Assessment of Domestic Wastewater Disposal in Anambra State, South-East Nigeria

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***Abstract*- The study evaluates the generation and disposal of domestic wastewater in ten locations in Awka urban, Anambra State, Nigeria. The study was conducted to identify high domestic wastewater generating sources across the locations and how the generated wastewater is disposed. The result showed that bathing, toilet flushing and cloth washing generated more wastewater. The most used method for toilet and bathroom wastewater disposal is the septic tank/soak-away method, while storm drain/gutter, open land and septic tank/soak-away are mostly used for kitchen wastewater. However, field observations show wastewater from bathrooms are disposed in storm drains in some cases, not minding the health implications. In the light of sustainability, the research recommends the installation of centralized wastewater treatment facility.**

***Keywords*- Domestic wastewater, Domestic wastewater sources, Domestic wastewater disposal, Awka.**

I. INTRODUCTION

Domestic Wastewater Management (DWWM) is one of the many basic strategies for keeping the environment clean and safe for human habitation (Christopher, 2013). Wastewater generated from residential areas should be properly collected, transported, and treated before it is released back into the natural environment or put to a more result oriented use. Domestic wastewater may not be totally a waste as the name may suggest, if it is well managed.

Domestic wastewater derives its name from water containing wastes or water that has already been used for domestic applications. Mara (2003) defined domestic wastewater as the water that has been used by a community and which contains all the materials added to the water during its use. It is thus composed of human body wastes (faeces and urine) together with the water used for flushing toilets, and sullage, which is the wastewater resulting from personal washing, laundry, food preparation and the cleaning of kitchen utensils. According to UNEP (2010), domestic wastewater can be viewed as any water that has been adversely affected in quality by anthropogenic influence arising from domestic residences.

This research defines domestic wastewater as any water from homes (domestic residences) that have been altered chemically, physically or biologically and as a result, is no longer needed or useable (disposed or about to be disposed).

Gallagher (2010) in his study of advanced decentralized wastewater management planning study and demonstration project for the Colorado State University, Foothills Campus, identified domestic wastewater to consist of blackwater (kitchen sink, dish washers, toilets) and greywater sources (hand sinks, baths and showers, cloth washers). According to UN Water (2014), domestic wastewater consists of blackwater (excreta, urine and faecal sludge) and greywater (kitchen and bathing wastewater). In order to effectively quantify water use and wastewater generation in Maiduguri Nigeria, Abba, Badawi, and Kagu (2013) listed sources of domestic wastewater generation as: bathing, washing, food preparation, others e.g. ablution, teeth brushing, body cleaning after using toilet.

Parkinson and Kevin (2003) asserts that increasing populations, combined with increasing water consumption and a proliferation of waterborne sanitation, create widespread domestic wastewater disposal problems. In many cases, wastewater is discharged locally into open ground and vacant plots, creating ponds of foul-smelling stagnant water. Traditionally, domestic wastewater discharge was not a major concern especially for sparsely populated areas. However, the rapid urbanization phenomenon worldwide has caused an increase in population density and activities. Consequently this resulted in increased stresses on the natural environment. The discharge of insufficiently treated domestic wastewater is threatening the quality of the environment to the extent that it is no longer acceptable to dispose wastewater without concern for environment (Refsgaard, 2001). One of the major causes of pollution is the discharge of untreated domestic wastewater into water bodies. Nabegu (2010), Aboyeji (2013) and Ezeabasili, Okoro, and Okonkwo, (2014) showed that domestic wastewater can adversely pollute ground and surface water, and affect aquatic ecosystem. Ezeabasili et al (2014) attributed domestic wastewater to be one of the major causes of ground water pollution in Awka, Anambra State.

Domestic wastewater management (or the lack thereof) has a direct impact on the biological diversity of aquatic ecosystems disrupting the fundamental integrity of our life support systems, on which a wide range of sectors, from urban development to food production and industry, depend (UN Water, 2014). It is essential that domestic wastewater management be considered and integrated into the full life cycle, functional eco-system based management system that operates across all three dimensions of Sustainable

Development (social, economic and environmental dimensions).

