leachate varies from black to brown. A landfill site may still produce leachate with a high concentration of NH3-N for over 50 years after filling operations have ceased. The leachate that seeps from a landfill can infiltrate the surface water, posing potentially serious hazard net only to aquatic organisms, but also to public health in the long-run. For this reason, landfill leachate from solid waste represents a potentially serious environment threat with regard to the pollutants introduced into the aquatic environment.

Solid waste blocks open street drains and is often dumped into sewers through missing manhole covers. The non-biodegradable shopping bags get inflated and block sewer pipes [13]. And hazardous solid wastes that are radioactive cause loss of vegetable and plant life, loss of animal life, and mutations of species over time.

The decomposition of solid waste has resulted to the emission of methane gas and carbon dioxide. Methane has a 21-fold global potential as compared to carbon dioxide. According to the intergovernmental panel on climate change, such emissions contribute to 18 per cent of the total Methane emissions to the atmosphere, ranging from 9 to 70 Tg (Megatonnes) annually. This Methane emission has led to global warming. The changing temperature and rainfall patterns will bring a variety of pressure upon plant and animal life, leading to migration or extinction [14].Solid wastes found in urban areas are sources of contamination due to the incubation and proliferation of flies, mosquitoes, and rodents, which, in turn, are disease transmitters that affect population health, which has its organic defenses in a formative and creative state. This situation leads to malaria, cholera and diarrhea [15].

More so, in Agbor, a nordal town in Delta state, most of these solid wastes are dumped in street drains even near sewer pipes in residential buildings. The street drains are blocked by the

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solid waste, and when it rains, the run-off easily overflows the drain thereby causing flood and erosion activities which are global environmental hazard. Some of these solid wastes are carried to the roads thereby distorting flow of traffic, and even destruction of automobiles tyres and tubes. Pedestrians are not left out as they come in contact with sharp waste objects. These scenarios have been made very much active due to the large composition of solid waste physically seen in the area. Arising from the above, there is therefore need to study solid waste composition and management, as a means of throwing light to solid waste minimization and management. Therefore, this study is aimed at assessing the solid waste composition and management in Agbor and its implication on human health. To achieve this aim, the specific objectives are to; assess composition of solid waste, examine solid waste management practices in the area and examine the effects of solid waste management on human health.

Materials and Methods

Study Area Location and Size

Ika South Local Government lies within 06°7[1] and 06° 25[1]North of the Equator, and Longitudes 06° and 8[1] and 06° 18[1] Eastof the Greenwich Meridian [16]. Agbor town, which is the Headquarters of the Local Government Area, is located at Latitude 6° 08[1] North and Longitude 6° 07[1]East. It is bounded in the North by Otah village, in the South West by Owa-Ofien, in the South East by Boji-BojiOwa, in the East by Emuhu village, and in the West by Alihame village. The relief of the area is of a gentle slope with the Orogodo River having its course through the shallow valley [16]

The study area is characterized by tropical equatorial climate with a daily rainfall total of 175mm in the wettest month of July and September. The mean maximum rainfall is 240mm during the wet season and 50-70mm during the dry season. November to April is dry, intercepted by the "August Break" in August.There is harmattan from December to February caused by the North East trade wind blowing across the area from the Sahara Desert. The temperature does not vary mush during the year. There is an average minimum temperature of 22°C and maximum of 34°C. The diurnal variation is less in the wet season than in the dry season when it is as much as 4° C[17]. .

The natural vegetation of the study area lies within rainforest belt and hence the dominant features of the vegetation are deciduous and evergreen forest [16].The forest is rich in palm trees,

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fruit trees and few timber trees. However, the vegetation has been greatly hampered as a result of human activities such as farming, fetching of firewood, buildings development, road construction, etc.

The Southwestern ends of the area are watered by a River which runs from Mbiri across Agbor, Owa, Abavo, before it flows into a lake of Urhomehe between Urhonigbe and Umutu. It is called Atova River at its source in Mbiri, Orogodo river of Agbor, Owanta Stream of Owa, and Igbogili Stream of Abavo. A confluence is formed near the bridge by the Express highway where Yi-Ekpen flows into the Orogodo River [16]

The population of Agbor was 54,850 in 1991 (NPC, [18]. In 2006, the population was 49, 401 [18].In 2011, the population was projected to 51, 278 using the 3.8% Nigeria standard growth rate but, the projection for 2014 was 52,404. The population of the area is not evenly distributed as people prefer living in the commercial areas to the Government Reserved Area.

