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The Effect of Plastic Sachet Water Waste in Kafanchan Town, Kaduna State, Nigeria

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Abstract

Plastic wastes have become a serious hazard that is bedeviling the environment and man. This study focuses on the effect of plastic sachet water waste in the study area. Data for the study was collected quantitatively through 200 questionnaires and qualitatively through key informant interview. Data was analysed using five points Likert scale, using mean index (MI) of 3.0, and IBM SPSS version 29 to achieve set objectives. The Alpha Reliability and Cronbach's Alpha levels were 0.86 respectively, indicating high reliability and correlation levels of the test instruments. Findings are: the daily average usage rate per person is 4 sachets and estimated total waste generated daily is 997.1kg; most sachet wastes generated are disposed indiscriminately, becoming hazardous to the environment and humans. Furthermore, plastic waste management is inadequate, hence the need for sustainable management. Finally, recommendations include; proper disposal, recycling and upcycling, waste to wealth, education and possible plastic ban.

Keywords: *Effect, Plastic, Sachet water, Waste, Waste Management*

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Background to the Study

Plastics are organic polymeric materials consisting of a large collection of synthetic organic compounds that are produced by polymerization of many repeating units (monomers) that come together to build copolymers (Hammer, Kraak, & Parsons, 2012). It is said that more than 300 million metric tons of virgin plastic is being manufactured every year globally and more than half is disposed within the year of manufacturing. Thinking about ways to manage it is therefore of utmost importance (Singh & Sharma, 2015; Avong & Musa, 2022). In the year 2023, the United Nation Environmental Programme (UNEP) revealed that as of 2011, the environmental cost of plastic application is more than $7 billion and this is likely to go beyond $9 billion by 2050. Because of the pressure put on resources and the continuous utilization of the same, it has led to environmental degradation as well as climate change (Ogwo, Obasi, Okoro & Dibia 2013). The pervasiveness of plastic waste harms ecosystem and biodiversity (Raji, 2021; Alabi, Ologbonjaye, Awolosun, & Alalade, 2019; Avong & Musa, 2022; Kehinde, Ramonu, Justine and Babaremu, 2020). Report shows that plastic waste accounts for 80% of marine pollution; 8–10 million metric tonnes is dumped into the ocean annually (John, 2023). Furthermore, plastic waste possesses the ability to harm humans through ingestion via aquatic species and inhalation via air and also possesses capacity to trigger environmental degradation (Avong & Musa, 2022; Kehinde, et al, 2020). Plastic leakage into rivers and oceans is expected to rise one-third from 6 million tonnes in 2020 to over 9 million tonnes in 2040 (UNEP, 2024). Research shows that people consumed 50-60 million sachet water bags daily in Nigeria because of the increasing reliance on sachet water in Africa and other developing countries. Littering the streets daily has led to significant environmental challenges (Stanley, Chiudo. Osemudiamen, Chineyem & Realman, 2023; UNEP, 2023; Dumbilli & Handersen, 2020). Unfortunately, waste recycling plants are very few in Nigeria; less than 20% are being recycled and about 80% littered into the environment (Ishaya, Kachiro & Joseph, 2024).

Sachet water waste often composed of non-biodegradable low-density polyethylene (LDPE) and contributes substantially to plastic pollution. Improper disposal of sachets results in the followings; littering of urban and rural areas, clogging of drainage systems, and eventual accumulation in water bodies, posing threats to aquatic ecosystems. According to Akinbile, Olajide & Fayiga (2016) and Onuegbu (2022), this form of waste exacerbates urban flooding, especially during the rainy season, as blocked drains impede the free flow of water.

Additionally, the slow decomposition rate of plastic sachets, often estimated to take hundreds of years, which creates long-term environmental burdens. Ogundele, Adewumi & Ayo (2018) highlights that burning sachet waste which is a common disposal method, releases harmful pollutants such as dioxins and furans into the atmosphere, contributing to air quality degradation and climate change. Moreover, improperly disposed sachets can fragment into micro plastics, which are ingested by marine organisms, entering the food chain and potentially impacting human health. The environmental aesthetic is also affected, with sachet waste littering landscapes and creating visual pollution Alabi, et al, (2019). This issue often leads to reduced property values and can deter tourism in affected regions. Ezechi, Chukwu & Agbon (2020) emphasize that addressing the environmental impacts of sachet waste requires

robust waste management systems and policies promoting recycling and alternatives to plastic packaging.

