Household Practice Of Domestic Wastewater Management: Comparative Analysis Of Two Urban Neighbourhoods In Suleja, Nigeria

Abdul-azeez Bashirat Mustapha [1], Mohd Hisham Rasidi [2], Ismail Said [2]

Abstract— Water is essential for human survival, its daily use for human activities generates significant quantities of wastewater globally. Growing rates of urbanisation, population and living standards are expected to increase the volume of wastewater generated in the future. Hence, the 6th objective of the Sustainable Development Goal (SDG) agenda aims to improve wastewater management. Following the relocation of Nigeria's capital from Lagos to Abuja, the satellite town of Suleja began to witness uncontrollable development with pressures on its social infrastructure. Furthermore, the lack of sustainable systems has exacerbated domestic wastewater management in Suleja. Therefore, this study comparatively examined the household wastewater sources and management practices in Madalla and Bakin Iku areas of Suleja town in Nigeria. The influence of socio-demographics, educational background, household size, and monthly income on domestic wastewater management practices was examined. The study data were collected through Primary and Secondary sources comprising field survey and questionnaires. The results revealed that Madalla is an unplanned area, whereas Bakin Iku is partially planned. Four sources of water, namely; borehole, tap, water vendor and well water, were identified. The findings showed that 46.5% of Madalla residents' source water mainly from tap water compared to 50% in Bakin Iku. The areas examined lacks proper sewage system and plants for domestic wastewater treatment. Alternatively, residents primarily utilise soakaways for on-site wastewater treatment and disposal resulting into groundwater quality deterioration along with health concerns. The findings provide significant evidence for the need to address the myriad environmental problems posed by poor wastewater disposal and management.

Index Terms—Domestic Wastewater, Household Practice, Urban Planning, Urban neighborhood, Wastewater Management,

1 INTRODUCTION

The growing rates of urbanisation and lifestyle changes have increased the volume of wastewater generated around the world. Wastewater, if untreated, could severely impact on the immediate environment and freshwater bodies (Saad, Byrne, & Drechselcess, 2017). The quest to achieve the sixth (6th) Sustainable Development Goal (SDG), which targets improved wastewater management, has put immense pressure on most developing countries. Besides, factors such as inadequate urban infrastructural planning and lack of sustainable systems for the management of the increasing volumes of domestic wastewater produced are at the heart crises in Nigeria. Furthermore, most towns at the boundary with capital cities, where most Adhoc workers reside, lack adequate infrastructure for wastewater treatment. Hence, the wastewater generated is directly discharged into the environment without any form of treatment, posing severe risks to human health, safety, and the environment. Due to increasing rural-urban migration, the pressure on land and social infrastructure in urban neighbourhoods have intensified, over the years. As a result, numerous informal settlements have emerged on the fringes of urban areas to cater to inhabitants lacking adequate social provisions (Dumouchel, 2016). However, inefficient planning has resulted in poor drainage, onsite sewage, and open sewage, which pose significant threats to the adjacent human settlements. Kone & Doulaye, (2010) asserted that most urban settlements lack adequate facilities for disposing of wastewater. Therefore, the current urban wastewater policy including the limitations of conventional sanitary systems, better understanding of natural principles gained in previous decades, and societal goals for achieving sustainable development need reconsideration (Nabegu & Baba, 2014). For several reasons, these challenges are multi-faced and must be addressed through proper urban neighbourhood planning (OMOLAWAL & SHITTU, 2016). Urban planning involves the design and regulation of the use of space. Typically, it emphasises the economic functions, physical forms, and social impacts of the urban environment along with the location of different activities within it (Corburn, 2017). Since urban planning draws upon architectural, engineering, social and political concerns, it involves the political will, public participation, and instructional discipline. Urban planning is concerned with the development of open land and the revitalisation of existing parts of a city (Huseynov, 2011). Poor urban planning, in the face of rapid urbanisation and improper domestic wastewater management, is regarded as one of the major problems facing many urban areas in Nigeria (Mustapha & Al, 2017; Nabegu & Baba, 2014; Idris-Nda et al., 2013). Human beings generate waste while performing the daily activities required maintaining means of livelihood and making life more comfortable. Wastewater generated has a severe adverse effect on mankind and the environment (Eme & Izueke, 2013). The transformation agenda of the Federal Government has earned Nigeria the distinction as the largest economy in Africa. As a result, the nation has experienced rapid urbanisation and population growth with attendant issues such as poor urban planning and domestic wastewater management (Brown & Chikagbum, 2017). This distress has continued in line with the change of the pattern of urban development and wastewater management system in Nigeria. Hence, virtually all cities in Nigerian except in some areas in Abuja and Lagos use onsite sanitation systems. The onsite system typically consists of a non-sewer household connected to separate tanks (Libralato et al., 2012). In general, the study area in particular, employs very rudimentary individual on-site treatment system, which leads to many different negative consequences. However, in developed countries, wastewater management strategies can be categorised as centralised or decentralised systems, which can be applied to different scales. Centralised wastewater