II. MATERIALS AND METHODS

Awka is the capital of Anambra state. Awka is geographically located between latitudes 6°06` N and 6°15` N and longitudes 7°05'E and 7°15'E. Awka urban centre which is located in Awka South local government area is bounded by Awka North to the north, Njikoka to the West, Anaocha to the South and Oji River in Enugu State to the East. Awka is the seat of power and capital of Anambra State, Nigeria. The population of Awka was stated as 189, 654 thousand (96, 902 males and 92, 752 females) in the Nigerian National Population Census of 2006. Using the Anambra state official growth rate of 2.83 percent as the projection measure, the population projection for 2018 will be 265, 390 thousand people. According to Ezenwaji, Enete, Okafor, and Awopeju (2015), Awka urban has both clustered and scattered settlement patterns.

The researchers adopted a survey pattern of design for the study. Data for the study were collected from primary and secondary sources. Primary data were collected by use of a structured questionnaire from respondents. A structured questionnaire of four hundred copies (400) was coded according to location and administered by the researchers in ten urban communities of Awka Anambra state (the communities are: Agulu-Awka, Amaku, Amenyi, Amikwo, Ezioka, Ifite, Nkwelle-Awka, Temp site, Umudioka, and Umuokpu.). Forty copies were purposively administered in each of the ten locations, out of the four hundred copies of questionnaire administered; three hundred and ninety seven (397) were retrieved. The questionnaire contained questions on quantity of domestic wastewater generation and disposal points for toilet, bathroom and kitchen wastewater. At the end of the data collection process, all the codes and their corresponding data were entered into the master sheet according to location.

The qualitative data from the structured questionnaire were summed and converted to quantitative data. Conversion of qualitative data to quantitative data enabled further analysis of the generated data. The difference in quantity of wastewater generation was analyzed using Kruskal Wallis and post hoc test. Kruskal Wallis was used to determine variance while post hoc revealed the disparity in the variance in the variance of wastewater generation. The various methods of disposing wastewater was analyzed using post hoc test as well.

III. RESULTS AND DISCUSSION

Table 1: Demographic Factors of Respondents

S/N	Factors		Frequency	Percentages
1	Gender	Male	148	37.3%
		Female	249	62.7%
		Total	**397**	100%
2	Marital Status	Single	216	54.4%
		Married	181	45.6%
		Separated	0	0%
		Divorced	0	0%
		Total	**397**	100%
3	Educational Qualification			
		Primary	60	15.1%
		Secondary	172	43.3%
		Graduate	149	37.5%
		Post Graduate	12	3.0%
		Total	**393**	98.9%
4	Years Resident			
		1-3	122	30.7%
		4-6	88	22.2%
		7-9	50	12.6%
		10+	121	30.5%
		Total	**381**	95.9%

Source: Field Survey, 2019

Domestic Wastewater Generation

The research used five wastewater generating source from the domestic front (i.e. bathing, toilet flushing, food preparation, cloth washing and house cleaning) based on the study of Abba (2013). First we sort to determine if there exist differences in the amount of wastewater being generated from the sources, following which the significant wastewater generating sources were identified.

Table 2: Data for difference in quantity/volume of wastewater generation from each location of study

S/N	***Locations***	**1 Bathing**	**2 Toilet flushing**	**3 Food preparation**	**4 Cloth washing**	**5 House cleaning**
1	**Amikwo**	27	27	23	39	20
2	**Ifite**	38	23	9	33	0
3	**Umudioka**	10	25	7	28	12
4	**Umuokpu**	34	20	13	35	8
5	**Nkwelle**	29	10	7	32	9
6	**Amaku**	6	15	18	27	12
7	**Ezioka**	21	9	5	15	0
8	**Temp. Site**	36	25	9	36	9
9	**Amenyi**	27	26	9	13	8
10	**Agulu**	19	13	10	32	0

