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An Investigation Into Faecal Sludge Management In Onitsha Urban Area Nigeria

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I. INTRODUCTION

Poor Feacal Sludge Management (FSM) has been one of the foremost environmental problems in most urban areas of Nigeria. Despite this acknowledgement which is well known, there has consistently been veritable practices of poor management of FSM in these urban areas, preventing safe and commercially viable FSM services by both urban and Local Government Authorities. The survey by WHO-UNICEF Joint Monitoring Program (JMP) showed that 29 percent of Nigerians were using sanitation technologies considered to be safe while 71 percent of others daily use unsafe sanitation facilities (Fed. Ministry of Water Resources, 2018). However, quite recently the outcome of the national routine map of WASH services in Nigeria clearly revealed that only 44 percent of the Nigerian populations have guaranteed access to basic sanitation services (NBS, 2019). Within this broad discovery of somewhat below average performance is masked still the worsening situation of fecal sludge management in our urban areas. Prevalent statistics indicate that open defecation continues to pose a great and intractable challenge in the country. Data collected from recent survey of WASH situation in Nigeria show that a large population of about 48 million people still practice open defecation which represents a large percentage of 23% of the national population (Bevan, 2021). This record has now placed Nigeria as the country with the highest open defecation practice. The large population of 48 million that practice open defecation results in serious negative health consequences especially among the vulnerable population especially the children, the physically challenged and the poor (Kale, 2018). It is in this realization that the Federal Republic of Nigeria through a Presidential Initiative launched the National open defecation roadmap, followed by the National Action Plan for Revitalization of the Nigerian WASH and declared a state of emergency on the sector (FGN, 2018) to address this obvious gap in our sanitation service delivery. Unfortunately, since 2018 when this programme was launched, there has been stunted progress in the sector resulting only in marginal gains (Gray, 2021). Following from this effort, a national sanitation campaign was equally launched known as *clean Nigeria: use the toilet* to address and tackle the open defecation problem in the Country.

The problem of open defecation which has been the feature of many urban areas of Nigeria indicates a very poor fecal sludge management practice as apart from a section of Lagos and Abuja urban areas no urban area in Nigeria can surely boast of a piped sewer network. The understanding that a prohibitive cost is involved in setting up the network which most of our States do not have, has forced them to adopt a ready option of developing an effective FSM systems which ensures a clear plan for the safe collection, transportation, treatment and disposal of fecal sludge from pit latrine, septic tanks and other on-site sanitation facilities (Strunde, et-al 2014 and WB, 2017). To ensure the improvement of on-site sanitation facilities in the Nigeria urban communities, the World Bank is already piloting services in Port Harcourt and other Southern cities which are already yielding good fruits (Agagbo, 2022). Lagos is on its way to the adoption of structured plan for the proper management of fecal sludge that will result in improved sanitation services in the urban area which will invariably promote and expand the economic and environmental benefits of the city.

In some other urban areas, only marginal efforts have been recorded in addressing this challenge. For example, in Owerri, no definite management plan has been adopted for FSM as about 40 percent of fecal sludge find their way into the water bodies around the city mainly in urban rivers of Otamiri and Nworie (Ezekwe, Odubo, Odubo and Akosa, 2011). Furthermore, in Akure, Ondo State of Nigeria manual emptying involving use of spade, shovel to scope the FS are still the dominant emptying option (Rotowa and Ayadi, 2020), while in Yobe State of Nigeria, the same poor management of FS has remained as majority of the people in the urban areas of the State dispose their FS by landfill, a very rudimentary management method (Karkarna & Adama, 2021).