Improper disposal of sachet water waste poses significant public health risks. Accumulated sachets create breeding grounds for disease vectors, including mosquitoes and rodents. Mosquitoes, particularly those that thrive in stagnant water trapped in discarded sachets, are responsible for transmitting diseases such as malaria and dengue fever (World Health Organization, 2019; Dunoma, Ma., Bu, George, Gashau, & Suleiman 2024). Furthermore, rats attracted to improperly managed waste contribute to the spread of leptospirosis, a bacterial infection. The blockage of drainage systems by sachet waste increases the frequency and intensity of urban flooding, which exacerbates the spread of waterborne diseases such as cholera, typhoid, and dysentery. Floodwaters often mix with sewage and other contaminants, creating conditions conducive to the outbreak of these illnesses (Nwachukwu, Orji & Ogbonna, 2017; Alabi, et al, 2019).

In addition to direct health risks, the economic burden of treating diseases linked to improper sachet disposal further strains public health systems, particularly in low-income communities. Women and children are disproportionately affected, as they are often the primary users of sachet water in domestic settings (Adewumi, Olatunji & Bolarinwa, 2020). Addressing these health risks requires public awareness campaigns, enforcement of sanitation laws, and the promotion of reusable water containers to reduce dependence on sachets. Plastic products and their wastes are a global problem, but with regional inconsistency. Plastic is burnt releasing toxic gases into the atmosphere, liberates hazardous halogens and pollutes air, harmful to central nervous system, carcinogens, heart disease, aggravates respiratory ailments such as asthma and emphysema and cause rashes, nausea or headaches (Verma, Vinoda, Papireddy & Gowda, 2016). Most plastic industries used additive materials like bisphenol A, phthalates, poly-fluorinated, dioxins, brominated flame retardant and antimony trioxide during manufacturing and these materials have unfavorable effects on environmental and human health (Halden, 2010; Avong & Musa, 2022).

Other researches indicated that plastic waste have miscellaneous effect on environment, including fish, soil, human health, cattle and national parks. Furthermore, plastic waste possesses the ability to harm humans through ingestion via aquatic species and inhalation via air and also possesses capacity to trigger environmental degradation (Kehinde, et al, 2020; Verma, et al, 2016). High amount of waste plastics has serious effects on the ecosystem through soil pollution by landfilling, marine pollution by ocean dumping, and air pollution by open dumping (Mourshed, Masud, Rashid, & Joardder, 2017). Plastic waste management poses significant socio-economic challenges globally, particularly in developing countries. Improper disposal of plastic waste, which includes single-use plastics such as bottles, bags, and sachets, results in costly environmental degradation and public health crises. According to Jambeck, Goyer & Wilcox (2015), the cost of managing plastic pollution exceeds $13 billion annually, including expenses related to cleaning polluted environments, loss of biodiversity, and health care costs for treating pollution-related illnesses.

For urban communities, the economic burden of plastic waste is reflected in increased municipal waste management budgets. Governments must invest in landfills, recycling plants, and other waste disposal facilities, often diverting resources from critical sectors like education and healthcare. Furthermore, improperly managed plastic waste clogs drainage systems, exacerbating flooding in urban areas and leading to significant property damage and economic losses (Kaza, Yao, Bhada-Tata, & Van Woerden 2018). In coastal and fishing communities, plastic waste negatively impacts livelihoods. Marine plastic pollution reduces fish stocks and damages ecosystems, thereby threatening the income of millions who depend on fishing and tourism. The World Bank (2021) estimates that marine plastic pollution results in an annual economic loss of $2.5 billion to the global fishing industry. Additionally, informal waste pickers, who form the backbone of plastic recycling in many developing countries, often work in hazardous conditions without fair compensation. This labour-intensive work is undervalued, leaving these workers exposed to exploitation and health risks, such as respiratory illnesses from burning plastic waste (Ogunseitan, Schoenung & Ajao, 2020).

Community involvement plays a critical role in addressing the challenges of plastic waste management. Grassroots initiatives and local government programs have demonstrated varying levels of success in reducing plastic pollution. For instance, waste segregation at the source is gaining traction in some urban areas, where communities are encouraged to separate recyclables from general waste (Adeyanju, Ogbo & Olayede, 2022). These efforts promote recycling and reduce the volume of plastic waste reaching landfills. Community-based recycling programs, such as waste buy-back schemes, incentivize residents to collect and return plastic waste for monetary rewards. Such initiatives improve recycling rates and create income opportunities for marginalized populations. An example is the "Trash for Cash" program in Lagos, Nigeria, where individuals exchange plastic waste for cash or household items, contributing to cleaner neighborhoods and reduced environmental impacts (Okeke, Abubakar & Mbah, 2021).