Agbor is an administrative, educational and commercial centre. It is a nodal town linking the south west, south east and north central part of Nigeria. The socio-economic activities of the people in Agbor are grouped into primary, secondary and tertiary activities. The primary activities include subsistence agriculture, rearing of pigs, and poultry farming. The secondary activities include Tailoring and Carpentry. The tertiary activities include the service industries such as the financial institution, educational institutions and transport services. The financial institutions consist of the banks and local insurance firms. The educational institutions include the college of education, secondary schools, primary and nursery schools. Public and private transport operators render transport services. There are hospitals, health centers and clinics that render health services in Agbor.

Methods

The study was based on field survey. The data used were primary and secondary sources of data. The primary data was based on solid waste management practice, which was generated from respondents through the use of questionnaire, the hospital report on malaria and typhoid, and the solid waste composition obtained through waste characterization and measurement while the secondary data on solid waste management and composition were from the sanitary records from the Local Government Council, and private waste firm in Agbor called Total Resource Management Limited.

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The stratified sampling technique was adopted for the distribution and collection if questionnaire, and solid waste measurement. The stratified sampling technique deals with the breaking down of overall sample size into strata or units to ease effectiveness. Based on this, the study area was divided into eight (8) smaller areas simply for effectiveness in the distribution of questionnaire and actual measurement of solid waste. The eight areas are shown in the Table 1

Table.1: Sampled Areas

SN	Areas
1	Dr. Whyte
2	Charles
3	Prof. Ebie
4	Mariere
5	Balake
6	Umudein
7	Edike
8	College Junction

Source: Reconnaissance Survey, (2012).

From the above, a total of eight areas were sampled. Six hundred and twenty five (625) questionnaires were distributed to respondents in each area, thereby rounding up the total questionnaires distributed in the study area to be 5,000 based on the ten percent of the entire population. The sampled areas were also based on its already existence. To ensure affective distribution of the questionnaire in each sampled area, the systematic sampling procedure was utilized.

The administration of questionnaire is the ultimate method used to collect data on solid waste management practice, mostly on disposal method. The data on solid waste composition was collected through solid waste categorization and actual measurement by the researcher and research assistants. The solid waste generated per day by respondents were characterized and measured respectively. For the solid waste categorization, six polythene bags were labeled plastic, food items, cellophane, bottle, tin can and papers respectively. The respondent in each household was instructed to dump his/her solid waste in the polythene bag following the type of solid waste labeled. Thereafter, the solid waste in the various polythene bags was measured in kilogram using weighing scale.

The systematic approach was adopted in the administration of questionnaire and also in line of with the solid waste measurement, whereby interval scale of six buildings was observed.

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That is, the questionnaire was administered to the 1st, 7th, 13th and so on respondents in each sampled area. A respondent assumed to be head of a building was given the questionnaire; the questionnaire was retrieved after three days of administration.

The data on malaria and typhoid as the diseases being researched were obtained from the medical records of central hospital, Agbor. The use of the central hospital report was as a result of the whole study area primarily been served by the hospital, and also due to availability of data. The hospital's record on malaria and typhoid for both in-patient and out-patient covered a period of 14 years (1997-2011). For relevant questions and meaningful conclusion, the research instrument was subjected to validity through various criticisms and amendment. The lecturers in the department helped to determine the facial content validity. The final copies after scrutiny were produced and sent to the field for administration.

Percentages mean and charts were used for the data analysis and presentation. In addition to the testing of the hypotheses, the analysis of variance (ANOVA) was employed. Then the Pearson product moment correlation was used to test and analyse the correlation variables.

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Results and Discussion

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Table 2: The Occupational Status of Respondents.

Sampled areas	Trading	Civil servant	Farming	Business	No. of respondents	Percentage
Dr. Whyte	176	189	90	170	625	12.5%
Charles	217	142	57	209	625	12.5%
Prof. Ebie	195	164	49	217	625	12.5%
Mariere	244	111	90	180	625	12.5%
Baleke	210	100	143	172	625	12.5%
Umudein	227	89	166	143	625	12.5%
Edike	220	115	98	192	625	12.5%
College Junction	218	197	24	186	625	12.5%
Total	**1707**	**1107**	**717**	**1469**	**5000**	**100%**
Percentage	**34.14%**	**22.14%**	**14.34%**	**29.38%**	**100%**	

Source: Field Survey

In table 2, out of the 5,000 respondents (100%), 34.14% were traders, 22.14% were civil servants, 14.34% were farmers, and 29.38% were business men and women. The result from the table shows that there are more traders in Agbor. This is because Agbor is a commercial town due to the ever increasing population size and numbers of immigrants. Most of the educated or

learned and non-formally educated individuals engage in trading and business as a result of lack of companies and white callers' job for the educated ones. This is why the business occupation type is ranking second, being 29.38%, followed by civil servants (22.14%) and farming (14.34%)(Fig 1).

