Scholars Journal of Engineering and Technology
Abbreviated Key Title: Sch J Eng Tech
ISSN 2347-9523 (Print) | ISSN 2321-435X (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Solid Waste Audit and Characterization Study at Tuensang Town Nagaland

Nohochem Sangtam[1*]

[1]Assistant Professor, Department of Environmental, Science Fazl Ali College, 798601, Mokokchung, Nagaland

DOI: 10.36347/sjet.2023.v11i06.002 | **Received:** 01.05.2023 | **Accepted:** 05.06.2023 | **Published:** 19.06.2023

***Corresponding author:** Nohochem Sangtam
Assistant Professor, Department of Environmental, Science Fazl Ali College, 798601, Mokokchung, Nagaland

Abstract **Original Research Article**

Today scenario improper waste management causes serious pollution and health risk, which is the main concerning environmental management in developing countries. In most cities, the use of open dumps is common for the disposal of wastes, resulting in soil and water resource contamination. The study carried from March to May 2023.A Total of 30 households were studied for data collection (210 samples) from three types of family, low income, medium income and high income family using the random sample, out of 15 wards,8 wards were used for the sample selection. The study shows that the majority of the residents are very much concerned about the poor condition of the environment due to the inappropriate and improper SWM in Tuensang town. The residents are not much satisfied with the service of the town council in regard with SWM dumping in the hearts of Tuensang. There is no scientific engineered solid waste disposal site in the Tuensang town and the results can be a starting point in planning for such. This paper give the total waste generation in the household level, weekly and yearly per capita per day and and also give the types of solid waste generation in the town. Based on the findings of the study, researcher proposes that district and town needs to provide proper solid waste segregation awareness to the general citizen to every household. It may also encouraged citizens not to dispose of their household wastes randomly.

Keywords: Household Solid Waste Management, Tuensang town, waste generation.

1. INTRODUCTION

Solid waste is any material which comes from domestic, commercial, and industrial sources arising from human activities which is of no use to the people who possess it and not intended to be discharged through a pipe. Solid waste is classified into domestic, commercial due to construction and demolition, agricultural, institutional and miscellaneous ways (Hagerty *et al*., 1973).

Many times domestic and commercial wastes are considered together as urban waste. In the olden days waste management did not pose many problems because of the lesser number of inhabitants in the communities. It has however become problematic due to the large masses of people in the towns and cities where the problem is serious.

Rapid urbanization, poor financing capacity of local authorities, low technical capacity for planning and management of solid waste, weak enforcement of environmental regulations - which allow local authorities to flout environmental regulations without any sanctions - have all contributed in compounding the problem. There have been several strategies in the past to tackle this menace but these have sometimes succeeded in moving the problem around. Solid waste management has therefore emerged as a suitable alternative to keep towns and cities clean and healthy.

Solid Waste Management refers to the collection, storage, transportation and final disposal of waste in an environmentally friendly manner. Solid waste management includes all activities that seek to minimize the health, environmental and aesthetic impacts of solid wastes. Solid waste management has become an essential aspect of health delivery. Effective waste management is a very important element of the health of a people, thus managing it in an environmentally sustainable way is of paramount importance.

Could you guess, what is the real capacity of the solid waste size storage capacity at your home and your city, how big composting plant should be to treat all the generated organic waste in the city or town, what is the potential income from recovering plastic waste or do u recount will it be viable to build incineration plants for your city, these are the sort of the common question many municipality face while planning the waste infrastructure. However, in order to answer them, you need to know how much municipality waste generated in the town and what is the waste consist of. In order to get these information you need to conduct a waste generation and characterization study also called waste audit**.**

The purpose of this case study was to study the waste generation rate, and characterize of solid wastes from low, middle and high income households at Tuensang Town

2. OBJECTIVES OF THE RESEARCH

i. Conduct the waste generation and characterization study for household waste.
ii. To identify Types of waste generation in the town
iii. Measure generation rates of per capita and total waste generation in the town

3. REVIEW OF LITERATURE

The critical review of the available literature is important in order to achieve research objectives. It is carried out in order to identify the available waste management practices in different regions as well as to select the best possible method for site identification for disposal of municipal solid waste.

Per capita waste generation of developing countries is less than the developed one but in the last two decades there is threefold increase in per capita waste generation of developing countries. Economic development, growth and prosperity are accompanied by the generation of large amount of waste which can be minimized by improving the design of products, packaging material and by enhancing the intensity of service per unit mass of material used.

(McDougall, 2001) defined waste as “Lack of Value” or “Useless remains”. Physically waste contains the same material as found in useful products and is mainly the by-product of human activities. It differs from useful products by its lack of value.

“The City to City Cooperation – Issue arising from Experience Report” framed by UNCHS (2001) discussed the promotion of SWM in various cities by developing new strategies and by subsequent implementation through city to city cooperation.