Awareness campaigns are also critical in changing attitudes toward plastic use and disposal. Non-governmental organizations (NGOs) and community groups have organized clean-up drives and educational programs, emphasizing the importance of reducing single-use plastics and adopting eco-friendly alternatives. These initiatives have been particularly effective in schools, where children act as agents of change in their households and communities (Nwankwo & Uche, 2020).

Despite different studies on the menace of different plastic wastes, not much has been done on sachet water waste, hence the focus of this study. It is against this background that an appraisal of how this waste affects the environment and humans becomes necessary and important. Therefore, the study examined generated waste and the effect of sachet waste on the environment and human health.

Study Area

Kafanchan is located between Latitude 9.5849^{0} N and longitude 8.2924^{0}E with an elevation of 742 meters above sea level. The vegetation of the area is the Guinea Savanna type; and the

area is designated as Koppen's Aw climate with two distinct seasons, a wet season in summer and a dry season in winter. Rainfall occurs between the months of April to October with a peak in August. The mean annual rainfall is about 1800 mm and the mean monthly temperature is 25°C, while the relative humidity is about 63%. The orographic effects of the Jos-Plateau and the Kagoro Hills have positive influence on the climate around Kafanchan in the study area influencing rainfall, temperature and relative humidity. The main type of soil is the Ferruginous tropical soil which is related to the climate, vegetation, lithology and the topography of the area. The relief is relatively flat and undulating and it influences the drainage pattern of the area (Abaje, Ishaya & Usman, 2010; Abaje & Oladipo, 2019; Avong & Binbol, 2020). Socioeconomically, Kafanchan Town is the headquarters of the entire southern Kaduna and is characterized by business hubs, schools of all levels, mining activities, many motor parks, recreational centres and hospitals. It is also the headquarters of NorthWest Railway Corporation of Nigeria therefore, many ethnic groups make up the teeming population of the area (Avong & Binbol, 2020; Wikipedia, 2024).

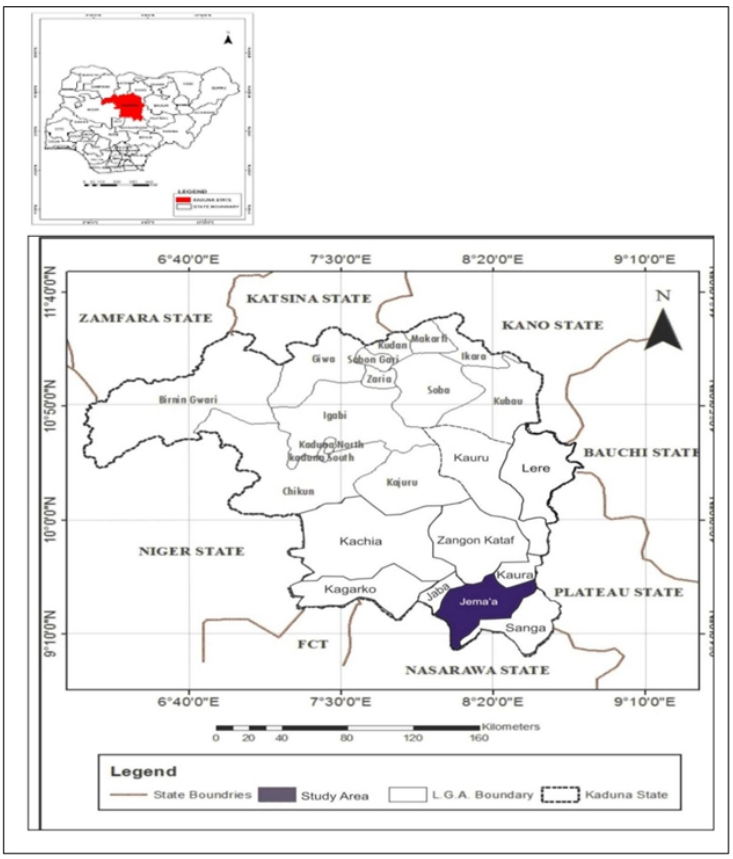

Figure 1: Map of Nigeria Showing the Study Area
Source: Abaje, Ishaya & Usman, 2010