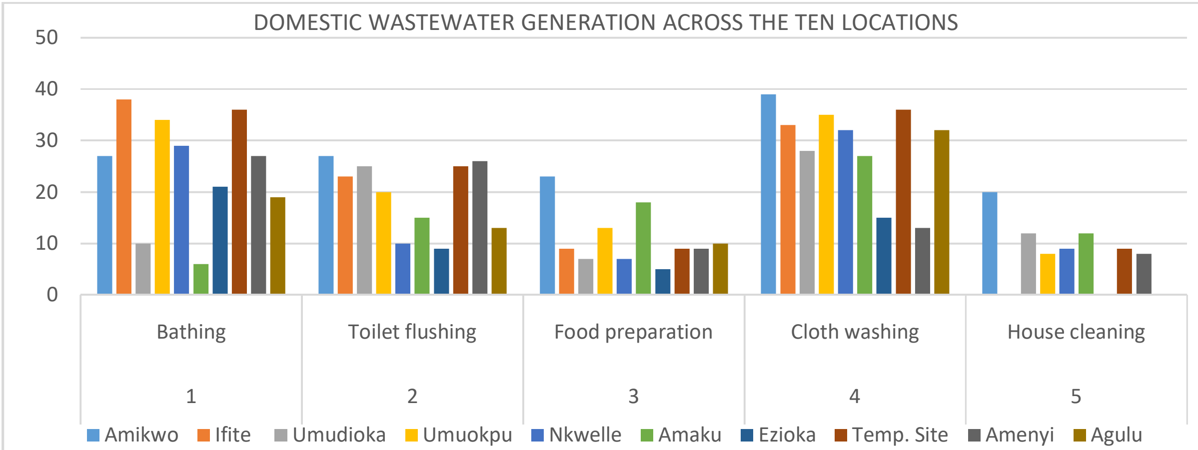

Figure 1: Difference in domestic wastewater generation across the ten locations of study

Result output for test of difference in quantity among the sources of domestic wastewater using Kruskal-Wallis test

Kruskal-Wallis Test on obs

factors	N	Median	Ave Rank	Z
1	10	27.000	33.6	1.98
2	10	21.500	27.6	0.50
3	10	9.000	15.1	-2.52
4	10	32.000	39.6	3.43
5	10	8.500	11.6	-3.38
Overall	50		25.5	

H = 26.99 DF = 4 P = 0.000

H = 27.08 DF = 4 P = 0.000 (adjusted for ties)

The result shows that there is significant difference in the rate of domestic wastewater generation since the P-value is less than 0.05.

To determine the most prevailing domestic wastewater generating source across all ten locations together, post hoc test was used.

Table 3: Post Hoc tests for most prevailing domestic wastewater generating source

Multiple Comparisons

Obs
LSD

(I) factors	(J) factors	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	5.40000	3.52124	.132	-1.6921	12.4921
	3.00	13.70000*	3.52124	.000	6.6079	20.7921
	4.00	-4.30000	3.52124	.228	-11.3921	2.7921
	5.00	16.90000*	3.52124	.000	9.8079	23.9921
2.00	1.00	-5.40000	3.52124	.132	-12.4921	1.6921
	3.00	8.30000*	3.52124	.023	1.2079	15.3921
	4.00	-9.70000*	3.52124	.008	-16.7921	-2.6079
	5.00	11.50000*	3.52124	.002	4.4079	18.5921
3.00	1.00	-13.70000*	3.52124	.000	-20.7921	-6.6079
	2.00	-8.30000*	3.52124	.023	-15.3921	-1.2079
	4.00	-18.00000*	3.52124	.000	-25.0921	-10.9079
	5.00	3.20000	3.52124	.368	-3.8921	10.2921
4.00	1.00	4.30000	3.52124	.228	-2.7921	11.3921
	2.00	9.70000*	3.52124	.008	2.6079	16.7921
	3.00	18.00000*	3.52124	.000	10.9079	25.0921
	5.00	21.20000*	3.52124	.000	14.1079	28.2921
5.00	1.00	-16.90000*	3.52124	.000	-23.9921	-9.8079
	2.00	-11.50000*	3.52124	.002	-18.5921	-4.4079
	3.00	-3.20000	3.52124	.368	-10.2921	3.8921
	4.00	-21.20000*	3.52124	.000	-28.2921	-14.1079

*. The mean difference is significant at the 0.05 level.