Workshop organized in Bangalore on “Decentralised Composting” conducted by (Zurbrugg *et al*., 2002) highlighted the potential of decentralized composting as a part of sustainable SWM and the main challenges faced by composting sector in India involving lack of technical and operational knowledge, quality assurance of compost and lack of proven technologies

(Zhu *et al*., 2008) in book “Improving Municipal Solid Waste Management in India” reviewed the MSWM system of Indian cities and financial resources for tackling them which involves the levying and collection of taxes, carbon trading, private sector participation, regionalisation of small municipalities and suggested plans and proposals for effective SWM with world over examples of successful implementation of projects.

(Rajeshwari Chatterjee 2009) in Municipal Solid Waste Management in Kohima City, Nagaland, India an overview of current solid waste management practices in Kohima, Nagaland, India and suggests solutions to some of the major problems. The levels of socio-economic development determine the quantity and composition of solid waste. Higher the level of economic development, greater the proportion of waste composition.

(Ghosh, 2016) discussed the schemes undertaken for SBM for effective SWM in India.

In “Revised guidelines for common bio-medical waste treatment and disposal facilities” formulated by CPCB (2016) mandates that the operator of biomedical plant ensures the collection of bio-medical waste, transportation, treatment and disposal of incinerated waste without any adverse effect to the human health and environment.

(Rao & Sultana, 2017) described the fundamentals of solid and hazardous waste management and also discussed landfill gases measurement techniques for methane gas estimation with the models used in different countries.

(Rathore & Sarmah, 2019) in “Modeling transfer station locations considering source separation of solid waste in urban centres: A case study of Bilaspur city, India” implemented mathematical optimization model for the overall cost of municipal solid waste management and GIS tools for MSWM.

4. METHODOLOGY

4.1 Description of Study area

Tuensang town is the District Head Quarter located in Nagaland, India.Town is with population estimation of 36,211 as reported 2021. It is 323 km north from State Capital Kohima, which is the Second largest City in the State. The town has 15 wards. The study areas covered households in Extension 8 wards located in the centre of the town.

The Tuensang Town Committee has population of 36,774 of which 19,471 are males while 17,303 are females as per report released by

Census India 2011. Current estimated population of Tuensang Town Coordinates: 26.271559°N 94.831384°E

Map

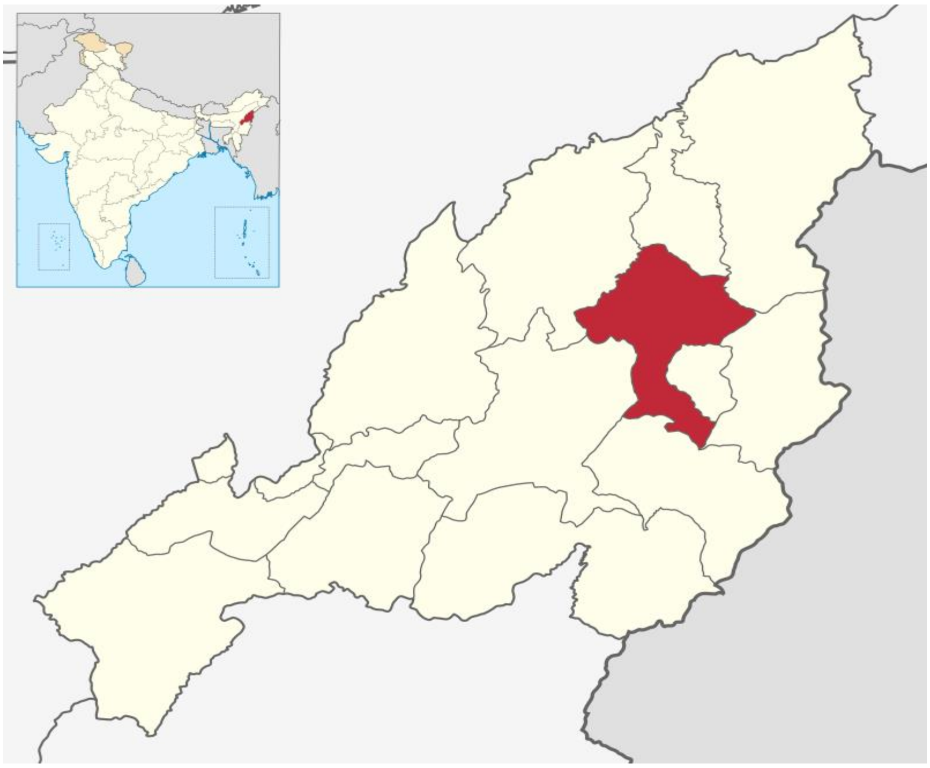


Figure i: Red showing Tuensang

Fig ii: Sample collection 8 ward showing in the Red circle, Tuensang Town

4.2. Waste Sampling and Procedure

Sampling of wastes from households was achieved by categorising the houses into high, middle and low income. The sizes of households sampled ranges from 2 to 9 persons per household.

Households in each category were sampled and given plastic bags with proper code number to place wastes during weekdays and weekends. The bags were collected from Sunday and Monday and characterization study was been conducted within 8 hours. In this research we limit our study upto the waste characterization and quantity of waste generation in the household.