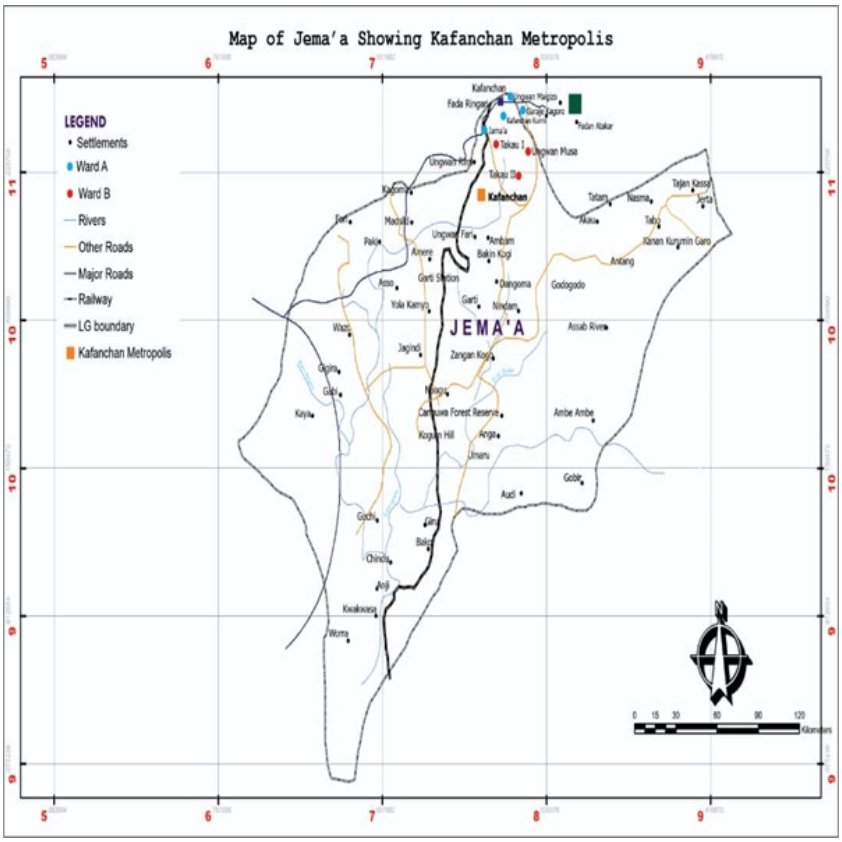

Figure 2: Map Showing the Study Area
Source: Abaje & Oladipo, 2019

Materials and Methods

In this study, the researcher used Descriptive survey design using questionnaires, interview and observation. The questionnaire was mainly on 5 points Likert scale of strongly agreed (5), agreed (4), undecided (3), disagreed (2) and strongly disagreed (1). 50 questionnaires each were administered randomly in the four wards, namely Maigizo, Takau, Wards A and B. A total of 200 respondents of a sample population size of 83,092 (Wikipedia, 2024) were used, adopted from Yamane (1967) application of sample size and split half method of selecting sample. Alpha Reliability and Cronbach's Alpha tools were used to test reliability and correlation levels of test instruments, and IBM SPSS package, version 29 was also used to achieve set objectives.

Data Analysis

Descriptive statistics such as frequency, mean and standard deviation were used to analyze the data using IBM SPSS version 29 package. The Likert scale mean index (MI) of 3.0 was used to assess the criticality of the effect of plastic sachet water waste on the environment and human health. Responses from 3.0 and above are accepted to be critical, and responses less than 3.0 are rejected. The SPSS package indicated an Alpha reliability level of 0.86. This indicates that the measuring tools (questions) were highly reliable. Cronbach's Alpha level was also

0.86, indicating that the measuring tools have high correlation. The simple estimate method was used to quantify waste generated daily in Kafanchan. That is, daily sachet waste generation = population size × sachet usage rate × total sachet × sachet weight.