In totality, the same poor management system is seen being practiced across many urban areas of Nigeria. In this wise, Onitsha urban area is not an exception, but manifests one of the worst FS management system in the country. Nkasah (2015) noted that this unwholesome management practice has resulted in poor health to many citizens of the urban area as a result of its associated environmental pollution problems. Some of which arise from many inhabitants inability to empty their pit latrines and or septic tanks when they are filled. This is very common in the city especially in middle and low income areas such as Odoakpu and Fegge districts, as well as, Okpoko slum area. The emptying in the city is often carried out by private companies with some of them lacking in the use of appropriate equipment and expertise to handle it. There are cases in the town where the available equipment breakdown always as could be found in cases of transport machines and evacuation vehicles. Again poor road network which is made worse by the construction of unapproved street stores with shanty materials hamper the free movement of the emptying vehicles to remote locations added to the poor condition of the roads themselves. These limit prompt evacuation of sludge from the filled toilets or other on-site containers. The result of all these show that mere provision of these on-plot latrines by households do not guarantee total sanitation unless there is a means to regularly empty them. Failure to carryout regular emptying often results in indiscriminate dumping of the FS in unauthorized locations which gives rise to poor health and environmental problems that gives rise to water pollution from $E-Coli$ materials and other associated transmission of diseases and infections that adversely affect a major part of the Onitsha urban population. Recent studies of the state of sanitation in urban area indicate that sanitation related diseases constitute about 70 percent of diseases that afflict the populace (Okere, 2022). Some of the diseases that are common in Onitsha urban area are cholera, typhoid, dysentery, malaria, diarrhea or their combination thereof. Igibah, Agashua and Sadiq (2018) in a study on the impacts of poor septic sludge management techniques in Nigeria noted that most of the diseases from these ailments afflict mainly children below 5 years. In a study of Onitsha, Orji, Okoli and Ezenwaji (2015) found that poor sanitation of the town which is largely as a result of poor FS management manifested in high open defecation practices, consumption of suspected FS polluted water and unwholesome wastes disposal system resulting in high incidence of diarrhea disease found largely among children aged between 0 and 4 years. The study concluded that despite the great wealth being generated in the city as a result of huge commercial activities daily taking place, provision of adequate sanitation through proper FS management is essentially lacking thus sanitation associated diseases still remain on the increase in the urban area and the fact that the management of fecal sludge in the area is yet to attain the required basic level of service is a source of worry. This, therefore, necessitates a close examination of the state of on-site sanitation in the urban area with a view to ascertaining its present poor situation and the reason why it has remained so despite its much published adverse effect on the health of the inhabitants with a view for appropriate solution to be proffered. This forms the focus this paper.

II. MATERIALS AND METHODS

Area of Study

Onitsha is one of the three urban areas of Anambra State (Fig. 1).

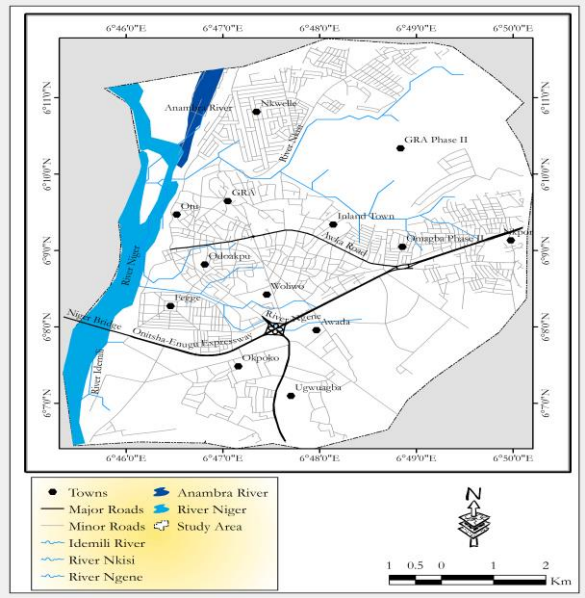


Fig. 1: Map of Onitsha Urban Area showing districts

It is the largest urban area in South East region of Nigeria in terms of population and commercial activities and prides itself as the commercial centre of the State and indeed South East Nigeria. Other urban areas in the State are Awka which is the administrative centre being the capital of the State and Nnewi, the industrial town. Onitsha is located at the western part of the State, at the gateway to the east and at the eastern bank of the river Niger. It is bound by $latitudes\ 6^0 60^1\ and\ 6^0.12^1 N\ and\ longitudes\ 6^0.45^1\ and\ 6^0.50^{11} E$. With an estimated area of about 69sqkm (Fig. 1) (Anambra State Physical Planning Board, 2019). Its geographical area has increased as a result of high rate of urbanization that has since spread to its neighboring communities.

Geology, Relief and Drainage

The main geological feature of the urban area is the Bende – Ameki formation which has its lateral facies equivalent to the Nanka formation. The formation ensures adequate underground water replenishment. Generally, the formation has the average water table to depth of about 122m (Ofomata, 1975).

In terms of topography, the town has generally a gentle topography, that slopes from Army barracks in the east to the river Niger in the west, although some uplands can be found around Trans-Nkisi and 3-3 areas, as well as, in Awada district.

The hydrology of the town shows that it is drained by three major rivers namely; river Niger, Nkisi river that drains the old Akpaka forest reserve in the northern parts of the town and Idemili river that traverses Okpoko low income district in the south from where it passes through the East Niger Industrial Harbor before it empties into the river Niger.

Onitsha is located in the transition zone between the tropical Monsoon climate and the tropical savanna climate. There are two main seasons – the wet and the dry seasons. The 40 year rainfall statistics of the town (1977 – 2016) is 1817mm with some of the years recording slightly higher or lower departure from this mean (Ezenwaji, 2018). Howeve,r annual rainfall averages about 1850mm (UN-Habitat, 2012) and usually starts in early March and ends towards the end of November thus indicating seven months duration, while the remaining three months (December, January and February) experience dry weather. Temperature of the town averages between $23℃\ and\ 27℃$ with the month of March experiencing the hottest weather. Relative Humidity is equally high ranging from 70 percent to 80 percent with the highest value being recorded between June and October, which is during the heart of the rainy season. The vegetation of Onitsha is the tropical high forest which is still seen along the banks of the water channels especially in the guinea savanna (derived savanna) environment and around the locations of ancient shrines. However, severe urbanization of the town and its environ has resulted in the rapid clearing of the original high forests even in some of these outliers with some areas turning into veritable derived Savanna.