- *Abdul-azeez Bashirat Mustapha 1, Mohd Hisham Rasidi 2, Ismail Said 2*
- *1, 2,3 Faculty of Built Environment and Survey University Teknologi, Malaysia. (E-mail:bashiratmustapha82@gmail.com, b-hisham@utm.my, ismailbinsaid@gmail.com)*

management consists of integrated sewers that collect wastewater from many wastewater producers such as households, commercial areas, industrial plants and institutions. Subsequently, the wastewater is transported to a central treatment plant at an off-site location outside the settlement (Chirisa, Bandauko, Matamanda, & Mandisvika, 2017). The treated effluent is then disposed of or reused at locations far from the point of origin. The centralised wastewater management approach has been continuously extended to expanding urban areas, particularly in the industrialised countries, throughout the twentieth century. However, the treatment technologies have been developed and adapted over the years to meet the changing needs of the population, public health requirements, and environmental concern. Meanwhile, the most significant disadvantage is that these technologies have markedly higher land area requirements, and thus, only feasible when land is available at suitably low prices (Hophmayer-Tokich, 2006). However, the decentralised treatment approach is mainly defined by the treatment of raw wastewater next to the source (Libralato, Volpi Ghirardini, & Avezzù, 2012b).

2 THE STUDY AREA

The study was carried out in the urban area of Suleja in Nigeria. Suleja is located in Niger State, North Central Nigeria, and lies on Lat. 9°31‟ to 9°56‟ North of the Equator and Longitude 7°58‟ to 8°43‟ East (Figure 1). The town is situated near the boundary between Niger State and the Federal Capital Territory. Hence, it is sometimes considered a city within the Federal Capital Abuja due to proximity. As such, Suleja was initially called Abuja before the Nigerian Government adopted the name from the then Emir Suleiman Bare for its new federal capital in 1976. Besides its proximity to the Nigerian Federal Capital, Suleja is also known for traditional West African pottery (Ladi Kwali Pottery). The leading exponent of this school of pottery was Dr Ladi Kwali, who received universal acclaim for her works, which are on display worldwide.

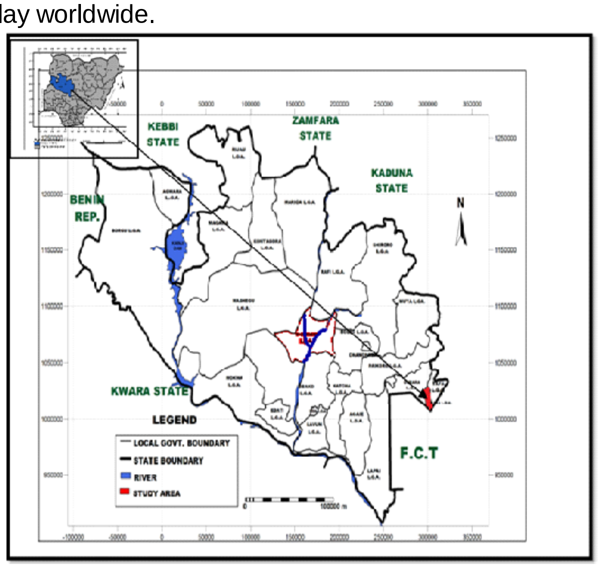

FIGURE 1: LOCATIONAL MAP OF SULEJA (SOURCE: MINISTRY LAND AND HOUSING, MINNA, 2017)

Suleja was chosen as the study area because it is one of the largest in Niger State coupled with its proximity to the Federal Capital Territory. Thus, the city represents others sharing boundaries with larger cities because it inhabits people of different cultures and ethnicities across Nigeria. Until 1976, when the incumbent regime decided to move the nation's capital from Lagos to Abuja, Suleja was mainly a traditional settlement with the typical Hausa-Fulani traditional setup with a well-defined boundary (though not totally in compliance with the city master plan). Due to its predominant ethnic composition, among other reasons, Suleja was not included in the Federal Capital Territory (F.C.T, Abuja) by the Federal Military Government. Despite the exclusion, about 80% (6,400 km^2) of the total area of the FCT was recovered from Suleja. The remaining 20% was from former Keffi and Koton Karfe Local Governments of former Plateau and Kwara States, respectively.