Categorisation of the Household

Low Income Household	Middle income household	High income Household
Poor family, low income, low water supply, rented house, poor security, low drainage facility mostly tenants	Middle income, moderate family, middle income family, unreliable water supply, both rented house and owners' family, people stay in government quarters, poor security, unreliable drainage facility	Officers, high income family, good water facility, electricity, good road and drainage facility, high population.

Measure waste Generation Rate

Collect the waste:

The observation was carried out from 8 wards out of 15 wards selecting purposively every two ward in Tuensang Town.

Sampling of 30 selected household, 10 from low income group, 10 middle income and 10 High income groups. Collect the waste 8 consecutive days of collection. Discard waste from day 1, analyze waste from day 2 to day 8.

On day 1 provide biodegradable polygene bags to the selected household to collect all the generated waste they have in the home in this plastic bags. The waste collected in day one will be discarded. As Acids may contain wastes accumulated two or more days.

On all the other day from day 2 to day 8, the waste has be collected from each household provide with new plastic bags.

Note the following information from each household where waste is collected. Number of people in the household, income level, Date and time of collection. Everyday bring the collected bags to the measurement site for analysis. Use convenient vehicle for transport. Once all the wastes collected is brought to the site for analysis. Weight each sample bags and record the weight in the data sheet.

Household Waste Generation formula

The per capita waste generation of each household was calculated by dividing total number of waste produced in each household with the number of people living in the house per the number of days the waste was generated:

$$\text{Generation rate (Kg/cap.day)} = \frac{\text{Mass of solid waste}}{\text{Number of people (no of family members) x number of days}}$$

The total waste generated was calculated as:

Total Waste generated (Kg/day) = Waste generated per Capita X Total no. of population

Conduct characterization study

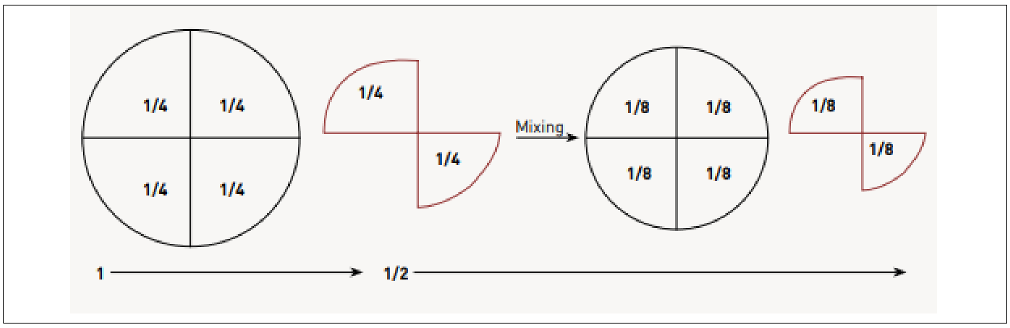
The Limit the collection and analysis was standardize between maximum of 8 hours.

Waste characterization procedure

Steps: Mix all waste from the bags.

Quartering and Coning Techniques

The quartering and coning method is one of the best techniques for determining the composition and characteristic of municipal waste. The sample is reduced to a more manageable size as the actual classification is carried out by hand. Selection of sampling sites is a critical first step in this process. The following aspects shall be considered: Waste sampling sites and frequency of sampling shall be in accordance with guidance. The sample collection sites should be representative and include all major sources of waste generation including residential areas (including slums), commercial, business, and market areas (vegetable market, meat market, slaughterhouse, grain market, etc.). Sample sites should also be representative of all income groups within the urban local bodies.



Source: Sustainable Solid Waste Management; Case study of Nagpur, India by Chandramani Bhimrao Patil et al., 2020 Pages: 650]

Sampling procedure

For day one and repeat the same to the subsequent day.

Take 10 kg of municipal waste mixed from outside and inside of the waste pile, sourced from random entities in an identified sampling location. Waste heap is mixed till wastes are homogenized, it is then divided into four equal parts, A and C or B and D.

Waste from opposing corners of the divided heap is removed to leave half of the original sample. The remaining portions are again thoroughly mixed and the quartering process is repeated until a desired size is obtained (10 kg of waste can be handled or segregated efficiently). The heap is divided into four portions using straight lines perpendicular to each other. Waste from opposing corners of the divided heap (say A and C) is removed to leave half of the original sample

The last remaining opposing fractions of waste (say B and D) shall be mixed homogenously.

Figure 1: Waste collected at Household level

Figure 2: Mixing waste during analysis

Figure 3: Quartering and Coning Techniques

Sorting Procedure

The wastes were sorted out according to composition. Sorting was conducted by separating the wastes into plastics, glass, food, paper and cardboard, textile, yard waste, and tin.

The sorted waste was weighed to determine the mass and volume of each waste composition using electronic scale and calibrated buckets after compaction.

A weighing scale was used to weigh the different compositions of the wastes after sorting to determine the mass of each waste composition. A container of known volume and mass was used to measure the volume of the samples. Knowing the mass and volume of each waste composition, the percentagefor each waste type in a sample was calculated.

Fig 4: Wastes being sorted for measurement.