The population of the town according to the 2006 Census figure is 256,941 but Anambra State government has questioned the veracity of the figure reasoning that it is grossly underrepresented stating that the 2022 population of town should be above 1,000,000 (Anambra State Government, 2022). However, our projection of the population of the urban area, as well as, the already engulfed neighbouring LGAs, using the 2006 figure as the base, as well as, parts of other neighbouring LGAs is 1,188,166.

Onitsha covers a total land area of 68.72sqkms of which about 42.90sqkm or 62 percent of the land are completely built up.

Presidential Structure of Onitsha

Onitsha has eight principal districts namely Fegge, Omagba, Woliwo, Odoakpu, GRA, Awada, Inland Town, Okpoko. The original districts included in Onitsha legal city are the above outlined ones except Okpoko that was recently included into the city as a result of the rapid spread of urbanization. Details of the districts are as follows;

Fegge

Fegge is located at the south western part of the town. Right from its establishment in 1940s, it was a planned area with laid-out grid pattern of roads. The ward is an outlying business area with about two housing estates. Most of the houses are bungalows which are now a shadow of their former beauty. The district has moved from modern estate to a slum as water supply is very scarce while houses and road network are old and dilapidated. Pit latrines and WCs connected to the septic tanks are two main on-site sanitation facilities.

Omagba

Omagba is a comparatively new settlement which came into being after the Nigerian Civil War in 1970. With the construction of the Enugu-Onitsha expressway which provides a good access to the area, the layout has expanded eastwards into Nkpor. The newly established settlement from this expansion is named Omagba Phase II to differentiate it from the initial layout. The ward is a middle income residential area whose

special feature is its large numbers of mainly three-storey blocks of modern flats. The houses operate largely with WCs which are connected to septic tanks. The inhabitants rely on wells and water vendors for their water supply.

Woliwo

This district is located at the south-eastern part of the town. It has three and four-storey buildings most of them are now dilapidated. The ward suffers from overcrowding (average density 6.2 persons per room). There is an absence of adequate water drainage system which makes the streets to be flooded each time it rains. Water supply is very scarce as inhabitants rely on water vendors. Basic sanitation is equally low as the environment is dotted with unkempt septic tanks, most of which are filled and overflowing.

GRA

The Government Reservation Area (GRA) is located in the northern part of the town, close to the Nkisi River and Nkisi forest reserve. The GRA is a high income low density residential area and has modern houses interspersing the old colonial bungalows. Each compound here is normally large in size with lawns and adequate water supply. Most households rely on boreholes from where they provided their own water, while sanitation is not quite good, despite the high socioeconomic status of many heads of households in the area.

Inland Town

This is the original settlement of the indigenes of the town. It has a large population, greater percentage of which are natives of Onitsha and encompasses Otu ward near the market area. The district is crowded with old bungalows and has an average occupancy ratio of 5.7 persons per room. Like other districts, water supply and sanitation have issues of scarcity and extreme poor delivery. Almost 40% of the households here rely on on-site sanitation especially pit latrine infrastructure while the rest use either improved pit toilets or WCs.

Odoakpu

Odoakpu like Fegge, is an old layout in the central parts of Onitsha. Originally, the ward was planned as a middle income residential area, but has now turned into a low income residential area with slum features. It suffers from very poor water supply like others as over 90% of the residents rely on shallow wells for their domestic water need as well as poor FS management (Ezenwaji, 2015, 2016) and water from this source has been found to be of a very poor quality (Ezenwaji, 2012, Anyaeche, 2014 and Okoye, 2014). This is in addition to the fact that the quantity which households collect continues to be below requirement. About 60% of the households use pit latrines, 30% make use of WCs, while 5% adopt other on-site sanitation technologies another 5% practice open defecation (Obijeme, 2015).

Okpoko

Okpoko district is located in the south eastern part of Onitsha. It is a highly density area in terms of population with very poor dwelling units. Water scarcity is too severe as about 80% of them rely on nearby Idemili River for their domestic water need. 20% of the remainder obtain their domestic water supply from shallow wells most of which are located very close to either septic tanks or soak-away pits. In terms of sanitation, about 40% of them practice open defecation, 55% pit latrine and 5% WCs. Most of these on-site sanitation technologies are overstretched as some toilets which were observed during fieldwork have filled up to the brim with some of them overflow without emptying.

Awada

Awada is located on the high elevation south of the town. It has a boarder with Ugwuagba district and has modern homes built in flats, although most of them have become dilapidated owing to poor maintenance. Room occupancy ratio here is in the region of 4.0. Water supply like in other parts of the town is in great shortage, while WC connected to septic tank is their main on-site sanitation facility.