3 GENESIS OF THE DEVELOPMENTAL CHALLENGES OF SULEJA

The primary cause of the apparent uncontrollable developmental challenges in Suleja is the decision not to locate the city within the boundaries of the FCT. Moreover, it could be attributed to the decision to designate it as a satellite town, as was done to other areas. Suleja has been experiencing the serial phenomenon of urbanisation, which is one of the major driving forces for the increase in informal settlements on the boundary of city centres ((Alfred, Makwin U. Gillian, Mike, L., & Justina, 2016). It is now evident that formal approaches to land administration and urban planning control in Suleja have had consequential constraints. Coupled with the nature of the environment and many increases in population since 1982, these constraints have wrapped up in a complicated urban situation. As a result, several urban distresses such as uncontrolled developments and filthy wastewater management practice have become the norm. Numerous analysts (Bloch, 2014; Sawyer, 2014; Falade, 2012; Gandy, 2005) have identified and highlighted some of the underlying causes of informal settlements. The authors identified the absence of strategic planning processes, enforcement and implementation of detailed land use plans are vital factors. Other notable reasons adjudged include; environmental degradation, lack of production and inadequate or absent of urban infrastructure. However, two primary forms of urban developments, informal and formal have emerged, resulting in the current urban domestic wastewater management practice in the study area. Due to limited space and the close arrangement of building structures, individuals within the study area primarily utilise the soakaway system for on-site wastewater treatment and disposal. However, the soakaway systems used for collecting toilet wastewater contaminates the shallow groundwater, which is a vital water source for residents (Ebri et al., 2016). Hence, the faecal contamination of groundwater and the environment through inadequate wastewater management is a significant health concern (Kayembe et al., 2018). Besides, the residents commonly use drainage and footpaths as dumpsites for waste disposal. Consequently, Suleja has been transformed into a giant slum, due to the uncontrolled and unplanned growth of the size and density. Furthermore, the provision of essential urban services such as water and sanitation has virtually collapsed. Besides, factors such as inadequate mobility systems, unplanned peri-urban expansion, and improper waste management practices have become commonplace. The long term effects could exacerbate the effects of natural disasters, risk of vulnerable diseases, environmental degradation, and social conflicts over land resources in urban areas such as Suleja. In principle short, inadequate control of development activities as a result of the obsolete master plan and lack of proper planning for domestic wastewater in the area might have contributed to the deterioration of services such as water supply, sewers, drainage systems and other services. From experience, it is evident that if the FCT were to have moved to any other part of Nigeria, the same fate would have awaited the indigenous population without necessary safeguards and deliberate effort to protect their interest. So many cities are emerging as the engines for the future economy (Riffat, Powell, & Aydin, 2017). While city development is regarded as an opportunity for economic growth; it is also a significant threat to liveability (United Nations, 2013). As the population is increasing, the existing infrastructure is unable to keep up with growing demand from multiple users. Already many cities lack infrastructure for wastewater due to ageing, inadequate or absent of wastewater management systems. As over one-fifth of the global population is expected to be living in urban centres by 2030 (WHO, 2010), there is an urgent need to manage wastewater effectively. It is envisioned that such prudent practices will not only reduce threats to public and environmental health but also create sustainable urban resilience and environmental quality. ll tables and figures will be processed as images. You need to embed the images in the paper itself. Please don't send the images as separate files.

4 METHODOLOGY

The data for this study were collected from both Primary and Secondary sources. A comprehensive field survey was carried out to gather information and access the conditions of different infrastructure such as; wastewater drainages, housing types, access roads and water sources. Next, a well-structured questionnaire was developed, coded, and uploaded to the Open Data Toolkit. The Open Data Kit community provides open-source software for collecting, managing, and using data in resource-constrained environments (Signore, 2016). It allows the collection of data offline, which can then be uploaded when internet connectivity is available. Furthermore, the Open Data Toolkit provides a platform for uploading survey questions to the cloud for access, along with the geographical attributes of the collected data. The toolkit also supports all forms of data collection. Lastly, the interviews were also carried out to elicit information from key stakeholders.