Figure 5: Composition of each waste

5. RESULT

Table 1: Weight collected waste from Low Income Level House

HOUSE N	FAMILY SIZE	AMOUNTS(Kg)							TOTAL (Kg)
		Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	
1	2	0.55	0.57	0.45	0.78	0.78	0.15	0.56	3.84
2	2	0.43	0.43	0.23	0.33	0.34	0.23	0.12	2.11
3	4	1.34	1.56	1.78	1.34	1.23	1.97	1.45	10.67
4	5	1.23	1.45	1.67	1.43	1.89	1.56	1.65	10.88
5	3	1.02	1.09	1.03	1.62	1.34	1.03	1.43	8.56
6	4	1.98	1.98	1.34	1.63	1.73	1.34	1.48	11.48
7	1	0.22	0.23	0.12	0.34	0.34	0.32	0.43	2
8	5	1.45	1.34	1.43	1.34	1.54	1.34	1.43	10.06
9	6	2.00	1.67	1.34	1.67	1.40	1.54	1.23	10.85
10	8	2.43	1.09	1.43	1.45	1.54	1.23	2.00	11.17
Total waste		12.65	11.41	10.82	11.93	12.13	10.71	11.78	81.43
Total People		40	40	40	40	40	40	40	
Per cap.generation (kg/cap/day)		0.31	0.28	0.27	0.29	0.30	0.26	0.29	0.28

Table 2: Waste Characterization Calculation exercise

Waste fraction	AMOUNTS(Kg)							TOTAL (Kg)	% Amount
Day	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8		AmountX 100 = % Total
Bio-waste/ Organic	5.8	6.4	4.0	7.8	6.7	6.0	4.89	41.59	41.59x 100 = 51 % 81.43
Plastic	2.8	0.31	2.8	0.5	3.9	1.0	2.40	13.71	13.71 x100 =16.83 % 81.43
Paper	1.5	1.8	1.82	0.63	0.53	1.6	1.43	9.31	9.31 x100 =11.43 % 81.43
Others Clothes/ woodMetals/ /E-waste	2.5	2.9	3.2	3.0	1.0	2.11	3.06	17.77	17.77x100=21.82 % 81.43
Total	12.65	11.41	10.82	11.93	12.13	10.71	11.78	81.43	