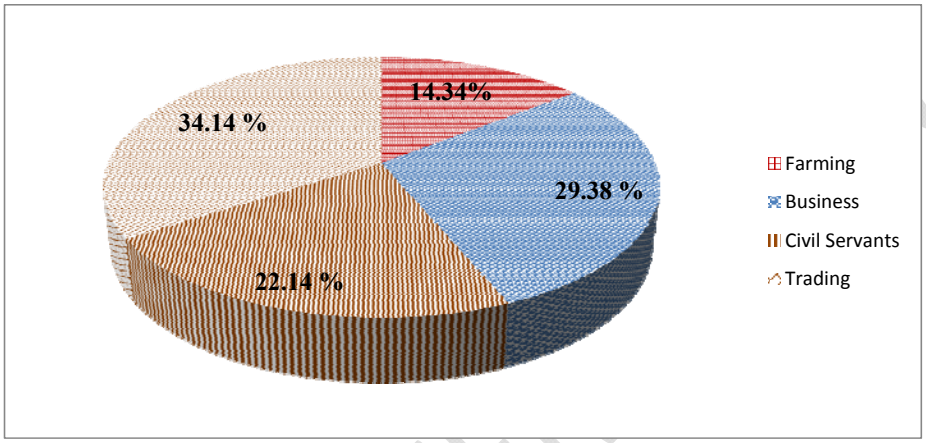

Fig 1: Occupation of the Respondents

Table 3: The Educational Status of the Respondents.

Sampled areas	No. formal education	Pri. School	Sec. school	NCE	Degree	No of respondent	%
Dr. Whyte	8	100	300	101	116	625	12.5%
Charles	7	100	311	102	105	625	12.5%
Prof. Ebie	11	160	195	121	138	625	12.5%
Mariere	10	144	188	139	144	625	12.5%

Baleke	13	114	198	182	118	625	12.5%
Umudein	32	242	109	187	55	625	12.5%
Edike	9	139	191	146	140	625	12.5%
College Junction	5	66	187	216	151	625	12.5%
Total	95	1075	1679	1194	967	5000	100%
Percentage	1.9%	21.5%	33.58 %	23.88 %	19.2 4%		12.5%

Source: Field Survey

The educational status of respondents above shows that out of the five thousand (5,000) respondents, 1.9% had no formal education, 21.5% were primary school learners, 33.58% were secondary school certificate holders, 23.33% were national certificate examination (NCE) holders, and 19.34% were degree holders. From this finding, almost the entire populations are literate. This shows that the respondents can write, read and understand issues on solid waste management, composition and human health.

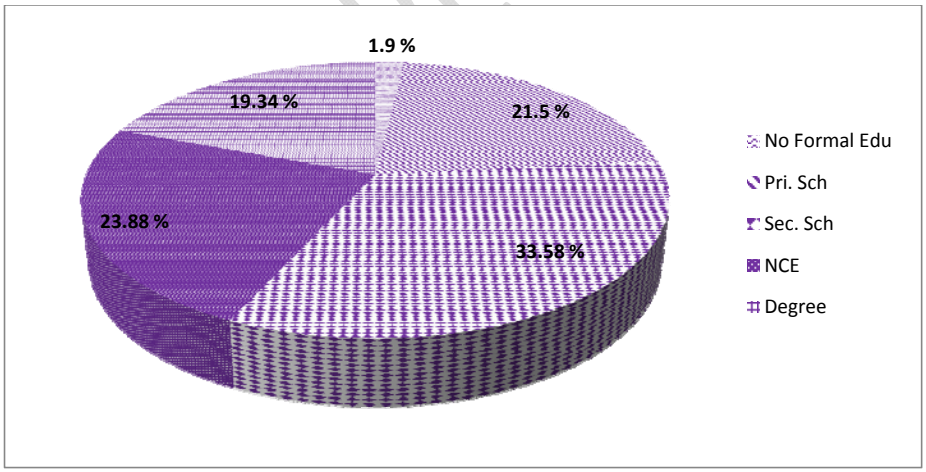

Fig 2: Educational status of respondents

Table 4: Income Distribution of Respondents

Sampled areas	Below ₦20,000	₦21,000 - ₦40,000	₦41,000- ₦60,000	₦61,000- ₦100,000	Above ₦100,000	No. of respondents
Dr. Whyte	147	154	218	94	12	625
Charles	208	221	139	44	12	625
Prof. Ebie	241	209	120	45	10	625
Mariere	199	218	134	63	11	625
Baleke	198	249	140	31	7	625
Umudein	307	200	81	35	2	625
Edike	201	188	180	51	5	625
College Junction	278	205	111	27	4	625
Total	**1779**	**1644**	**1123**	**390**	**64**	**5000**
Percentage	**35.58%**	**32.88%**	**22.46%**	**7.8%**	**1.28%**	