5 SAMPLE FRAME

Two neighbourhoods; Madalla (unplanned) and Bakin Iku (somewhat planned) were selected to represent the entire neighbourhoods in Suleja. The sample frame for the study was the total population of households in the selected neighbourhoods. However, the 2006 National Population Census data available does not capture the neighbourhoods or ward population. Hence, it is difficult to determine the population of the selected neighbourhoods. However, since the study is household-based, a preliminary enumeration of households in the study area was conducted. The total number of buildings enumerated in Bakin Iku is 1,470, while 2,231 buildings were enumerated within the Madalla area. The study area (each neighbourhood) was divided into eight clusters using the road networks. The neighbourhood clusters were subsequently superimposed on the satellite image of the study area to identify the structures within each cluster. Three clusters were randomly selected from each of the neighbourhoods for household enumeration. During the enumeration, the number of residential buildings and the number of household within each building was determined. Next, the percentage of residential building within each cluster and the average number of household in a building were computed. Furthermore, the average percentage of residential buildings in the three selected clusters and the average number of household per building was computed (Table 1). Table 1 revealed that 87% of the buildings enumerated within the three randomly selected clusters were residential buildings, whereas the average household size recorded is 1.39. However, in Madalla, 75% of the buildings are residential with an average size of 3.77 households per building. The recorded results were used to generalise on each of the neighbourhood. The estimated number of residential households within the two neighbourhoods is presented in Table 2. The data shows that the estimated number of households in the study area is 8,085. Bakin Iku has a total of 1,778 households, whereas Madalla has a total of 6,307 households. Therefore, the sample frame for the study is 8,085 households in the selected neighbourhoods.

Table 1: Household enumeration in the selected neighbourhoods

Neighbourhood Cluster	No of Buildings Enumerated	% of Residential Building	Average Household Size
Bakin Iku			
Cluster A	142	87% (124)	1.42
Cluster B	156	83% (129)	1.51
Cluster C	134	91% (122)	1.23
Average	**144**	**87% (125)**	**1.39**
Madalla			
Cluster A	178	79% (141)	3.40
Cluster B	215	74% (159)	4.10
Cluster C	189	73% (138)	3.80
Average	**194**	**75% (146)**	**3.77**

Table 2: Sample frame of the study area

Neighbourhood	Number of Buildings Enumerated (N)	Proportion of Residential Building (P)	Average No of Household/building (H)	Estimated No of Households = N*P*H
Bakin Iku	1470	0.87	1.39	1,778
Madalla	2231	0.75	3.77	6,307
Total	**3701**			**8,085**

6 SAMPLE SIZE

The Krejcie & Morgan (2006) sample size tabulation method was adopted to deduce a representative sample size of the population in the study area. The study arrived at a sample size of 370 at 95% confidence level and a margin error of 5%. To account for any shortfalls due to wrong questionnaire filling or missing results, 10% of the sample size 37 was added to obtain a sample size of 407 households in the study area. The adjusted sample size also includes at least one representative of all the identified groups or organisations within the sample frame of the study for focused group discussions. The sample size of 407 households is distributed according to the proportion of each neighbourhood to the total population of households in the study area (Bakin Iku and Madallaa). Table 3 shows that 90 households were sampled in Bakin Iku and 317 households in Madalla to arrive at a total of 407 households in the study area.

Table 3: Sample size distribution in the study area

Neighbourhood	**% of the total population**	**Sample Size**
Bakin Iku	0.22	90
Madalla	0.78	317
Total	**1.00**	**407**

7 ANALYSIS

The analytical tools employed for this study were descriptive and inferential statistics. Hence, the descriptive statistics employed in the study include; simple frequencies, percentage, mean and standard deviation, along with Analysis of Variance (ANOVA) and Chi-square tests. The descriptive statistics and Chi-square were used to analyse the household wastewater management practices, whereas ANOVA was used to evaluate the variation in wastewater management practices in the Madalla and Bakin Iku areas of Suleja in Niger State. The qualitative data collected from the interview and focused group discussions were analysed through content analysis.

8 Results

The respondents for this study consist of male (73.10%) and female (26.90%) (Table 4). As observed, the male respondents are twice the number of female respondents; this situation can be attributed to the religious and cultural belief of the people who frown at the interaction between married women and men other than their husbands or family members. Therefore, when men are available, women are not expected to welcome visitors. This belief accounts for why households are run by males. The result also shows that more women participated in Bakin Iku (38%) compared to Madalla (23%). This variation may be due to the literacy and exposure of the people in Bakin Iku who are primarily educated. Furthermore, majority of the respondents are married (85%), whereas singles accounted for 7% and others (widows, divorcees) accounted for 7%. This shows that the bulk of wastewater produced is from households with two residents (i.e. husband and wife) on average.