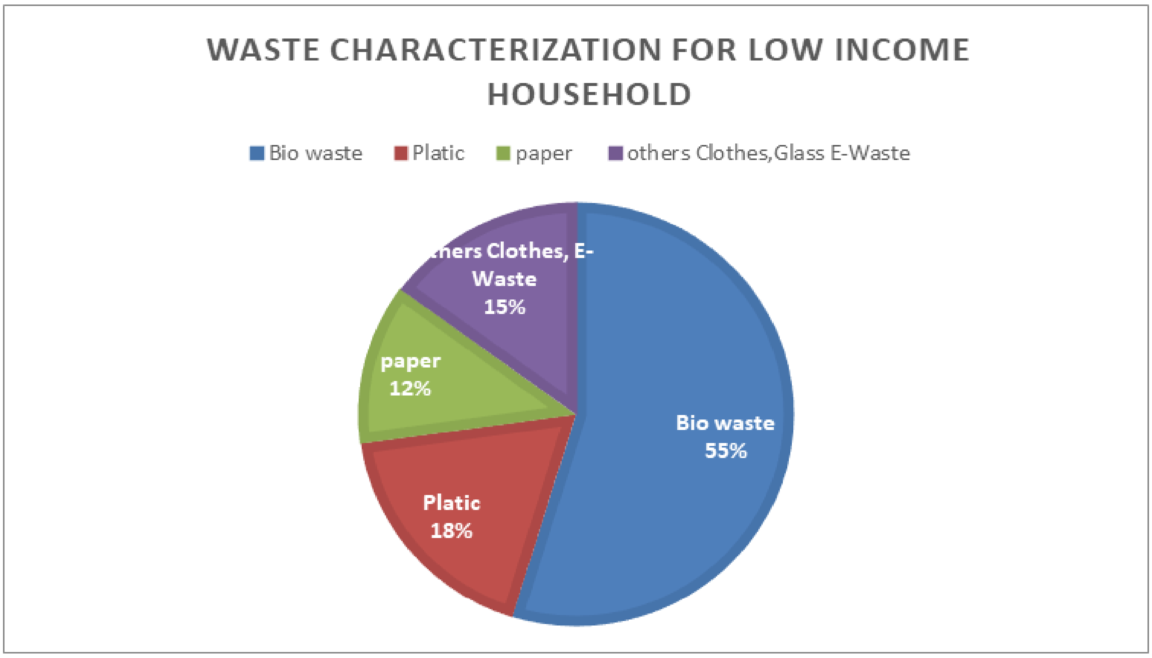


Figure 6: Pia-Chart Representation of Waste in Low Income Household

Table 3: Weight collected waste from Medium Income Level House

HOUSE N	FAMILY SIZE	AMOUNTS(Kg)							TOTAL (Kg)
		Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	
1	3	1.21	1.66	1.36	1.41	1.87	1.88	1.34	10.73
2	4	1.56	1.57	1.89	1.30	1.67	1.43	1.56	10.98
3	6	2.0	2.10	2.34	2.50	2.56	2.67	2.01	16.18
4	4	1.78	1.87	1.89	1.76	1.56	1.98	1.23	12.07
5	3	1.02	1.3	1.03	1.07	1.78	1.09	1.8	9.09
6	2	0.9	0.99	0.6	0.8	0.9	1	1.2	6.39
7	5	2.0	2.1	2.2	2.5	2.4	2.6	3.6	17.4
8	4	1.9	1.8	2.1	2.1	2.0	2.4	1.3	13.6
9	2	1.5	1.7	1.4	1.4	2.4	2.2	2.1	12.7
10	6	3	3.4	3.2	3.5	3.5	3.5	3.6	23.7
Total waste		16.87	18.49	18.01	18.34	20.64	20.75	19.74	132.84
Total People		39	39	39	39	39	39	39	
Per cap.generation (kg/cap/day)		0.43	0.47	0.46	0.47	0.52	0.53	0.50	0.48

Table 4: Waste Characterization Calculation exercise

Waste fraction	AMOUNTS(Kg)							TOTAL (Kg)	% Amount
Day	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8		AmountX 100 = % Total
Bio-waste/ Organic	5.8	6.3	5.7	5.6	5.2	5.8	6.3	40.7	40.7 x 100 =30.6% 132.84
Plastic	3.3	3.5	4.6	4.9	2.7	4.8	4.9	28.7	28.7 x100 =21.6% 132.84
Paper	3.90	4.98	3.4	3.8	4.5	5.0	4.3	29.88	29.88 x100 = 22.5% 132.84
Others Clothes/ Wood Metals/cans Glass/E-waste	3.87	3.71	4.31	4.04	8.24	5.15	4.24	33.56	33.56 x 100 =25.3% 132.84
Total	16.87	18.49	18.01	18.34	20.64	20.75	19.74	132.84	

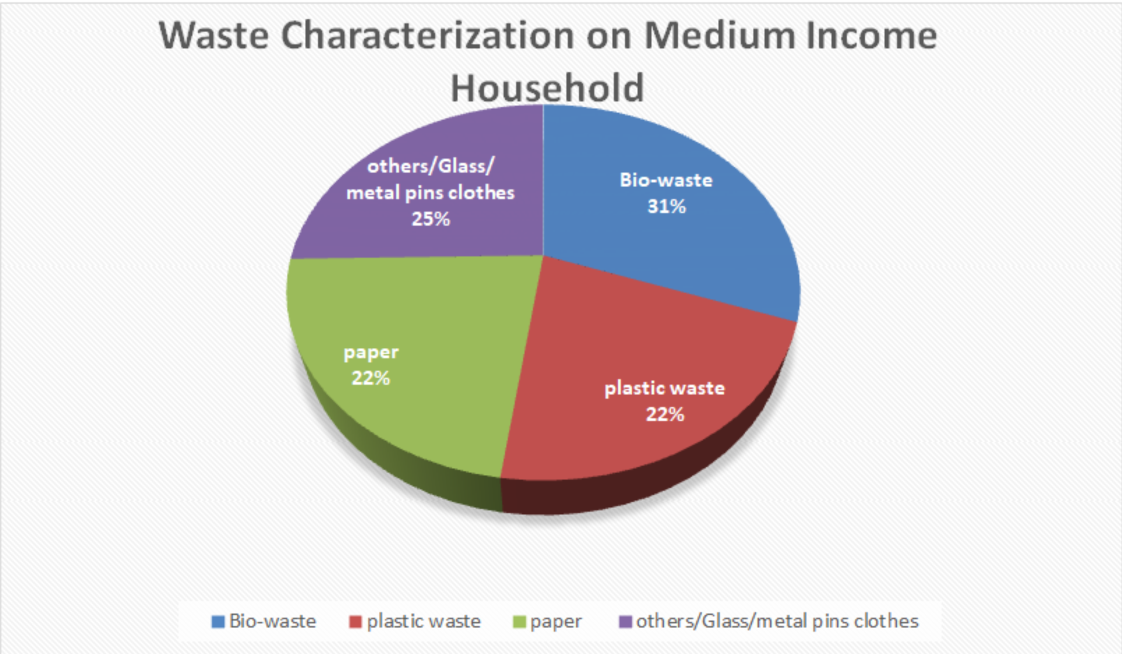


Figure 7: Pia-Chart Representation of Waste in Medium Income Household

Table 5: Waste collected from High Income family

HOUSE N	FAMILY SIZE	AMOUNTS(Kg)							TOTAL (Kg)
		Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	
1	3	1.5	1.6	1.4	1.5	1.6	1.5	1.4	10.5
2	4	2.	2.1	2.3	2.0	2.3	2.3	2.6	15.7
3	8	4.5	4.0	4.2	4.0	4.0	4.5	4.9	30.1
4	5	3.2	3.0	3.2	3.1	3.0	3.4	3.1	22
5	2	1.5	1.1	0.9	0.3	1.4	0.6	1.2	7
6	3	2.5	2.0	2.0	2.3	2.3	2.4	2.0	15.5
7	5	3.0	2.4	2.3	2	2.3	2.3	3.1	17.4
8	4	3.5	3.3	3.4	3.2	3.0	2.9	2.9	22.2
9	1	0.5	0.2	0.3	0.5	0.4	0.3	0.6	2.8
10	3	1.5	1.2	1.3	1.5	1.5	1.6	1.2	9.8
Total waste		23.8	20.9	21.3	20.4	21.8	21.8	23	153
Total People		38	38	38	38	38	38	38	
Per cap.generation (kg/cap/day)		0.62	0.55	0.56	0.53	0.57	0.57	0.60	0.57