Data Collection

Five of the six instruments recommended for use by the World Bank for FS study were utilized. These are Household survey, Observation of service providers, Transect Walk, Focus Group Discussion (FGD) and key informants interviews. Only the result of the testing of FS characteristics was not used because we have left it for the next paper which follows after because of its prime importance in determining the characteristics of the sludge materials along the FS service chain. This determination is important because it will help us to ascertain the best removal method and the type of protective materials that can be employed for effective FS

management. Again it will equally help to ascertain how FS can be transported and treated after removal in addition to the assessment of its resource value to determine its final product.

The result of the instruments deployed is very important because when it is used in the FS value chain it will show clearly the value to be obtained from different stages of the FS value chain with the aim of addressing both health and environmental challenges of the urban area when FS services are delivered (Medland et-al, 2016).

Deployment of the Instruments

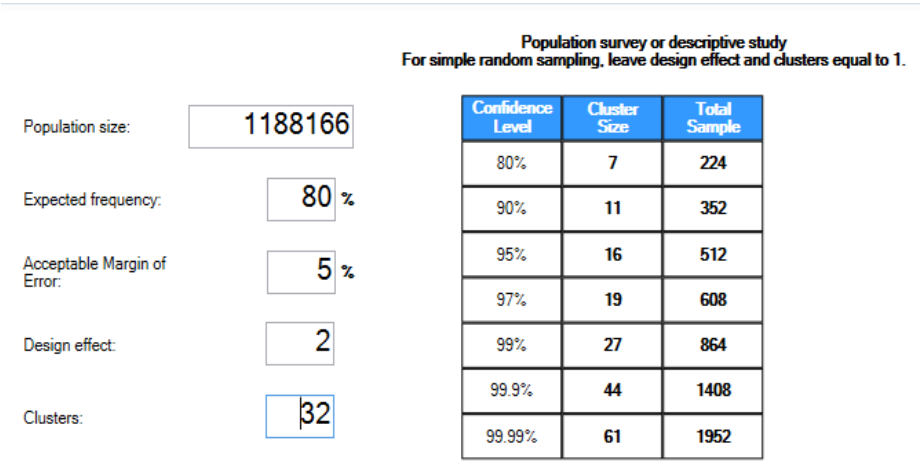
The methodology, sampling procedure and field work for each of the five instruments utilized are discussed here to enable us understand the extent of FS problem in Onitsha urban area.

Households Survey (HS)

The main aim of this survey is to gather relevant information from the inhabitants of the households that make use of on-site sanitation in the entire city especially how they make use of FS services and what they desire for future FS services. The questionnaire which we employed as a tool to achieve this was adapted from the World Bank format to suit our objectives and the prevailing urban situation. Eight enumerators were hired with each administering and collecting the questionnaire.

Methodology of the HS Instrument

The study adopted a diagnostic research design whereby key elements or the root factors determining the status of FSM in Onitsha are identified, evaluated and solution provided. A cluster survey was adopted that cover all settlements (meaning that only city wide survey was carried out). The smallest unit of sampling frame is the Primary Sampling Units (PSUs) which is also known as 'urban blocks'. The sample size was defined based on the population of Onitsha (projected population for 2023). The World Bank recommended accepted minimum number of cluster surveys of 30 for the Household Survey was utilized. Thus, the first sampling approach of adopting at least 30 PSUs from the entire city based on existing districts in the urban area was chosen. The actual size of clusters or PSUs was determined through a power calculation using Epilnfo statistical software developed by the US Centre for Disease Control and Prevention (CDC). The population size of the urban area, the expected frequency, adopted margin of error, the cluster size and the number of clusters are shown in Table 1.



However, based on the fact that the study placed premium on representativeness across the city of Onitsha, confidence level of 95 percent was selected and this translates to 16 households per PSU which gives an overall sample size of 512. The study area was divided into 8 strata or clusters representing the eight major districts in Onitsha urban area with each cluster representing a PSU. A total of eight enumerators were engaged for each of the eight clusters and the sampling of the households was done using random walk.

Fieldwork

As already stated, eight (8) enumerators were hired, which was limited to that number considering the cost. With 8 clusters and each enumerator assigned to a cluster, two days were spent in collecting necessary data from the field. The fieldwork was undertaken between 3rd and 4th July, 2022.

Observation of Service Providers

This tool was employed to validate the reliability of information obtained from related studies in developing countries. We made clear observations of service providers practices from containment to final disposal site in order to determine possible risks at every point of the service chain. We employed structured observation to ascertain environmental challenges (risks) that result from the adopted procedure, as well as, the nature of the equipment utilized and action taken by stakeholders in handling the entire gamut of the FS service chain.