Table 4: Distribution of Respondents in the study area

Variables		**Madalla**		**Bakin Iku**		**Overall**	
		Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Gender	Male	219	77.10	55	62.50	272	73.10
	Female	65	22.90	33	37.50	100	26.90
	Total	284	100.00	88	100.00	372	100
Status	Married	250	88.00	73	83.00	323	86.83
	Single	10	3.50	14	17.00	24	6.50
	Others	24	8.50	0	0.00	24	6.50
	Total	284	100.00	88	100.00	372	100.00

9 RESPONDENTS' SOCIAL-DEMOGRAPHICS

Social-demographic: The data were collected in a continuous form. The level of education was also collected based on the number of years spent in school and was further coded as Primary (6 years and below), Secondary (7 to 12 years), Bachelor degree (13-17 years) and Postgraduate degree (17 years and above). This approach allows for easy and valid data analysis. The respondents in Madalla are closely aged between 49 years and above, whereas Bakin Iku has about half (48.9%) of its respondents aged between 29 and 38 years. Overall, more respondents are within the age of 29 to 38 years compared to other age groups. This shows that the respondents are adults who can easily understand the subject matter and provide useful information for the study. As for the years spent in the neighbourhood, Bakin Iku is a new settlement area. Therefore, most of the respondent have only spent at most 20 years in the neighbourhood; while in Madalla, respondents have spent 31 years and above in the neighbourhood. Generally, most of the respondents have spent between 11 to 30 years in the neighbourhood.

Educational background: The analysis shows that the respondents have spent between 4 and 17 years in school. It implies that the population is comprised of people of different educational statuses ranging from primary school dropouts to persons with college degrees. As observed, the majority of the Madalla respondents have only elementary and secondary education, which account for 94.8%. However, more than half of the respondent in Bakin Iku have at least tertiary education. This shows that there is variation in the education status of the respondents in Madalla and Bakin Iku. This phenomenon could account for the variation in the attitude of the people to wastewater management in the study area (Table 5).

Household size: In Bakin Iku, no respondents have a household size greater than 10. Although most Madalla respondents have households of 1 to 10 persons, there are still households with more than 15 persons. The average household size recorded in the study area is 7.4, which is above the national household size of 6 reported by National Population Census Commission (2006). The average household size in Bakin Iku is 5.4, which is lower than the average national household size, whereas Madalla is 8.1 or above the national average household size. The findings indicate that the Madalla area is more populated than Bakin Iku; hence, more wastewater will be generated in the former.

Monthly income: The minimum monthly income earned by households is below N18,000.00, which is less than the national minimum wage of N18, 000.00 stipulated by the government (Chinwendu & Edet, 2017). The maximum income earned by respondents is above N100,000. As can be observed, the respondents for the study cut across different income groups (low, medium and high), which makes it suitable for a study of this nature.

Table 5: Comparative Study Demographics of the Study Area

Variables	**Frequency (Percentage)**		
	Madalla	**Bakin Iku**	**Overall**
Age group			

19-28years	16 (5.6)	1 (1.1)	17 (4.6)
29-38years	75 (26.4)	43 (48.9)	118 (31.7)
39-48years	67 (23.6)	22 (25.0)	89 (23.9)
49-58years	79 (27.8)	14 (15.9)	93 (25)
59years and above	47 (16.5)	8 (9.1)	55 (14.8)
Years spent in the neighbourhood			
1-10years	49 (17.3)	34 (38.6)	83 (23.5)
11-20years	102 (35.9)	54 (61.4)	156 (41.9)
21-30years	128 (45.1)	0	128 (34.4)
31years above	5 (1.8)	0	5 (1.3)
Level of Education			
Primary	74 (26.1)	11 (12.5)	85 (22.8)
Secondary	195 (68.7)	33 (37.5)	228(61.3)
Bachelor	15 (5.3)	38 (43.2)	53 (14.2)
Postgraduate	0	6 (6.8)	6 (1.6)
Household size			
1-5 persons	79 (27.8)	40 (45.5)	119 (31.9)
6-10persons	127 (44.7)	48 (54.5)	175 (47.0)
11-15 persons	45 (15.8)	0	45 (12.2)
Above 15 persons	33 (11.6)	0	33 (8.9)
Monthly income ('000)			
18 and below			
19-50	64 (22.5)	0	64 (17.2)
51-99	189 (66.5)	30 (34.1)	219 (58.9)
100 and above	23 (8.1)	47 (53.4)	70 (18.8)
	8 (2.8)	11 (12.5)	19 (5.1)

However, the average monthly income of the respondents in Madalla is low relative to Bakin Iku. The findings also showed that half of the respondents in Madalla earn between N19,000 and N50,000 monthly, while over half (66.5%) of respondents in Bakin Iku earn from N51,000 to N99,000. In general, 58.9% of the total respondents earn between N19,000 and N50,000, while 18.8% earn between N51,000 and N99,000 and lastly, 5.1% earn N100,000 and above. This could account for the reason why most households in Suleja cannot afford private wastewater management facilities. Consequently, the study area can be categorised as a low-income settlement.