Table 6: Waste Characterization Calculation exercise

Waste fraction	AMOUNTS(Kg)							TOTAL (Kg)	% Amount
Day	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8		<u>AmountX 100 = %</u> Total
Bio-waste/ Organic	11.2	10.4	9.8	8.8	6.4	7.9	9.1	63.6	<u>63.6x100= 41.56 %</u> 153
Plastic	4.2	3.9	4.3	4.7	5.0	4.8	4.2	31.1	<u>31.1</u> x100 = 20.3 % 153
Paper	3.8	4.7	5.6	6.8	5.6	5.0	5	36.5	<u>36.5x100= 23.85</u> % 153
Others Clothes/ Wood Metals/ Glass/E-waste	4.6	1.9	1.6	0.1	4.8	4.1	4.7	21.4	<u>21.4 x 100</u> = 13.9 % 153
Total	23.8	20.9	21.3	20.4	21.8	21.8	23	153	

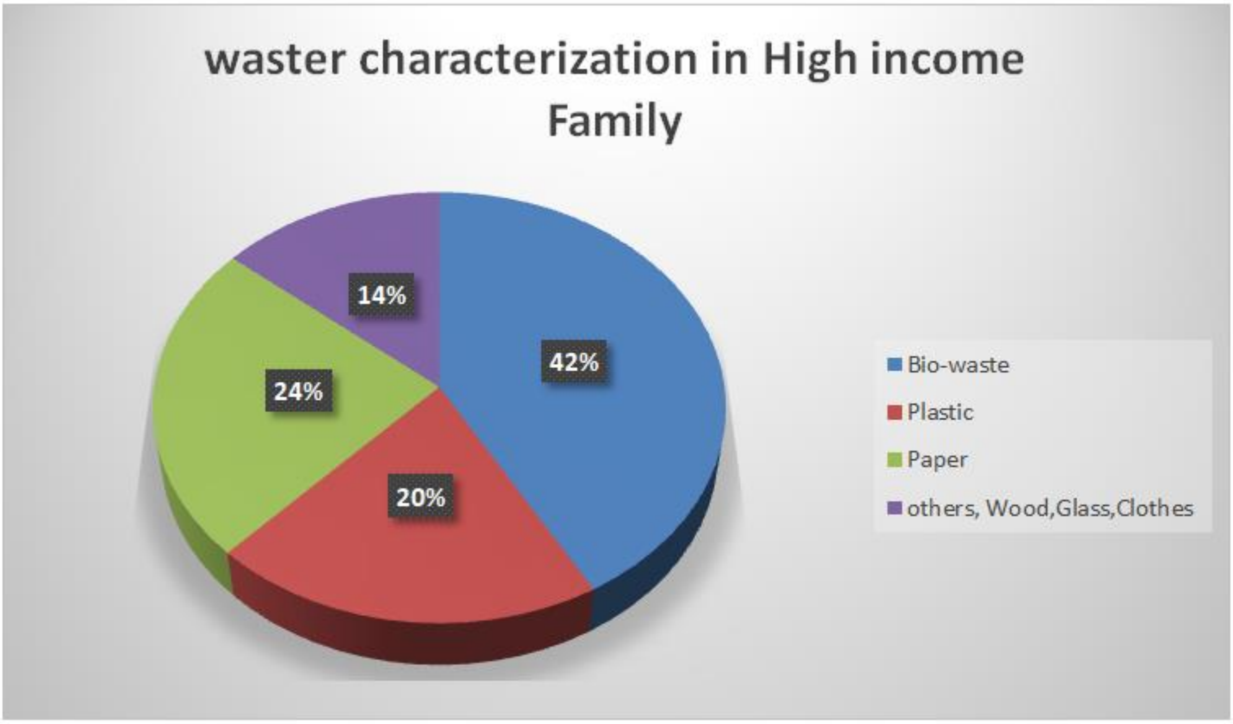


Figure 8: Pia-Chart Representation of Waste in High Income Household

Calculate Waste Generation rate

Average per capita generation rate: $\frac{0.28+0.48+0.57}{3}$ **=0.44 (kg/cap/day)**

Tuensang town Inhabitants as on 2023 –hirta = 49,000
0.44 kg/cap/day x 49000 = 20560 kg/day or 21 tonnes per day (TPD)

Characterization
Waste generation per cap.generation rate (kg/cap/day)

1 Day	Weekly	Yearly	Per person/ seasonal
0.44	0.44 x 7 = 3 kg	3 x 52 = 156kg	156divide 4 = 39kg

6. DISCUSSION

Characterization

Some of the general observations associated with the composition of waste include the following:

The major constituents are biotic waste organic waste and paper waste. More often than not, metal, glass ceramic, textile, dirt and wood from part of the composition, and their relative proportion depends on local environmental factors.