Source: Field Survey

From Table 4. showing the income distribution of respondents on monthly basis, 35.58% of the respondents receive less than ₦20,000 monthly, 32.88% receive between twenty one to forty thousand naira (₦21,000- ₦40,000) monthly sixty thousand naira (₦41,000 – ₦60,000) monthly, 7.8% receive between sixty one to one hundred thousand naira (₦61,000 – ₦100,000) monthly while, 1.28% receive above one hundred thousand naira monthly. This finding shows that the respondents in the study area are more of moderate income earners with four flamboyant income earners. With this, one can say that the study area is still a growing urban center.

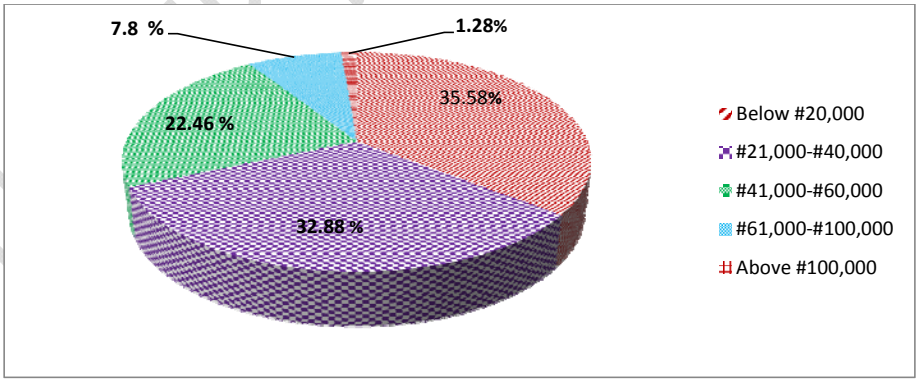

Fig 3: Income distribution of respondents

Table 5: Solid Waste Composition and Generation (per day) in Agbor.

Sampled areas	Cellophane (kg)	Food items (kg)	Plastic (kg)	Papers (kg)	Tin cans (kg)	Bottles (kg)	Total rate of W.G
Dr. Whyte	10.05	150.41	12.11	10.00	19.09	11.81	214.46
Charles	12.61	152.37	10.11	15.41	14.41	9.14	214.05
Prof. Ebie	11.88	141.59	11.49	9.84	10.97	6.41	192.18
Mariere	11.76	143.52	12.37	14.00	12.48	11.00	205.13
Baleke	20.20	150.40	14.01	12.98	10.11	15.73	223.43
Umudein	10.41	138.87	7.14	7.49	9.42	3.13	180.46
Edike	11.18	134.91	9.41	8.98	8.98	7.08	180.34
College Junction	10.08	123.14	11.10	21.81	7.91	10.02	184.06
Total	98.17	1135.21	87.74	101.30	93.37	78.32	1594.11

Source: Field Survey

Table 5 shows the data on solid waste composition in a day. The data was based on the total number of respondents in each sampled area.From Table 5, the grand total of the waste generated was 1594.11 kilogram. This shows that allthe respondents generated 1594.11 kilogram of solid waste daily. Baleke area has the highest rate of waste generated which is 223.43 kilogram followed by Dr. Whyte area which generate 214.46 kilogram of solid waste daily. Edike area generates the harvest amount of solid waste in the entire sampled areas, having 180.34 kilogram of solid waste generated daily.

In the solid waste composition measurement of the sampled areas, food items have the greatest amount generated daily, with 1135.21 kilograms per day, followed by papers,

cellophanes with 101.30 kilograms and 98.17 kilograms respectively. Bottles constitute the smallest amount generated with 78.32 kilograms per day.

SOLID WASTE MANAGEMENT PRACTICES IN AGBOR

The data on solid waste management practices on disposal system were obtained through the use of questionnaire. Table 6 shows raw data obtained from the respondents on solid waste disposal system in each sampled area.

Table 6: Solid waste disposal system in Agbor.

Areas	Disposal on water front	Disposal on street drains	Disposal on road side	Landfill	Open burning	Disposal of point of collection
1	-	210	124	4	82	205
3	-	199	112	1	100	213
4	-	214	60	18	92	200
5	27	313	41	8	87	149
6	121	209	83	13	99	100
7	45	204	32	11	134	199
8	-	218	14	3	178	212
Total	**193**	**1754**	**566**	**60**	**871**	**1515**

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From Table 6, a total number of 193 respondents dispose their solid waste on water front, 1754 respondents dispose their solid waste on street drains, 566 respondents dispose their solid waste by road side, 60 respondents dispose their solid waste in landfill, 871 respondents dispose their solid waste through open burning and 1515 respondents dispose their solid waste at the points of collection by private waste managers.