Methodology

We developed a checklist that helped us to identify the major risks involved with practices along the entire FS service chain. We visited the service providers mostly during emptying. In order to handle this most efficiently, we employed identification code for the locations and districts. Important information namely; the name of the urban area, PSU, the coordinates, the day of visit and name of service providers interviewed were all in the checklist. Finally, our results were transferred into the excel spread sheet which was used for the analysis.

Sampling

We recorded observation in eight separate locations in the urban area taking cognizance of the FS service chain using purposive sampling. This is a group of non probability sampling in which samples are selected because they have the characteristics we needed to carry out the research. In employing this technique, we sampled service providers and ensured that our observation concedes with only households with pit latrines or other types of containment technology considering the timing and locations which were agreed on before the visit.

Fieldwork

Fieldwork under this instrument was carried out with two members of the team who are mainly sanitation workers in the State and local government areas in Onitsha urban. Two quality control officers were also recruited to confirm the report of the sanitation workers. All workers engaged used protective clothing and other protective tools during the fieldwork.

Transect Walk

This is the third instrument employed and under it we engaged methodology, sampling and fieldwork to achieve the purpose of the instrument for this research to make an observation and record necessary findings. The information gathered from this tool was so helpful that it assisted the data collected from the household questionnaire. The main objective of this tool is to determine the broad environmental risks to public health in the urban area.

Methodology

Male and female members of the team living in each district were engaged. All routes agreed by the team members were representative of the PSUs. In addition, all information obtained were carefully summarized and necessary classifications of what is observed recorded.

Sampling

A total of 50 transect walks were carried out within the period covering all our PSUs.

Fieldwork

The fieldwork was carried out for one week (July 11 to 17, 2022) using this tool. Result obtained were employed to substantiate the one obtained from household survey.

Key Informant Interviews (KIIs)

We utilized this tool to determine the effects of the enabling environment and the operating environment on FSM services. We employed this tool again to clarify the interest of each stakeholder and assist further data collection.

Methodology

Only stakeholders who have interest in sludge services in the city were engaged and they are the five local government areas in the urban area, service providers, ASWAMA, Ministry of Environment and other agencies that are interested in FSM such as heads of academic institutions and others.

Sampling

Stakeholder mapping activity was carried out before gathering the necessary information from them. We carried out 28 interviews to obtain all the required information from these stakeholders. The stakeholders selected for interview were representative of all who were engaged for the interview. Purposive sampling technique was employed.

Fieldwork

The fieldwork was carried out for four days 11th to 14th July 2022 under an experienced sanitation officer employed to interview the Local Government Chairmen of the Component Local Government areas that make up the urban area, the Hon. Commissioner for Environment in Anambra State, Chairman of Anambra State Waste Management Authority, Director Environmental Health, Anambra State, service providers at Nkwelle Ezunaka liquid waste dumpsite and Environmental Health officers in the relevant Local Government Areas. At the end of the exercise, information obtained were crosschecked for authenticity from neutral persons such as some academics at Nnamdi Azikiwe University Awka and Chukwuemeka Odumegwu Ojukwu University Igbariam, some media practitioners and some members of the Civil Society Organizations.

Focus Group Discussions (FGD)

FGD was employed in this research to further obtain more information, some of which will enable us to validate or question the answers we received from respondents during household survey. We focused on how households manage their fecal sludge, what interventions have been made and associated risks regarding FSM services that affect the urban community.

Methodology

FGD questions were developed by us. They were adapted from those of the World Bank and tailored them to our local situation using appropriate language. Teams who were involved in the formation of the questions were those who facilitated the discussions.

Sampling

Ten FGDs were constituted from 10 randomly selected PSUs in Onitsha urban area. As much as possible, we selected clearly homogeneous groups especially Landlord Associations, Women groups in the district, households using shared toilet, those using only pit latrines, those using septic tanks and so on.

Fieldwork

During the house survey we were able to identify groups listed under sampling. Letters were written to them to allow us to visit them on a stated date. When we visited them, our discussions lasted for about one hour so as not to allow the interest of the participants to run out. Most discussions were in Igbo language which is the local language of the groups after which it was translated to English Language.

Results and Discussions

The survey was carried out with five research methods developed by the World Bank as already discussed. The result is presented in Table 2.

Table 2: Sanitation Facility by Technology

Sanitation Facility by Technology	City Wide	
	No. of Households	Percentage
Automatic astern Flush	55	10.7
Pour/Manual Flush	150	29.3
Ventilated Improve Pit Latrine	35	6.8
Pit Latrine with slab	52	10.2
Pit Latrine without slab/open pit	120	23.4
Composting toilet	0	0
Bucket	22	4.4
Hanging toilet/hanging toilet	0	0
Open defecation	78	15.2
Others	0	0
	512	**100**

The result is based on city wide survey. Table 2 shows the type of containment systems for Onitsha, the mode of use of these facilities and how their usage vary across the city, as well as, the management of black water or where toilets discharge. As can be seen from Table 2, the percentage of people using each technology are outlined thus; pour/manual flush toilet system (29.3%). The automatic flush cistern which is quite similar to

the pour/manual system was reported to be in use by 10.7% of the households. Slightly improved latrine (pit latrine with slab and adequately ventilated) yielded 6.8% of the household who use it while pit latrine without slab yielded 23.4 percent. The report on the usage of latrine is dominant in the districts located close to or at the city centre and as high as 15.2% of households still practice open defecation.