Solid waste composition varies with the socio-economic status within a particular community.

For example, income determine the life style, composition pattern and cultural behaviour. Solid waste generation rates from all the income levels during weekdays and weekends are shown in.

Physical composition
Low income family Household

Figure 2 and Figure 3 shows physical composition of solid wastes during week days and weekend respectively from low income family. Bio-waste, occupied the highest portion of the waste generated during weekend followed by plastic and paper waste and others waste composed of clothes, woods and pins etc. There is no food waste has been found in the weekends but paper, plastic, woods, and other biodegradable waste has been observed.

The reason no food wastes were generated during weekends might be due to controlled cooking as parents are present during weekends but at work places during weekdays resulting in misuse of food by children. It was surprising to find a large percentage of bio- wastes in low income households were observed which may be due to food wastes is been feeding to the pigs, as many family is rearing pigs. However, others biodegradable waste is generating more.

These findings are comparable to studies conducted is shown below, Bio-waste (food, vegetable Trimmings (55%), plastic (18%), others waste-E-waste, clothes, pins (15%), paper (12%).

Many retail stores in the town use plastics for packing items bought by their customers which could be the reason behind for the presence of plastic wastes in the sample study.

Middle income Family Household

Figure 5 and figure 6 below show the physical composition of solid wastes during weekdays and weekends respectively. Unlike low income family the additional waste also contains tins and glass in the others waste, Bio-waste (31%), other waste-glass cans, tins etc (25%), plastic waste (22%) and paper waste (22%). The glass portion was dominated by soft drink bottles indicating that households have extra income to buy these items. In addition, tin wastes was from food staff. High percentage of Bio waste has been observed in the weekened of food wastes generated during weekdays might be due to misuse b children as parents spend most of the time at work places during weekdays.

High Income family Household

Figure 8 and Figure 9 show the results from high income households during weekdays and weekends respectively. The results still reveal high proportion of food there were new wastes generated which were textile and timber an cans from soft drinks and other construction wastes.

These results reveal that as the level of income rises, the composition of wastes generated increases. As weekday waste generation for low income household was 81 kg, medium income 132.54 kg and high income family household was 153kg respectively.

This could be due to people affording a variety of things which they can purchase and then disposing old or those items they render useless. It was observed that paper wastes were the second and plastic third dominant composition further suggesting that high income people afford socialising during weekends.

The presence of glass, tin, paper/cardboard and plastic wastes suggest that recycling of wastes is not practiced in the area.

All these wastes were stored in the same containers further suggesting that no recycling was practiced in the town.

Public attitudes towards wastes and waste management in the country have been reported as often problematic and no encouragement from the political institutions. Lack of political pressure towards waste management might have contributed towards lack of solid waste recycling and reuse as observed in this study.

Limited technologies and good practices for waste management, lack of equipment for the collection of sorted materials have been reported to hamper the development of waste separation programs.

Life styles, climate, economic status and region influence the physical composition of wastes [3].

The researchers go on to report that in regions with high living standards, wastes are composed of plastics, paper and textiles mainly. This contrasts the findings in this study where it was observed that food wastes in high income households dominate followed by glass wastes and plastic and paper/cardboard followed.

These results suggest high wastage of food in all categories of households studied suggesting a culture of cooking large quantities of food. The results show that organic waste is the highest component in all the samples. The high quantity of food waste has been reported to pose environmental problems as leachate at landfills results from the organic fraction of the solid wastes [4]. At the same time this might not be good for resource recovery, Owamah *et al*., [5].

Knowing the composition of solid wastes will help in evaluation of disposal methods as well as planning for resource recovery, reuse, recycle and the types of storage facilities and transportation needed.

High percentage of food wastes and papers present could further motivate studies on the possibility of using these wastes for the production of biofuel and manures generation. In addition, composting possibility using organic wastes can be studied which will be a source of soil amendment for horticulture purposes

Present of high percentages of plastic, glass, tin, cans in the high income family and medium income family motivate people to embark on recycling and therefore generate income for themselves.

Though recycling is encouraged in the town, this study has shown that there is need for public awareness education in this area and this should be supported by the provision of storage containers in each household or at strategic locations for recycling purposes.

CONCLUSION

The composition of solid wastes in the studied area is mainly dominated by food wastes. Highest quantities of wastes were generated during weekends in middle and high income households but weekdays in low income households. There was a significant difference between wastes generated during weekdays and weekends. Solid wastes generation rate ranged from 0. 28 kg/capita/day to 0.57 kg/capita/day. In average per capita generation rate (kg/cap/day) is o.44kg of solid waste per percent in day and 21 tonnes per day (TPD) in the town.weekly 3kg /cap/day and 156kg of solid waste in a year.