10 HOUSEHOLD WASTEWATER MANAGEMENT PRACTICES

Water is a necessity for human survival. However, its various uses typically lead to the generation of wastewater. To further discuss household domestic wastewater management, the sources of water in the two sample sites were evaluated. Hence, four sources of water were identified, namely; borehole, tap, water vendor and well water. Next, the water sources at the two sample sites were comparatively evaluated as presented in Table 6. The findings showed that 29.6% of all households sampled in Madalla source water from a borehole, 46.5% from tap water, 21.4% from well water and lastly 2.5% from water vendors. As deduced, half of the sampled households in Bakin Iku source water from taps, whereas 27.3% and 22.7% are from borehole water and well water, respectively. Based on the findings, the computed chi-square *p*-value is 0.472, which is higher than the 0.005 threshold. Hence, there is no significant difference between the sources of water in Madalla and Bakin Iku areas of Suleja. Therefore, the primary source of water in Suleja is tap water provided by the Water Board Authority. Thus, there is an abundant supply of water in the study area except during the dry season, when the most consistent and convenient source is from water vendors.

Table 6: Sources of water

Sources of water	**Madalla**	**Bakin Iku**	**Overall**	**Chi-square Test**
Borehole	84 (29.6)	24 (27.3)	108 (29)	X^2=2.516
Tap	132 (46.5)	44 (50.0)	176(47)	Df = 3
Water vendor				
Well	7 (2.5)	0	7(2)	p-value
	61 (21.4)	20 (22.7)	81(22)	=0.472

11 SOCIO-DEMOGRAPHIC CORRELATIONS OF DOMESTIC WASTEWATER MANAGEMENT PRACTICES

The relationship between socio-demography and sources of water was further assessed. The assessment was performed to evaluate the impact of the socio-demographic variables on the different water sources. Since the source of the water variable is on a nominal scale, a multinomial logistic regression was performed to evaluate the interrelationships. Table 7 shows the estimate and significance of each demographic variable on the source of water. The significant level of 0.05 or below implies that the variables significantly affect the household source of waste. As observed, the average monthly income of the household head has the most significant effect on the source of water, followed by the level of literacy, and lastly, age. However, the findings show that the household size and years spent in the neighbourhood do not have any significant effect on the source of water. The findings also imply that literate or aged heads of household with high-income levels can afford to pay bills or even dig boreholes to achieve constant water supply, which also eases wastewater management.

Table 7: Model fitting

Effect	**Model fitting criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	786.616	7.409	3	0.060
Age	788.147	8.940	3	0.030
Household Size	780.620	1.412	3	0.703
Years Spent in School	790.314	11.107	3	0.011
Average monthly income of the household head	805.519	26.311	3	0.000
Years spent in the neighbourhood	785.822	6.614	3	0.085

Table 8: Model Fitting Information

Model	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood	**Chi-Square**	**df**	**Sig.**
Intercept Only	830.966			
Final	779.208	51.758	15	.000

Table 9: Pseudo R-Square

Cox and Snell	.130
Nagelkerke	.145
McFadden	.062

12 SANITARY FACILITIES

The sanitary facilities available in the two-study area were comparatively assessed. The variables considered, include;

the availability of kitchens and toilets, type of toilets, and location of the toilets and kitchens in the households. The Cox and Snell method are the most commonly used statistics to report the explained variance in logistic regression (Peng, Lee, & Ingersoll, 2002). In this study, the Cox and Snell approach report that the socio-demographic variables could explain only 13% of the variation in the sources of water. This implies that, even though the model is significant, there are still other important factors that affect the source of water aside from the outlined socio-demographic variables in this model.

Table 10: Availability of toilet and kitchen

Variables	Frequency (Percentage)		
Location	**Madalla**	**Bakin Iku**	**Overall**
Do you have a toilet?			
Yes	284 (76.3)	88 (23.7)	372 (100)
No	0 (0.0)	0	
Do you have a kitchen?			
Yes	284 (76.3)	88 (23.7)	372 (100)
No	0 (0.0)	0	

It was observed that all the areas sampled in the study area have a toilet and a kitchen. These findings account for the reason why open defecation is limited in the study area.

Table 11: Type of Toilet

Variables	Frequency (Percentage)			
Location	**Madalla**	**Bakin Iku**	**Overall**	**Chi-square test**
Type of Toilet				χ^2=1.1 Df =1 *p*-value =0.121
Pit Latrine	89 (31.3)	20 (22.7)	109 (29)	
Water Closet	195 (68.7)	68 (77.3)	263 (71)	

The findings reveal that 31.3% of respondents in Madalla use pit latrine, whereas 68.7% use water closet. In Bain Iku, 22.7% use pit latrine, whereas 77.3% use a water closet. The Chi-Square statistics and *p*-value of 0.121 imply that there is no difference between the types of toilets used in Madalla and Bakin Iku. However, the percentage of households that use a water closet is comparatively higher in Bakin Iku. Overall, the findings indicate that most households in Suleja use water closet since water is more readily available.