A cross sectional review of the city wide data revealed further internal structure of the data as obtained from different districts of Onitsha urban area. Table 3 shows the variations in the type of sanitation facility used by households per district. It is evident that latrine technology is a common feature in Awada (54.6 percent), while pit latrine without slab is common in Okpoko (22.8 percent). Bucket and open defecation are equally very common in Okpoko with Bucket technology having 18.6 percent of the responses and open defecation as high as 44.5 percent. No district practice hanging toilet. An important observation is that 58.6 percent use automatic cistern flush technology in GRA which is quite expected while 1.5 percent make use of that technology in Okpoko.

Table 3: District Based Sanitation Facility by Technology

Sanitation Facility by Technology	Otu %	Odoapku %	Fegge %	Okpoko %	Awada %	GRA %	Woliwo %	Omagba %
Automatic astern flush	5.9	10.5	5.6	1.5	11.1	58.6	4.2	6.7
Pour/Manual flush	70.5	47.6	44.4	7.5	62.8	39.5	67.8	65.3
VIP latrine	5.4	14.2	7.2	1.2	10.6	11.3	8.6	5.9
Pit latrine with slab	2.3	24.6	10.3	3.9.	6.2	0.0	9.2	19.8
Pit latrine without slab/open pit	7.4	7.9	20.3	22.8	8.9	0.0	2.7	1.6
Composting toilet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bucket	1.8	0.0	1.6	18.6	0.0	0.0	0.0	0.0
Hanging toilet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open defecation	6.8	2.8	10.6	44.5	10.4	0.8	7.5	0.7
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Also Table 4 below reveals that 48.8 percent of the households use facilities considered to be shared while 39.5 percent of the households use completely private sanitation technology. 10.2 percent of the people use off-plot communal facility and only 1.5 percent utilize off plot private sanitation facility. The number using shared sanitation facilities is that high given the closeness between the numbers of households having private on-plot facility. All these facilities whether shared or private across the city are on site (non sewered). It is equally important to note that the quality and maintenance of shared facilities in certain areas of the city are not always be adequate.

Table 4: City Wide Usage of Sanitation Facility

Use of Facility	No. of Household	Percentage
On plot – Household Private	202	39.5
On plot – Shared	250	48.8
Off plot – Communal	52	10.2
Off plot – Public	8	1.5
	512	**100**

Furthermore, Table 5 gives a more detailed outlook on the sanitation facility used in various districts of the city. It clearly reveals that 84.0 percent of households in GRA reported using privately owned sanitation facility. A similar high percentage use was evident in Woliwo (77.8 percent) and Omagba (73.2 percent). Majority of the districts recorded lower than fifty percent in this facility except Awada with 60.6 percent. It is shown that high percentage response was obtained on On-plot shared facility from Okpoko (75.0 percent), Otu (70.6 percent) and Odoakpu (65.7 percent). None of the districts recorded up to 20 percent in off plot communal and off plot public facility.

Table 5: District Based use of Sanitation Facility

	Otu	Odoapku	Fegge	Okpoko	Awada	GRA	Woliwo	Omagba
On plot Household Private	14.3	20.8	33.8	5.0	60.6	84.0	77.8	73.2
On plot-Shared	70.6	65.7	46.9	75.0	25.4	14.8	18.2	24.8
Off Plot-Communal	6.5	10.5	10.5	15.0	10.9	1.0	3.0	1.5
Off plot-Public	8.6	3.0	8.8	5.0	3.1	0.2	1.0	0.5

Furthermore, the question of where the contents of toilets go after flushing is vital for depicting in more detail the type of sanitation and containment systems in the citywide survey. This is important knowing the FSM arrangements for shared facilities are likely to be different from those of privately – operated facilities from a management perspective. In a shared scenario, the accountability for dealing with filled or blocked pits is essentially lacking. Sometimes individual emptying introduce high risk in the compound because the shit is often unintentionally spilled in the environment during removal and transfer from the pit or septic tank to the truck. In our discussion during the focus group session, participants recognized that manual means of emptying poses a lot of health danger as the shits are mostly discharged into water bodies with only a very few discharged to safe point. The need for manual removal often arises as a result of high cost of engaging mechanical emptiers and almost always that the trucks do not come for the removal when households call them, which results in the overflowing of the pit or the septic tank.