The high percentage of food wastes could have led to high moisture content observed in waste samples.

The findings of this study can be used for planning for solid waste management by the policy makers and technical staff in the study area and towns and villages/colony having similar characteristics to the study area.

There is no scientific engineered solid waste disposal site in the Tuensang town and the results can be a starting point in planning for such.

The limitations of the study included short duration. Thus, it was not possible to observe seasonal variations during the study due to time limitations and fund shortage. It is recommended to further conduct the study for a longer period minimum of one year, seasonal variation and include transportation, storage and disposal in the research and analysis of chemical and biological composition however; this can be another scope of research.

Acknowledgement

The authors would like to acknowledge Er.T. Sangtam Chief Engineer WSSO & Sanitation PHED, Nagaland Kohima, Er.Echirang Executive Engineer, WSSO and Sanitation PHED for their inputs and ideas in the research. The authors will also want to thank the WSSO and Sanitation PHED Nagaland Kohima for funding this minor research project.

Author also would like to thank PHED Tuensang Division Executive engineer Er.Kedolhuto Punyu head of District Water Quality Testing Laboratory Tuensang PHED, for allowing me to use equipment in the analysis. I would also like to thank, Ms.Chaangkhumla, Chemist, Mr. Athriba Field worker and Prof. Abdul for their help in this project

Conflicts of Interest: The authors declare no conflicts of interest regarding the publication of this paper.

Disclosure Statement: There is no potential conflict of interest to declare.

Funding

This study was supported by WSSO & Sanitaion, Office of the Chief Engineer PHED, Kohima Government of Nagaland.

REFERENCE

- Kgosiesele, E., & Luo, Z. H. (2010). An Evaluation of Waste Management in Botswana: Achievements and Challenges. *New York Science Journal*, 3, 37-42.
- Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid Waste Management Challenges for Cities in Developing Countries. *Waste Management*, 33, 220-232. https://doi.org/10.1016/j.wasman.2012.09.008.
- Zhou, H., Meng, A., Long, Y., Li, Q., & Zhang, Y. (2014) An Overview of Characteristics of Municipal Solid Waste Fuel in China: Physical, Chemical Composition and Heating Value. *Renewable and Sustainable Energy Reviews*, 36, 107-122. https://doi.org/10.1016/j.rser.2014.04.024
- Palanivel, T. M., & Sulaiman, H. (2014) Generation and Composition of Municipal Solid Waste (MSW) in Muscat, Sultanate of Oman. *APCBEE Procedia*, 10, 96-102. https://doi.org/10.1016/j.apcbee.2014.10.024
- Owamah, I. H., Izinyon, O. C., & Igbinewekan, P. (2017) Characterization and Quantification of Solid Waste Generation in the Niger Delta Region of Nigeria: A Case Study of Ogbe-Ijoh Community in Delta State. *Journal of Material Cycles and Waste Management*, 19, 366-373. https://doi.org/10.1007/s10163-015-0426-3
- Miezah, K., Obiri-danso, K., Kadar, Z., Fei-baffoe, B., & Mensah, M.Y. (2015) Municipal Solid Waste Characterization and Quantification as a Measure towards Effective Waste Management in Ghana. *Waste Management*, 46, 15-27. https://doi.org/10.1016/j.wasman.2015.09.009
- Bertanza, G., Ziliani, E., & Menoni, L. (2018) Techno-Economic Performance Indicators of Municipal Solid Waste Collection Strategies. *Waste Management*, 74, 86-97. https://doi.org/10.1016/j.wasman.2018.01.009
- Dehghanifard, E., & Dehghani, M. H. (2018) Evaluation and Analysis of Municipal Solid Wastes in Tehran, Iran. Methods X, 5, 312-321. https://doi.org/10.1016/j.mex.2018.04.003
- Yukalang, N., Clarke, B. and Ross, K. (2017) Barriers to Effective Municipal Solid Waste Management in a Rapidly Urbanizing Area in Thailand. *International Journal of Environmental Research and Public Health*, 14, 9-14. https://doi.org/10.3390/ijerph14091013
- Yoada, R.M., Chirawurah, D. and Adongo, P.B. (2014) Domestic Waste Disposal Practice and Perceptions of Private Sector Waste Management in Urban Accra. BMC Public Health, 14, Article No. 697. https://doi.org/10.1186/1471-2458-14-697.
- https://www.census2011.co.in/data/town/801462-tuensang-nagaland.html
- Banerjee, P., Hazra, A., Ghosh, P., Ganguly, A., Murmu, N. C., & Chatterjee, P. K. (2019). Solid Waste Management in India: A Brief Review: Proceeding of 6th IconSWM 2016, Waste Management and Resource Efficiency, https://doi.org/10.1007/978-981-10-7290-1_86.
- Bhat, R. A., Dar, S. A., Dar, D. A., & Dar, G. H. (2018). Municipal Solid Waste Generation and current Scenario of its Management in India. *International Journal of Advance Research in Science and Engineering*, 7(2), 419-431.