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Table 7: Raw data on Hospital Record of Malaria and Typhoid (1997-2011) in Agbor

Year	Malaria (No. of cases)	Typhoid
1997	1802	1811
1998	1799	1824
1999	1811	1834
2000	1792	1718
2001	1712	1625
2002	1689	1541
2003	1626	1529
2004	1711	1407
2005	1692	1411
2006	1649	1396

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2007	1682	1305
2008	1617	1310
2009	1658	1256
2010	1729	1245
2011	1590	1195

Source: Medical Records Dept., Central Hospital, Agbor

MULTIPLE CORRELATION ANALYSIS AND ANOVA OF SOLID WASTE COMPOSITION AND MANAGEMENT OF MALARIA AND TYPHOID

In this section of the research work, the multiple correlation was used to test the correlation analyses of solid waste composition and solid waste management on malaria and typhoid respectively. And the analysis of variance (ANOVA) was used to test the hypotheses, either to be accepted or rejected. The various analysis were run separately, that is, analysis of solid waste composition on malaria, solid waste composition on typhoid, solid waste management on malaria, and solid waste management on typhoid respectively to achieve accurate results. The data for the hypotheses and their various analyses are shown and explained below.

Table 8: Data for Hypothesis 1

Cellophane	Food items	Plastic	Papers	Tin can	Bottles	Malaria	Typhoid
10.05	150.41	12.11	10.99	19.09	11.81	1802.00	1811.00
12.61	152.37	10.11	15.41	14.41	9.14	1799.00	1824.00
11.88	141.59	11.49	9.84	10.97	6.41	1811.00	1834.00
11.76	143.52	12.37	14.00	12.48	11.00	1792.00	1718.00
20.20	150.40	14.01	12.98	10.11	15.73	1712.00	1625.00
10.41	138.87	7.14	7.49	9.42	7.13	1689.00	1541.00
11.18	134.91	9.41	8.78	8.98	7.08	1626.00	1529.00
10.08	123.14	11.10	21.81	7.91	10.02	1711.00	1407.00
-	-	-	-	-	-	1692.00	1411.00
-	-	-	-	-	-	1649.00	1396.00
-	-	-	-	-	-	1682.00	1305.00
-	-	-	-	-	-	1617.00	1310.00
-	-	-	-	-	-	1658.00	1256.00
-	-	-	-	-	-	1729.00	1245.00
-	-	-	-	-	-	1590.00	1195.00

Hypothesis 1: There is no significant relationship between solid waste composition and human health.

Table 8 shows the weight of the categorized solid waste in the zoned areas, with the Hospital Record for malaria and typhoid from the year 1997 – 2011.

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Table 9: Descriptive Statistics for Solid Waste Composition on Malaria Cases

	Mean	Standard deviation	N
Malaria	1742.7500	67.85647	8
Cellophane	12.2712	3.33349	8
Food items	141.9013	9.76137	8
Plastic	10.9675	2.0184	8
Papers	12.6625	4.56239	8
Tin can	11.6713	3.63672	8
Bottles	9.7900	3.09718	8

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Table 10: Correlations of Solid Waste Composition on Malaria Cases

	Malaria	Cellophane	Food items	Plastic	Papers	Tin can	Bottles
Pearson correlation malaria	1.000	-.070	.532	.417	.166	.688	.123
Cellophane	- 0.070	1.000	0.464	0.592	0.013	-0.150	0.699
Food items	0.532	0.464	1.000	0.341	0.348	0.709	0.409
Plastic	0.417	0.592	0.341	1.000	-0.362	0.271	0.778
Papers	0.166	0.013	-0.348	0.362	1.000	-0.126	0.346
Tin cans	0.688	-0.150	0.709	0.271	-0.126	1.000	0.250
Bottles	0.123	0.699	0.409	0.778	0.346	0.250	1.000

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Cellophane has a mean of 12.2712, standard deviation of 3.33349 and a correlation of -0.070 with malaria. Food items have a mean of 141.9013, standard deviation of 9.76137 and correlation of 0.532 (52.2%) with malaria. Plastic has a mean of 10.9675, standard deviation of 2.09184 and a correlation of 0.417 (41.7%) with malaria. Papers have a mean of 12.6625, standard deviation of 4.56239 and a correlation of 0.166 (16.6%) with malaria. Tin can has a mean of 11.6713, standard deviation of 3.63672 and a correlation of .688 (68.8%) of malaria. Bottles have a mean of 9.7900, standard deviation of 3.09718 and a correlation of 0.123 (12.3%) with malaria.