Results and Discussion

Biodata of the Respondents

Table 1: Socio-economic Characteristics of the Respondents

A.	Gender	Frequency	Percentage
	Male	48	24
	Female	152	76
B.	**Marital status**	**Frequency**	**Percentage**
	Single	108	54
	Married	92	46
C.	**Age**	**Frequency**	**Percentage**
	20 years	48	24
	21 – 30	72	36
	31 - 40	48	24
	41 - 50	24	12
	50 above	08	04
D.	**Occupation**	**Frequency**	**Percentage**
	Student	66	33
	Employed	72	36
	Self-employed	44	22
	Unemployed	18	09
E.	**Residence**	**Frequency**	**Percentage**
	1 year	14	07
	1 – 5	42	21
	6 = 10	114	57
	10 above	30	15
F.	**Education**	**Frequency**	**Percentage**
	No education	10	05
	Primary	04	02
	Secondary	46	23
	Tertiary	108	54
	Others	32	16

Source: Field survey, 2024

Table 1 shows that 76% of the respondents were female and 54% of them were still single. 36% of the respondents were of 21-30 age group, 36% were employed and have in the study area for about 10 years. A good number of the respondents (54%) were educated up to tertiary levels. This indicates that the respondents were matured, employed, educated and have quite a good experience of the study therefore, could provide adequate and reliable information on the subject matter.

Table 2: Quantity of Sachet Water Waste Generated

Total Daily waste Generated (kg)	Total Population (Thousands)	Average Daily water use/person (sachet)	Total Daily Sachet waste	Single sachet weight (kg)
997.1kg	83,092	4	332,368	0.003

Source: Field survey, 2024

The result in table 2 shows that the daily average water consumption per person in the study area is four (4) sachets (2 litres) More so, the total daily sachet waste generated is 332,368 considering the population of 83,092 of Kafanchan town and the weight of a single empty sachet is 0.003kg (3 gms). The total daily sachet water waste therefore generated is 997.1kg, equivalent to 0.99 tonnes. This indicates that sachet water waste is generated from within the study area.

Effect of Sachet Water Waste on the Environment

The mean index (average score) of 3.0 is the basis for assessing the effect of plastic sachet water waste on the environment.

Table 3: Respondents' Perception of the Effects of Sachet Water Waste in the Study Area

S/N	Statement	SA	A	U	D	SD	Mean	Decision
1	Plastic sachet waste contributes to soil pollution in Kafanchan	112	60	12	12	4	4.17	Accepted
2	Accumulation of sachet waste clogs/blocks drainage systems in the area.	80	116	0	0	4	4.34	Accepted
3	Plastic sachet waste significantly affects the town's aesthetics/ beauty	96	94	4	4	2	4.39	Accepted
4	Sachet waste contributes to flood risks in Kafanchan due to clogged/blocked drains	72	90	8	8	8	4.05	Accepted
5	There are enough waste disposal facilities to manage sachet waste effectively	48	54	48	48	22	3.29	Accepted
6	Efforts to clean up plastic waste are insufficient in the community	48	102	26	26	12	3.74	Accepted
7	Plastic sachet waste is improperly disposed of in most public areas in Kafanchan	94	76	12	12	10	4.16	Accepted

Source: Field survey, 2024

The result in table 3 shows that Sachet water waste has a number of effects on the environment. The strongest effect as indicated on the table is on the town's beauty and aesthetics with mean value of (4.39) followed by the blocking of drainages with mean value of (4.34), sachet water waste is also responsible for soil pollution with mean value of (4.17). The respondents also agreed that the accumulation of sachet water contributes to flood risks in the study area. With the mean value of 3.74, it is clear that efforts to clean up plastic waste in the

study area are insufficient. Worthy of note is also the fact that there are not enough waste disposal facilities to manage sachet water waste effectively. The result also reveals that bulk of the sachet waste generated in the study area are in public places including market places and motor parks. This is perhaps due to the hawking of sachet water in these areas.

Effect of Plastic Sachet Waste on Human Health

Table 4: Distribution of Respondents' Perception on the Effect of Sachet Water Waste on Health
The mean index (average score) of 3.0 is the basis for assessing the effect of plastic sachet water waste on health.