During transportation of the fecal sludge it was noted by participants during the focus group discussion that the use of local trucks especially those not adapted for sludge transport usually splash sludge along the road. In parts of Okpoko and Otu such is a daily occurrence and this poses very high risk to the Community. Again the problem with disposal location being experienced with manual emptying is equally seen as some of them empty into nearby bush or pond while the majority empty into the water bodies.

Fecal Waste Flow Diagram for Citywide Situation in Onitsha Urban Area

Fecal waste flow diagram, also known by some authorities as shit flow diagram (SFD) is a presentation of the visual pathway of how fecal sludge flows along the sanitation service chain viz; containment, emptying transportation, treatment and reuse. However most flows in developing countries do not get to treatment and reuse stages. The flow identifies the percentage of fecal waste that is not effectively managed to the next stage of the service chain. However, when fecal waste is well managed along the service chain we term that FSM as 'safe'. When the proportion of fecal waste is not well managed along the same chain we then say it is unsafe like when it is channeled into ponds, canals, surface water bodies or even in an open bare land environment. The fecal waste flow diagram for Onitsha is presented in Fig. 2

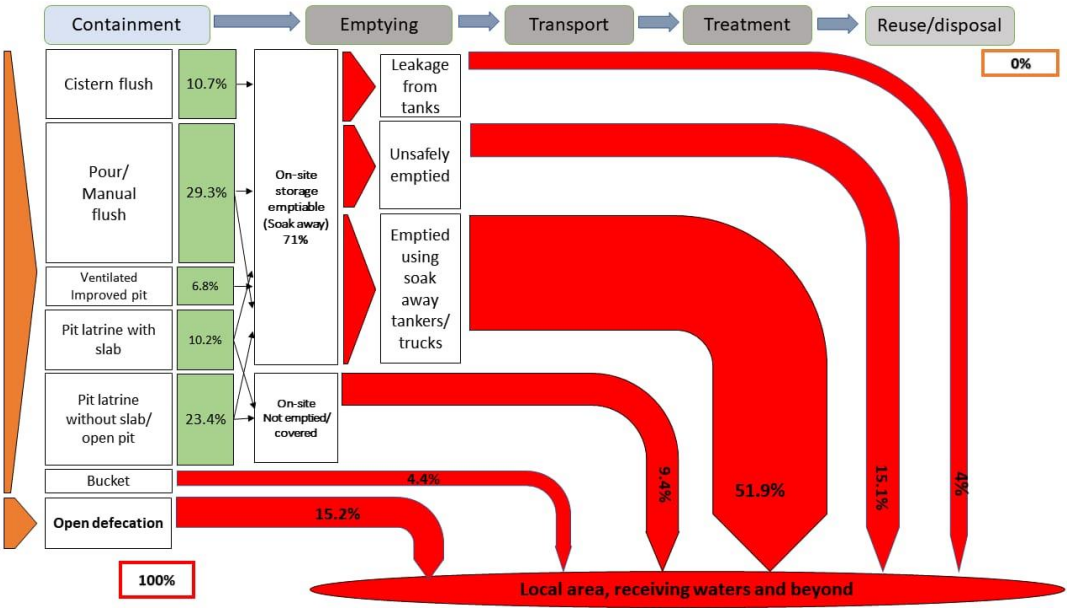


Fig. 2: Waste flow diagram for Onitsha

From Fig. 2, it could be seen that the fecal waste flow diagram for the citywide situation in Onitsha urban area resembles what is seen in slum areas of some cities in Africa and South East Asia. Ross, Scott and Ravikumar (2016) in their study of fecal sludge management in Dhaka, Bangladesh outlined the source of containment in the slum areas of Dhaka as well as percentage of people that patronize them as pour flush, (46%) pit latrine with slab, (36%) pit latrine without slab (6%) and hanging toilet (12%). In Onitsha urban area a similar situation exists not in the slum settlement, but in the entire city, the type of containment and the percentage of people using them are; cistern flush (10.7 percent), pour/manual flush (29.3 percent), ventilated improved pit (6.8 percent), pit latrine with slab (10.2 percent), pit latrine without slab/open pit (23.4 percent), Bucket (4.4 percent) and open defecation (15.2 percent). Overall improved on-site storage facilities that can be emptied constitute (57.0 percent), while unimproved on-site storage facilities are patronized by a whopping 43.0

percent of the people which is translated into 510, 911 persons in the urban area, while those with improved on-site facility are 677, 255 persons. During emptying, we gathered during the house survey, focus group discussion and transect walk that even these improved on-site facilities suffer from one of these problems or their combinations thereof; leakage from tanks (4 percent) unsafely emptied (15.1 percent), emptied using soak-away tankers/trucks (51.9 percent). All the fecal sludge end in the environment polluting it and resulting in the affliction of the populace by numerous water borne diseases. According to Adamu (2022) 60 percent of all diseases in the developing nations of the world are water borne.