Table 11: Model Summary

Model	**R**	**R square**	**Adjusted R square**	**Standard error of estimate**	**Durbin waston**
1	0.922	0.850	0.050	69. 5 2006	3.126

Predictor: bottles, tin can, papers, plastic, food items, cellophane

Dependent variable: malaria

From the model summary, Table 11, the R^2 of 0.850 indicates that 85% of malaria cases in Agboris consequent on solid waste composition.

Table 12: ANOVA

Model	Sum of squares	Df	Mean square	F	T-value	Significance
1. Regression	27398.461	6	4566.410	12.945	5.99	0.657
Residual	4833.039	1	4833.039			
Total	32231.500	7				

Predictor: bottles, tin can, papers, plastic, food items, cellophane

Dependent variable: malaria

Therefore, since the calculated value (12.945) is greater than table value (5.99) at $P < 0.05$ from the ANOVA statistics, we therefore reject the null hypothesis and accept the alternative hypothesis that there is significant relationship between solid waste composition and human health in Agbor. This means that the rate of solid waste composition has contributed to the occurrence of malaria in Agbor.

Table 13: Descriptive Statistics for Solid Waste Composition of Typhoid Cases

Comment [I52]: Table not reflected in text of paper.

	Mean	Standard deviation	N
Typhoid	1661.1250	160.30457	8
Cellophane	12.2712	3.33349	8
Food items	141.9013	9.76137	8
Plastic	10.9675	2.09184	8
Papers	12.6625	4.56239	8
Tin can	11.6713	3.63672	8
Bottles	9.7900	3.09718	8

Table 14: Correlations of Solid Waste Composition of Typhoid Cases

Comment [I53]: Table not reflected in text of paper and earlier comments should apply in all cases here.

	Typhoid	Cellophane	Food items	Plastic	Papers	Tin can	Bottles
Pearson correlation typhoid	1.000	0.071	0.800	0.308	-0.277	0.765	0.025
Cellophane	0.071	1.000	0.464	0.592	0.013	0.150	0.699
Food items	0.800	0.464	1.000	0.341	-0.348	0.709	0.409
Plastic	0.308	0.592	0.341	1.000	-0.362	0.271	0.778
Papers	-0.277	0.013	-0.348	0.362	1.000	-0.126	0.346
Tin can	0.765	-0.150	0.709	0.271	0.126	1.000	0.250
Bottles	0.025	0.699	0.409	0.778	0.346	0.250	1.000

Cellophane has a mean of 12.2712, standard deviation of 3.33349 and a correlation of 0.071 (7.1%) with typhoid, food items have a mean of 141.9013, standard deviation of 9.76137 and a correlation of 0.800 (80%) with typhoid. Plastic has a mean of 10.9675, standard deviation of 2.09183 and a correlation of (-0.277) with typhoid. Tin can have a mean of 11.6713, standard

deviation of 3.63672 and a correlation of 0.765 (76.5%) with typhoid. Bottle have a mean of 9.7900, standard deviation of 3.09718 and a correlation of 0.025 (2.5%) with typhoid.

Table 15: Model Summary

Model	R	R square	Adjusted R square	Standard error of estimate	Durbin waston
1	0.993	0.986	0.905	49. 42790	3.126

Predictor: bottles, tin can, papers, plastic, food items, cellophane

Dependent variable: malaria: typhoid

From the model summary, Table 15, the R^2 of 0.986 indicates that 98.6% of typhoid cases in Agbor results from solid waste composition.

The 98.6% of typhoid cases in Agbor that is consequent on solid waste composition is due to the dependent of the sampled areas of Baleke, Umudein and Edike on the Orogodo River or Yi – Ekpon for water used domestically. Some residents in these areas even drink the river water. The issue here is that the heaps of solid wastes dumped in the drains up – town, wash down into the river when it rains.

Table 16: ANOVA

Model	Sum of squares	Df	Mean square	F	T-value	Significance
1. Regression	177439.788	6	29573.293	12.105	5.99	0.217
Residual	2443.117	1	2443,117			
Total	**179882.875**	**7**				

From the ANOVA table, Table 16, the calculated value, F=12.105, is greater than our table of 5.99 at $P < 0.05$. The null hypothesis is rejected and the alternative hypothesis accepted, meaning that there is significant relationship between solid waste composition and human health is Agbor. This means that solid waste composition has contributed to occurrence of typhoid fever in Agbor.

Hypothesis 2:

It states that there is no significant effect of solid waste management on human health.