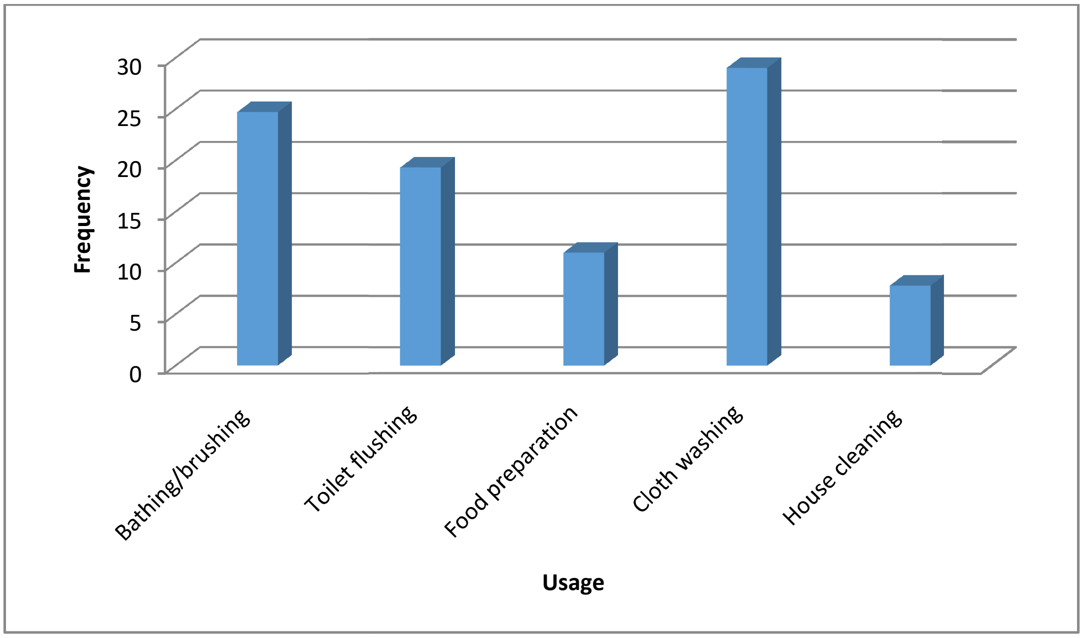

Figure 2: Most prevailing domestic wastewater generating source

Interpretation

The least among the sources in terms of quantity of wastewater generation is house cleaning and the source with the highest volume is cloth washing according to the respondents from the selected communities.

From the post hoc table 2 bathing/teeth brushing (1), toilet flushing (2), and cloth washing (4) are not significantly different while food preparation/washing of utensils (3) and house cleaning (5) are not significantly different in terms of quantity of wastewater generation. Abba et al (2013) also showed that bathing and washing generated higher volume of domestic wastewater in Maiduguri.

Domestic wastewater disposal

This objective looks at the preferred domestic wastewater disposal method for toilet, bathroom and kitchen wastewater in the study area put together.

Table 4: Preferred channel for **toilet** wastewater disposal

S/N	Response	Frequency	Percentage distribution	Remark
1	Storm drain/gutter	6	1.54	Low
2	Open land	0	0	Low
3	Septic tank/soak away	372	95.63	High
4	Open pit	3	0.77	Low
5	River/stream	0	0	Low
6	Self-owned treatment plant	0	0	Low
7	Centralized treatment plant	0	0	Low
8	Don't know	0	0	Low
9	Others	8	2.06	Low
		389	100%	

From Table 4 the highly rated option is Septic tank/Soak away, which implies the frequently used method for disposing toilet wastewater among the respondents is Septic tank/Soak away method.

Table 5: Preferred channel for **bathroom** wastewater disposal

S/N	Response	Frequency	Percentage distribution	Remark
1	Storm drain/gutter	45	11.69	Low
2	Open land	30	7.79	Low
3	Septic tank/soak away	297	77.14	High
4	Open pit	9	2.34	Low
5	River/stream	0	0	Low
6	Self-owned treatment plant	0	0	Low
7	Centralized treatment plant	0	0	Low
8	Don't know	4	1.04	Low
9	Others	0	0	Low
		385	100%	

The highly rated option is Septic tank/Soak away which implies the frequently used method among the respondents is Septic tank/Soak away. However, field observation showed that the storm drain/gutter and open land method are also in use for disposing wastewater from the bathroom (Plates 1 to 4 show some of the field observations). From Table 5, Storm drain/gutter and open land disposal follows the soak away method although with a wide margin. These methods are unsustainable and can lead to negative feedbacks in the system.

Plate 1: Pipes disposing bathroom waste into open land in John Nwogbo Street, Ifite.

Plate 2: Wastewater being disposed into open land in Eke Ejike Street, Aroma.

Plate 3: Disposing bathroom waste into open land in Andy Umeoji Street, Aroma.

Plate 4: Bathroom disposing wastewater directly into storm drain in Ezioka, Awka.