S/n	Statement	SA	A	U	D	SD	Mean	Decision
1	Exposure to plastic sachet waste increases the risk of waterborne diseases	64	90	16	22	8	3.90	Accepted
2	Stagnant water trapped in sachet waste contributes to mosquito breeding	98	88	6	4	4	4.36	Accepted
3	Plastic waste near residential areas affects air quality when it decomposes or burns	88	100	10	0	2	4.36	Accepted
4	The community is well-informed about the health risks associated with plastic waste	60	50	14	48	20	3.29	Accepted
5	Health authorities are actively addressing the health effects of sachet waste in Kafanchan	104	60	22	64	20	3.12	Accepted
6	Plastic sachet waste leads to littering and poor sanitation in public areas	64	104	12	8	12	4.00	Accepted
7	There are health programs to raise awareness about the risks of plastic waste in Kafanchan	38	60	26	58	18	3.21	Accepted

Source: Field survey, 2024

The result in table 4 reveals that stagnant water trapped in sachet waste contributes significantly to the breeding of mosquito in the area; plastic waste in residential areas affect quality when it decomposes or burns, these two items both have a mean value of (4.36). Another health risk associated with sachet water waste is the littering of public areas which has a mean value of 4.00, this will increase poor sanitation practice in the study area. Worthy of note also among the respondents is the fact that exposure to plastic sachet waste increases the risk of water borne diseases; with a mean value of 3.90, it suggests a strong level of agreement among respondents. The result also shows that the community is aware of the health risks associated with plastic waste in the study area. Although with a mean value of 3.29 slightly above the accepted mean index, it shows that such knowledge is not adequate. While others agree that health workers addressing the current health problems associated with plastic sachet waste are active, others still believe they are inadequate, this explains why the mean value 3.12 is slightly above the accepted mean index of 3.0. Finally, there are inadequate health programmes available to raise awareness about the risk of improper disposal of sachet plastic water because mean responses are slightly above 3.0.

Discussion

Table one revealed that the total estimated sachet waste generated daily in the area is 947.1 kg (0.99 tonnes), almost 1tonne. This clearly means that waste is generated like other urban centers in Nigeria. This agrees with Stanley et al, (2023) and Dumbilli & Handersen (2020) that a bag of water contains 20 sachets (locally called pure water). Therefore, an estimated 60 million water bags (1.2 billion water sachets) are consumed and generated daily as waste in Nigeria. It means about 3.6 million kg (3,600 tonnes) is generated daily as waste in Nigeria. Therefore, Kafanchan town contributes nearly a tonne daily out of 3,600 tonnes in Nigeria. This means Kafanchan town is a growing contributor of plastic sachet waste. Interestingly, this waste generation looks little compared to national standard yet it seems to be a growing monster that needs to be checked.

Findings from table 2 revealed the major effect on the environment as; alteration of beauty aesthetics; blocking of drainages, soil pollution and lastly flood risk. This also agree with Dunoma, et al (2024) and Alabi, et al (2019) that sachet waste cause environmental problems. This implies that the environment is affected negatively hence constituting environmental hazards. Furthermore, Findings agree with Dumbilli & Handerson (2020), Ezechi, et al (2020) and Ishaya, et al, (2024) that plastic waste management practices are not adequate and need to be improved.

Finally. Table 3 revealed the effect of sachet waste on human health which manifested in terms of breeding of mosquitoes, decomposition and burning, littering and water borne diseases. This also agrees with Dunoma, et, al (2024). Alabi et al, (2019), Dumbilli et al (2020), about how it poses serious danger to humans. Interestingly, the community is informed about the danger of sachet waste and related issues but do not know the magnitude of the danger because information on the growing danger is inadequate. The people in the area are also not aware that the effect of micro plastics is entering food chain. More so, actions taken by authorities to address health problems are still not sufficient as also noted by Raji (2021) and Adewumi, et al (2020)

Conclusion and Recommendations

The findings of this study show that the plastic sachet water waste generated in the study is high as indicated in table 2 considering the population of Kafanchan town, and the perception of the people on the effects of plastic sachet water waste is also high, with the strongest effects on town beauty and aesthetics, soil pollution and high flood risks. However, they are not aware that the danger is growing. The study also revealed that people in the study area are aware of the health risk associated with plastic sachet water waste. Efforts to manage the waste and health workers to address the health problems were inadequate. Therefore, plastic sachet water waste generation and its effects on the environment and man cannot be overemphasized. This study therefore recommends that;

i. The government and other organizations concerned should embark on thorough awareness campaigns on change of attitudes toward the use of plastic and disposal of plastic waste. If possible, use of some plastics should be banned in Nigeria.
ii. Communities should be incentivized in addressing the challenges of plastic

management by embarking on waste segregation at source, buy-back schemes and trash for cash initiatives at large scale.

iii. Sanitation workers should be incentivized to put in more efforts in waste management and more health workers should be employed to address the health challenges bedeviling the study area.

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