Table 17: Data for Hypothesis 2

Disposal	Disposal	Disposal	Landfill	Open	Disposal at	Malaria	Typhoid

water front	at street drain	at road side		burning	collection point		
0.00	210.00	124.00	4.00	82.00	205.00	1802.00	1811.00
0.00	199.00	112.00	1.00	10.00	213.00	1799.00	1824.00
0.00	187.00	100.00	2.00	99.00	237.00	1811.00	1834.00
0.00	214.00	60.00	18.00	92.00	200.00	1792.00	1718.00
27.00	313.00	41.00	8.00	87.00	149.00	1712.00	1625.00
121.00	209.00	83.00	13.00	99.00	100.00	11689.00	1541.00
45.00	204.00	32.00	11.00	134.00	199.00	1626.00	1529.00
0.00	218.00	14.00	3.00	178.00	212.000	1711.00	1407.00
-	-	-	-	-	-	1692.00	1411.00
-	-	-	-	-	-	1649.00	1396.00
-	-	-	-	-	-	1682.00	1305.00
-	-	-	-	-	-	1617.00	1310.00
-	-	-	-	-	-	1658.00	1256.00
-	-	-	-	-	-	1729.00	1245.00
-	-	-	-	-	-	1590.00	1195.00

Table 18: Descriptive Statistics for Solid Waste Management on Malaria Cases

	Mean	Standard deviation	N
Malaria	1742.7500	67.85647	8
Disposal on water front	24.1250	42.65957	8
Disposal on street drains	219.2500	39.08142	8
Disposal on road side	70.7500	40.11679	8
Landfill	7.500	6.07101	8
Open burning	108.8750	32.00195	8
Disposal at point collection	189.3750	43.76214	8

Table 19: Correlations of Solid Waste Management on Malaria Cases

	Malaria	Disposal on water front	Disposal on street drains	Disposal in road side	Landfill	Open burring	Disposal at point of collection
Pearson correlation malaria	1.000	-0.621	-0.251	0.710	-0.350	-0.495	0.492
Disposal on water front	-0.621	1.000	0.052	-0.089	0.461	-0.069	-0.878
Disposal on street drain	-0.251	0.052	1.000	-0.407	0.138	-0.181	-0.439
Disposal on road side	0.710	-0.089	-0.407	1.000	-0.326	-0.698	0.125
Landfill	-0.350	0.461	0.138	-0.326	1.000	-0.191	-0.505
Open burning	-0.495	-0.069	-0.181	-0.698	-0.191	1.000	0.234

Disposal at point of collection	0.492	-0.878	-0.439	0.125	-0.505	0.234	1.000

Solid waste disposal on waterfront has the mean of 24.1250, standard deviation of 42.65957 and a correlation of (-0.621) with malaria. Disposal on street drains has the mean of 219.2500 and standard deviation of 39.08142 and a correlation of (-0.251) with malaria. Disposal on road side has the mean of 70.7500, standard deviation of 40.11679 and a correlation of (0.710) with 40.11679 and a correlation of 7.500, standard deviation of 6.07101 and a correlation of (-0.350) with malaria. Open burning has a mean of 108.8750, standard deviation of 32.00195 and a correlation of (-0.495) with malaria. Disposal at point of collection has a mean of 189.3750, standard deviation of 43.76214 and a correlation of (0.492) with malaria.

Table 20: Model Summary

Model	R	R square	Adjusted R square	Standard error of estimate	Durbin watson
1	0.987	0.973	0.813	29. 34982	3.185

Predictor: disposal point of collection, disposal on road side, disposal on street drains, landfill, disposal at water front, open burning.
Dependent variable: malaria

From the model summary, Table 20, R^s of 0.973 indicates that 97.3% of malaria cases in Agbor are consequent on solid waste management.

Table 21: ANOVA

Model	Sum of squares	Df	Mean square	F	T-value	Significance
1. Regression	31370.088	6	5228.348	6. 070	5.99	-0.301
Residual	861.412	1	861.412			
Total	**32231.500**	**7**				

From the ANOVA table, Table 21, the calculated value F = 6.070 is greater than the table value of 5.99 at P < 0.05. The null hypothesis is therefore rejected and the alternative hypothesis accepted. This means that there is significant effect of solid waste management on human health in Agbor. This shows that the waste management practices have contributed to the growth of malaria.