12 LOCATIONS OF TOILET, KITCHEN, AND SOURCE OF WATER

More than half (59.2%) of the households in Madalla have sources of water within proximity. However, only 21.5% and 19.4% of the households in Madalla have water sources within the house and outside the compound, respectively. Majority of the houses in Bakin Iku have a water source in their houses or within the compound, whereas only a few households in Bakin Iku source water outside. The Chi-square *p*-value of 0.000 implies that there is a significant difference between the locations of the source of water in both areas. This is evident from the frequency statistics. The percentage of households that have water sources within the houses in Bakin Iku is twice Madalla. In the case of toilet and kitchen location, majority of the households in Madalla and Bakin Iku have a toilet within the house. Hence, only a few households have toilets within the compound. The chi-square measure of association has *p*-values below 0.005, which implies that there is no significant difference between the locations of toilets in the two sample sites. Meanwhile, variations exist in the case of the location of the kitchen at a *p*-value of 0.0001. Most households in Bakin Iku have the kitchen located within the houses, while the majority in Madalla have the kitchen situated within the compound.

Table 12: Location of Waster Sources, Toilets and Kitchen

Variables	Frequency (Percentage)			
Location	**Madalla**	**Bakin Iku**	**Overall**	**Chi-Square Statistics**
Location of Water Source				χ^2= 17.040 Df =2 p-value = 0.000
Outside the compound	55 (19.4)	9 (10.2)	64 (17.2)	
Within the compound	168 (59.2)	38 (43.2)	206 (55.4)	
Within the house	61 (21.5)	41 (46.6)	102 (27.4)	
Location of toilet				χ^2= 0.254 Df =1 p-value = 0.610
Within the compound (Shared with other tenants)	95(33.5)	32(36.4)	127(34.1)	
Within the house	189 (66.5)	56 (63.6)	245(65.9)	
Location of the kitchen?				χ^2= 0.026 Df =1 p-value = 0.0001
Within the compound	209 (73.6)	24 (27.3)	233(62.6)	
Within the house	75 (26.4)	64 (72.7)	139(37.4)	

13 CURRENT DOMESTIC WASTEWATER MANAGEMENT SYSTEMS

About half of the respondents from Madalla and Bakin Iku (51.4% and 47.7%, respectively) deposit wastewater from bathrooms to open drainage systems. The findings reveal the Soakaway system is the second most used approach for wastewater management in the study areas. However, some households in the study area deposit bathroom wastewater in closed drainages. The chi-square statistics further show that there is no significant difference in the system of bathroom wastewater management in Madalla and Bakin. Likewise, management of wastewater from laundry follows similar patterns, as there is no significant difference in the mode of management in the two sample sites. Hence, majority of the households utilise open drainage systems followed by soakage pits. Meanwhile, the system of disposing wastewater from kitchens follow a different dynamic in both study areas, based on the significant difference observed in the wastewater disposal system at a *p*-value of 0.000. Although about half of the households in both sites use an open drainage system, more households use the central sewer and on-the-ground method in Madalla compared to Bakin Iku. Wastewater from the kitchen is disposed on the ground and allowed to flow in the streets and walkways. However, the bulk of the kitchen wastewater is diverted into the open drainage system in Bakin Iku. More also, the study reveals that the wastewater from toilets in the two samples sites ends up in the soakage pits, which is the most common practice in Nigeria at large.

Table 13: Disposal of Wastewater from Bathroom, Kitchen, Laundry and Toilet

Variables	Frequency (Percentage)		
Location	**Madalla**	**Bakin Iku**	**Chi-Square Statistics**
Disposal of wastewater from bathroom Central Sewer Closed Drainage Open Drainage On the ground Soakaway	55 (19.4) 11 (3.9) 146 (51.4) 2 (0.7) 70 (24.6)	20 (22.7) 5 (5.7) 42 (47.7) 0 21 (23.9)	χ^2= 1.127 Df =3 p-value = 0.771
Disposal of wastewater from kitchen Central Sewer Closed Drainage On the ground Open Drainage Soakaway	42 (14.8) 16 (5.6) 141 (49.6) 51 (18.0) 34 (12.0)	1 (1.1) 4 (4.5) 20 (22.7) 40 (45.5) 23 (26.1)	χ^2= 21.604 Df = 4 p-value = 0.000
Disposal of wastewater from Laundry Closed Drainage On the ground Open Drainage Soakaway	0 (0.0) 7 (2.5) 200 (70.4) 77 (27.1)	0 (0.0) 0 (0.0) 77 (87.5) 11 (12.5)	χ^2= 10.865 Df = 2 p-value = 0.004
Disposal of wastewater from the toilet Central Sewer Open Drainage Soakaway	0 (0) 0(0) 284 (100)	0 (0) 0 (0.0) 88(100)	