Table 6: Preferred channel for **Kitchen** wastewater disposal

S/N	Response	Frequency	Percentage distribution	Remark
1	Storm drain/gutter	95	22.84	High
2	Open land	126	30.29	High
3	Septic tank/soak away	191	45.91	High
4	Open pit	0	0	Low
5	River/stream	0	0	Low
6	Self-owned treatment plant	0	0	Low
7	Centralized treatment plant	0	0	Low
8	Don't know	4	0.96	Low
9	Others	0	0	Low
		412	100%	

The highly rated options are storm drain/gutter, open land and Septic tank/Soak away methods but the frequently used method among the respondents is Septic tank/Soak away.
To test for significant difference generally among the methods.

This was determined using test of significant difference among the methods Kruskal-Wallis test with Post Hoc at 5% level of significance.

After using Kruskal Wallis test to analyse difference in domestic wastewater disposal methods, the result obtained showed that the P-value is less than 0.05. This is therefore enough evidence to conclude that method of wastewater disposal differs in Awka urban, and they include septic tank/soak away method, storm drain/gutter disposal method, and open land disposal methods.

To identify the most preferred method among the different methods in use in the study area, Post hoc and bar graph is used to analyse and present the result respectively.

Table 7: Post Hoc Tests table for most preferred method of disposal **Multiple Comparisons**

(I) factors	(J) factors	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	.60000	.42947	.167	-.2582	1.4582
	3.00	-36.60000*	.42947	.000	-37.4582	-35.7418
	4.00	.30000	.42947	.487	-.5582	1.1582
	5.00	.60000	.42947	.167	-.2582	1.4582
	6.00	.60000	.42947	.167	-.2582	1.4582
	7.00	.60000	.42947	.167	-.2582	1.4582
2.00	1.00	-.60000	.42947	.167	-1.4582	.2582
	3.00	-37.20000*	.42947	.000	-38.0582	-36.3418
	4.00	-.30000	.42947	.487	-1.1582	.5582
	5.00	.00000	.42947	1.000	-.8582	.8582
	6.00	.00000	.42947	1.000	-.8582	.8582
	7.00	.00000	.42947	1.000	-.8582	.8582
3.00	1.00	36.60000*	.42947	.000	35.7418	37.4582
	2.00	37.20000*	.42947	.000	36.3418	38.0582
	4.00	36.90000*	.42947	.000	36.0418	37.7582
	5.00	37.20000*	.42947	.000	36.3418	38.0582
	6.00	37.20000*	.42947	.000	36.3418	38.0582
	7.00	37.20000*	.42947	.000	36.3418	38.0582
4.00	1.00	-.30000	.42947	.487	-1.1582	.5582
	2.00	.30000	.42947	.487	-.5582	1.1582
	3.00	-36.90000*	.42947	.000	-37.7582	-36.0418
	5.00	.30000	.42947	.487	-.5582	1.1582
	6.00	.30000	.42947	.487	-.5582	1.1582
	7.00	.30000	.42947	.487	-.5582	1.1582
5.00	1.00	-.60000	.42947	.167	-1.4582	.2582
	2.00	.00000	.42947	1.000	-.8582	.8582
	3.00	-37.20000*	.42947	.000	-38.0582	-36.3418
	4.00	-.30000	.42947	.487	-1.1582	.5582
	6.00	.00000	.42947	1.000	-.8582	.8582
	7.00	.00000	.42947	1.000	-.8582	.8582
6.00	1.00	-.60000	.42947	.167	-1.4582	.2582
	2.00	.00000	.42947	1.000	-.8582	.8582
	3.00	-37.20000*	.42947	.000	-38.0582	-36.3418
	4.00	-.30000	.42947	.487	-1.1582	.5582
	5.00	.00000	.42947	1.000	-.8582	.8582
	7.00	.00000	.42947	1.000	-.8582	.8582
7.00	1.00	-.60000	.42947	.167	-1.4582	.2582
	2.00	.00000	.42947	1.000	-.8582	.8582
	3.00	-37.20000*	.42947	.000	-38.0582	-36.3418
	4.00	-.30000	.42947	.487	-1.1582	.5582
	5.00	.00000	.42947	1.000	-.8582	.8582
	6.00	.00000	.42947	1.000	-.8582	.8582

*. The mean difference is significant at the 0.05 level.