It is however, very important to note that in Onitsha urban area, all the fecal sludge from all the existing containment technology ends in the water bodies, drains or in nearby bushes. This, thus, means that the aecal sludge that begins containment collection ends in transportation stage, while the remaining two stages (treatment and reuse) are subsequently not attained.

The issue of the completion of sanitation chain in the management of fecal sludge in Onitsha urban should be given a serious thought otherwise very soon the entire urban area and even neighbouring settlements may be engulfed in serious epidemic from one of the known water borne diseases such diarrhea, typhoid, dysentery, cholera, malaria and many others. This therefore, calls for serious efforts to ensure that the fecal sludge collected from source are well treated, reused and those that cannot be used safely disposed.

Ezenwaji (2018) analyzed the use of a range of techniques for siting appropriate FS dumpsite and treatment plant. He assessed the regional model for appropriate siting (Fernandez, Kishen, & Vogel, 2008), use of material flow analysis approach, as well as, life cycle assessment evaluation in systems analysis model of waste water systems (Jeppson and Hellstorm, 2002) and finally statistical technique of centrographic analysis used by Zwanga (2015). After assessing the techniques, he found that all these techniques fell short of the engagement of all the spatial attributes of a region for ensuring appropriate and a clear site determination. He therefore, employed the use of GIS technique and determined the appropriate site for the location of FS dump and treatment site in Onitsha urban area. The site chosen should be easily accessible by road, have a clear distance from any nearby water body, be gentle slope, be away from existing residential areas and separated from flood prone area.

Fecal Sludge Situation in Onitsha in the Context of JMP Service Ladder for Monitoring of Sanitation

To portray the level of fecal sludge situation in terms of performance in Onitsha urban area we assessed it within the context of the JMP sanitation ladder for the monitoring of sanitation service under the SDGs. The sanitation service level is the construct of the WHO/UNICEF JMP and was used to categorize sanitation performance of an area into five namely; safely managed, basic, limited, unimproved and open defecation. In Onitsha improved fecal sludge sanitation technology is used by 57.0 percent of the households. These are automatic cistern flush (10.7 percent); pour/manual flush (29.3 percent), ventilated improved pit latrine (6.8 percent) and pit latrine with slab (10.2 percent). However the percentage of households utilizing the unimproved sanitation is as high as 43 percent segregated as follows; pit latrine without slab/open pit (23.4 percent), bucket system (4.4 percent) and open defecation (15.2 percent). In our citywide usage of sanitation facility (Fig. 3), we saw that 39.5 percent of on-plot households use private technology, 48.8 percent use on-plot shared, while 10.2 percent of the households use off-plot communal (i.e. the facility built outside the house) and 1.5 percent use off-plot public. From all these, it could be concluded that 60.5 percent of the households use unimproved facility. This, when translated into the WHO/UNICEF JMP service ladder for monitoring sanitation specifically the use of fecal sludge technology in Onitsha urban area the following picture is revealed (Table 6).

Table 6: Sanitation Service Ladder for Onitsha

Open Defecation	Unimproved Sanitation	Limited Sanitation	Basic Sanitation	Safely Managed Sanitation
15.2 percent	27.8 percent	10.2 percent	36.1 percent	10.7 percent
36, 120 Households OR 180, 601 persons	66, 062 Households OR 330, 310 persons	24, 239 Households OR 121, 195 persons	85, 786 Households OR 428, 930 persons	25, 427 Households OR 127, 135 persons
Fecal is disposed in the open (fields forests, bushes, open water bodies)	Fecal is not separated from human contact as a result of use of pit latrine without slab	Latrine is shared by 2 or more households. It is functional and accessible	Latrine that is not shared by households. It is functional and accessible.	Improved latrine. It is private functional, and accessible.

From Table 6, it could be seen that the population of Onitsha urban which is 1,188,166 was reduced to households by applying the World Banks household population size of 5 for developing countries. This translates to 237,633 households which was used to determine the number of households in each sanitation ladder. The sanitation ladder presented revealed that Onitsha urban area is clearly dirty.

III. CONCLUSION

Poor fecal sludge management is visibly one of the greatest environment problems in the developing countries. In many urban areas of Nigeria, there is no sewerage connection, forcing a great majority to depend on on-site sanitation technology while still a large population practice open defecation.

This study has interrogated this problem in Onitsha urban area one of the foremost commercial centres in Nigeria with a large population

Various research instruments used have been wildly utilized in many developing countries of the world. The results obtained revealed that there is still a big fecal sludge management challenge in Onitsha which needs to be dealt with. The Waste Flow Diagram (WFD) shows that almost all the fecal wastes end up in the open water bodies, gutters, and bare ground, a situation that has dealt with the health of the populace.

Placing the fecal waste situation in Onitsha into the WHO/UNICEF JMP ladder, revealed that the town can greatly be placed on the unimproved and open defecation rung of the sanitation ladder. This means that a lot has to be done to ensure that the goal of attaining unfettered access to sanitation as contained in the SDG 6.2 is achieved.

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