Furthermore, the findings of this study reveal that no portion of the domestic wastewater generated in Suleja is treated due to the total absence of treatment plants. Typically, the black water from toilets in most houses is diverted into the soakage pits. Generally, the other portions of the domestic wastewater generated are discharged either into a soakage pit or open drainage, which is later emptied into the central sewage system designed for stormwater conveyance. This direct discharge of domestic wastewater is prevalent in both sample sites, as deduced during the study.

13 SOCIO-DEMOGRAPHIC RELATION WITH A SYSTEM OF DISPOSAL OF WASTEWATER FROM KITCHEN

There is no difference in the wastewater generated from sources such as the bathroom, laundry and toilet in both study areas. However, a significant difference was observed in the case of domestic wastewater disposed of from kitchens. To further examine the cause of this variation, a regression analysis was performed to test the effect of social demographics. Table 14 below shows the multinomial logistic regression of the disposal of wastewater from the kitchen and respondents' socio-demographics.

Table 14: Significance

Effect	Model fitting criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	959.189	15.899	5	0.007
Age	962.848	19.557	5	0.002
Household Size	966.004	22.714	5	0.000
Years Spent in School	956.143	12.852	5	0.025
Average monthly income of the household head	960.417	17.126	5	0.004
Years spent in the neighbourhood	978.727	35.436	5	0.000

As observed, the demographic variables are significant at a *p*-value of 0.05. Household size and years spent in the neighbourhood are the most significant factors of waste disposal from the kitchen, followed by age and income.

Table 15: Model Significance

	Chi-Square	df	Sig.
Pearson	1535.232	1360	.001
Deviance	941.669	1360	1.000

The socio-demographics of the respondents only explain 35% of the variations in the disposal of wastewater from the kitchen. The overall model goodness of fit shows that the model is significant.

Table 16: Pseudo R-Square

Cox and Snell	.350
Nagelkerke	.369
McFadden	.145

As earlier observed, there is a disparity in household head income level, household density, age, educational level and household duration of stay in the neighbourhoods at both sample sites. The level of significance of these variables in relation to the wastewater disposal system from kitchens is clearly evident. For example, the low-income level of most household heads in Madalla hampers the provision of wastewater management facilities. Hence, the wastewater generated from kitchens is mostly allowed to flow on the ground within the neighbourhood. This finding also implies that domestic wastewater will be generated from cooking, dishwashing, and laundry. This observation is attributed to the number of households with many children. However, it is evident that households in Madalla despite having lived in the neighbourhood for extended periods are still ignorant of the effects of the practice. However, this practice could be ascribed to the respondent's level of education. Hence, the domestic wastewater generated in Bakin Iku is mostly managed due to the higher income levels of households.

14 SUMMARY OF FINDINGS

The findings show that the study area has no proper sewage system. Due to limited space and close arrangement of building structures, individuals within these neighbourhoods utilise the soakaway system as a primary means for on-site wastewater treatment and disposal, while others employ different methods. The soakaway systems used in the collection of toilet wastewater regularly pollute groundwater, which is a vital source of water for residents. Likewise, the faecal contamination of water and environmental systems in Suleja is ascribed to the inadequate management of wastewater, which poses significant health concerns. Furthermore, the findings indicate that residents use drainages and footpaths as dumpsites. The provision of essential urban services, primarily sanitation and water, has virtually collapsed. As a result, the entire town of Suleja has been transformed into a giant slum, growing in density and size in the most uncontrolled and unplanned manner imaginable.

15 CONCLUSIONS

The study examined the domestic wastewater sources along with the basic methods utilised for disposal and management in Suleja town located in Niger State, Nigeria. The findings provide significant evidence for the urgent need to address the myriad environmental problems posed by poor wastewater disposal and management in the study area. The authors observed that the challenges faced by respondents in the study area are due to the inevitable consequence of rapid technological advancement. This has affected the quality of the environment and is of great concern. In addition, the challenges of wastewater collection, disposal, and management have highlighted the need to re-evaluate the basis for efficiently delivering modern services in urban centres. It is believed that every citizen has a critical part of an undertaking in this re-evaluation. Therefore, the careful planning and management of the expending life support system in most urban centres is crucial. Lastly, the imminent environmental crises can be averted by enlightening the public on the risks of current wastewater management practices.

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