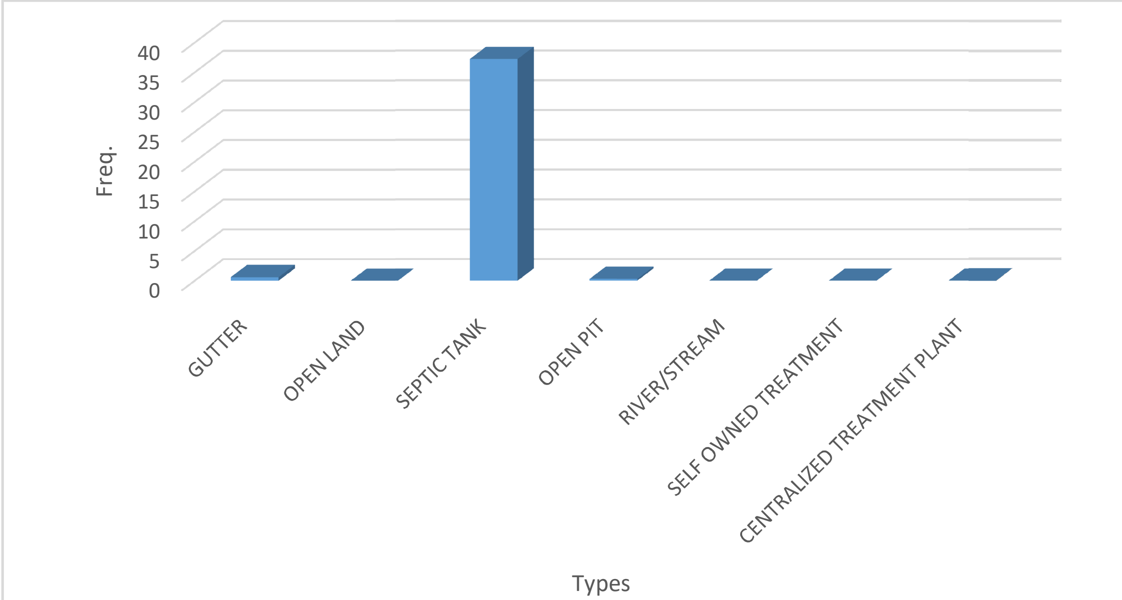

Figure 3: Bar graph for most preferred method of domestic wastewater disposal.

The bar graph and the Post Hoc test show that method 3 is the prevailing method which is septic tank/soak away method. The result in Figure 3 also show that no self-owned mini-treatment plant or central domestic wastewater treatment plant is installed or in use in the study area. Jhansi and Mishra (2013) stated that in most developing countries, a large population do not have access to domestic wastewater facilities. Idris-Nda et al (2013) research conducted in Minna Niger State Nigeria showed that domestic wastewater management in that area consist of the use of septic tanks and other unplanned methods. In the course of this research, it was discovered that the septic tank/soak away method of domestic wastewater disposal is not an end by itself but a means to an end. This is so because the interview and field observation showed that when the soak away gets filled, the services of soak away evacuators are employed for the final disposal of the waste.

Plates 5 and 6 show the kind of evacuation equipment and the method of final disposal used by the evacuators in Awka respectively. From Plate 6 it can be said that this method of disposal is unsustainable and can easily seep into water sources as reported elsewhere by Dhameja (2006), Nabegu (2010), Aboyeji (2013) and Ezeabasili et al (2014). Nwabineli's (2014) work discovered that the Imoka River and IyiAgu stream were recharged by a polluted aquifer. This method of wastewater disposal may not be unconnected with such pollution.

Plate 5: Evacuation equipment preparing for evacuation in Nodu, Okpuno.

Plate 6: Evacuation truck disposing wastewater openly in AguAwka

IV. CONCLUSION

From the findings of the study, it is evident some form of improper disposal of domestic wastewater still exist in the area. Domestic wastewater disposal in the area consists of the use of septic tanks, and other means involving direct disposal into the environment.Wastewater evacuated from filled septic tanks are transferred and openly discharged. The open disposal of domestic wastewater shows that government regulations on wastewater management are not effective. These by implication shows that government have not been doing much in terms of implementing regulations on effluent discharge.Abba et al (2013) made an assertion on human health consequences by stating that “open disposal of wastewater provides convenient ground for breeding germs, disease vectors and an eye sore with offensive odour”. Wastewater that is directed to the environment is the prime breeding sites for mosquitoes, houseflies, rodents, and other vectors of communicable diseases such as dysentery, diarrhoea and so on. The study recommends that wastewater disposal should be far from water sources and residential areas, a better option will require installation of centralized wastewater treatment plant.

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