Table 22: Descriptive Statistics for Solid Waste Management on Typhoid Cases

	Mean	Std deviation	N
Typhoid	1661.1250	160.30567	8

Disposal on water front	24.1250	42.65957	8
Disposal on street drains	219.2500	39.08142	8
Disposal on road side	70.7500	40.11679	8
Landfill	7.5000	6.07101	8
Open burning	108.8750	32.00195	8
Disposal at point collection	189.3750	43.76214	8

Table 23: Correlation of Solid Waste Management on Typhoid

	Typhoid	**Disposal on water front**	**Disposal on street drains**	**Disposal on road side**	**Landfill**	**Open burring**	**Disposal at point of collection**
Pearson correlation typhoid	1.000	-0.448	-0.237	0.851	-0.284	-0.753	0.411
Disposal on water front	-0.448	1.000	0.052	-0.089	0.461	-0.069	-0.878
Disposal on street drain	-0.237	0.052	1.000	-0.407	0.138	-0.181	-0.439
Disposal on road side	0.851	-0.089	-0.407	1.000	-0.326	-0.698	0.125
Landfill	-0.284	0.461	0.138	-0.326	1.000	-0.191	-0.505
Open burning	-0.753	-0.069	-0.181	-0.698	-0.191	1.000	0.234
Disposal at point of collection	0.411	-0.878	-0.439	0.125	-0.505	0.234	1.000

Disposal on waterfront has a mean of 24.1250, standard deviation of 42.65957 and a correlation of (-0.448) with typhoid. Disposal on street drains has the mean of 219.2500, standard deviation of 39.08142 and a correlation of (-0.237) with typhoid. Disposal on roadside has a mean of 70.7500, standard deviation of 40.11679 and a correlation of (0.851) with typhoid. Land fill has a mean of 7.500, standard deviation of 6.07101 and a correlation of (-0.284) with typhoid. Open burning has a mean of 108.8750, standard deviation of 32.00195 and correlation of (-0.753) with typhoid. Disposal at point of collection has a mean of 189.3750, standard deviation of 43.76214 and a correlation of (0.411) with typhoid.

Table 24: Model Summary

Model	**R**	**R square**	**Adjusted R square**	**Standard error of estimate**	**Durbin waston**
1	0.998	0.996	0.974	26.01937	3.185

From this model summary table, Table 24, R^s of 0.996 indicates that 99.6% of typhoid cases in Agboris consequent on solid waste management

Table 25: ANOVA

Model	Sum of squares	Df	Mean square	F	T-value	Significance
1. Regression	179205.868	6	29867.645	44.117	5.99	0.115
Residual	677.077	1	677.007			
Total	**179882.875**	**7**				

From the ANOVA table, Table 25, the calculated value F = 44.177 is greater than the table value of 5.99 at P < 0.05. The null hypothesis is rejected and the alternative hypothesis accepted. This means that there is significant effect of solid waste management on human health in Agbor.

PROBLEMS OF EFFECTIVE SOLID WASTE MANAGEMENT IN AGBOR

The result of respondents' perception on the problems militating against effective solid waste management in Agbor is shown in Table 26

Table 26: Respondents' Perception on Problems of Solid Waste Management in Agbor

Sampled areas	Lack of fund	Few labourers	Non challant attitude	Lack of waste bin	No. of respondent
Dr. Whyte	79	51	104	361	625
Charles	60	36	129	400	625
Prof. Ebie	85	52	99	389	625
Mariere	87	33	114	397	625
Baleke	41	57	126	401	625
Umudein	98	30	98	399	625
Edike	77	60	77	411	625
College Junction	55	95	61	414	625
Total	**576**	**444**	**808**	**3172**	**5000**
Percentage	**11.52%**	**8.88%**	**16.16%**	**63.44%**	

Source: Field survey

From Table 26, out of 500 respondents, 11.52% of the respondents are of the opinion that lack of fund is military against the effectiveness of solid waste management. Also 8.88%, 16.16% and 63.44% of the respondents are of the opinion that few labourers, non-challant attitudes and lack of waste respectively are the factors that are militating against effective solid waste management in Agbor.

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RECOMMENDED MEASURES FOR EFFECTIVE SOLID WASTE MANAGEMENT IN AGBOR

To enhance effectiveness in solid waste management in Agbor, the Local Government Authority should subsidize the amount of money paid for the services of private waste managers to enable the populace pay less for effective solid waste disposal system. And as this done, the payment of some part of the salaries of the solid waste disposal personnel should also be considered and implemented. This will make the private solid waste managers to have more man power effectively dispose waste.

The promulgation of punishable laws on the indiscriminate dumping of solid waste will help avoid the dumping of waste waterfront, road side and street drains. Anybody found working should be severely punished without discrimination. The provision of waste bin by the government and other philanthropists will seriously help in effective solid waste management.

Government bodies and non-governmental organization should create seminars, awareness programs and campaign to enlighten the populace on issues of solid reduction, segregation and recycling, and also the solid waste management practices. One-Saturday in a month environmental sanitation exercise should be intensified through law enforcement agencies. And the use of incinerators should be introduced by the government

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Comment [I55]: Insert is before done.

Comment [I56]: Insert at before waterfront.

Comment [I57]: Referencing style should improved on.

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