International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 19-10-2020; Accepted: 04-11-2020; Published: 18-11-2020
Volume 2; Issue 4; 2020; Page No. 587-594

Physical composition and characteristic of solid waste in east jaintia hills district, Meghalaya, India

Shri Heipor-Uni Bang
Department of Environmental Management, William Carey University Nongmensong, Shillong, Meghalaya, India

Abstract
Waste or Unmanaged Solid waste is one of the forefront environmental challenge and perpetual issue in East Jaintia hills. Increasing population, changing consumption patterns, economic development, climate change, urbanization and industrialization are some of the responsible factors leading to anincreasinggeneration of solid waste. The quantities and composition of solid waste vary from place to place and bear rather consistent correlation with the average standard of living. This study is engaged in field investigations for quantification and analysis of physical composition of solid waste in the dumping site. An attempt has been made to analyzed food waste, leaves and Litter, ash and Dust, Papers, Plastics, Textile, Metals, Rubbers and Moisture Content by using genuine parameters in this study. The main objective is to provide certain research based recommendations and valuable assistance in preparing a sustainable and effective planning for solid waste management with special reference to the district of East Jaintia Hills, Meghalaya.

Keywords: solid waste, physical composition, moisture content

Introduction

Solid waste is the garbage, refuse, sludge and other discarded materials including solid, liquid, semisolid, or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities (Peavy, *et al*., 1985; Kumar, *et al*., 2016). Generation of solid waste and improper management or decomposition of these waste were found risingin Jaintia hills, due to the growing number of population. The rapid growth in the urban and rural areas and the changing life style of the people lead to an alarming threat to the surrounding environment. It is also due to the rise of economic activities in most part of the region, random dumping of the waste is rising in the region. At the same time the administrations of the district have not yet set up a municipal board till date to look up the matter and the institution, political social and technology framework in the district as it is most frequently not ready to deal with such problem.

Solid waste is a non-liquid waste release from domestic, trade, industrial, agricultural, mining, construction activities and from public services. With the rapid growth of population, there has been a substantial increase in the generation of solid waste resulting into the contamination of air, water and land resources and breeding ground for vermin [1]. Situation is more critical since, waste is not collected or disposed properly. Wastes were left on the street, in the market and in open grounds, or they were dumped and sometime set on fire without any precautions. These kinds of practice severely harm not only the health system of the Soil but also to human health and the ecosystem as a whole. In India especially in the rural, waste is a severe threat to the public health. Though the form of the waste is predominantly organic and biodegradable yet it has become a major problem to the overall sustainability of the environment. It is estimated that rural people in India are generating metric tons of waste per day respectively (M.C Gowda) [2]. Solid waste management has become a major environment issue in India. The per capital of MSW generated daily in India ranges from about 100g in small town and 500g in large town.(CPCB) [3] proper collection and disposal of waste is necessary to minimize the environment health impacts and degradation of land resources, profanation of vectors and unsanitary condition systematic disposal methods are composting, land filling and incineration. Looking at the composition and characteristic of the refuse of a particular city, proper disposal method can be selected as refuse characteristic varies from city to city and even within the different areas of the same city (Bhide and Sunderasan 1983) [4]. The quantities of solid waste generation of the district are ranges from 90-150 gms/head/day (appox). If these solid wasteare not managed properly, it will certainly have a negative impact on sustainable living style, local environment, and human health.In India several studies have been conducted on solid waste management in major cities like Bangalore, Delhi, Kolkata, Chennai, Mumbai, Pune etc. (CPCB, 2000), in North East India these studies are scanty (Bhuyan, 1995, Goswami and Sharma, 2007) [5]. This paper attempts to make a comprehensive study on the physical characteristic of solid waste generated in Jaintia hills and expected To provide with adequate information for sustainable management of waste.

[1] Boehlke, L,. "The effect of improper garbage disposal" Organism which is common harmful and difficult to control/
[2] Gowda, M.C., "Rural Waste Management in South India village": A case study
[3] CPCB, "Management of Municipal Solid Waste". Central Pollution Board, Delhi.2000.
[4] Bhide, A.D., and M. Sunderasan, "Solid Waste Management in developing countries": INSDOC, New Delhi 1983.
[5] Goswami, U., and Sarma, H. P., "Study of groundwater contamination due to municipal solid waste dumping in Gauwhati, city", India, Poll. Res. 26(2): 211-214, 2007

Study Area

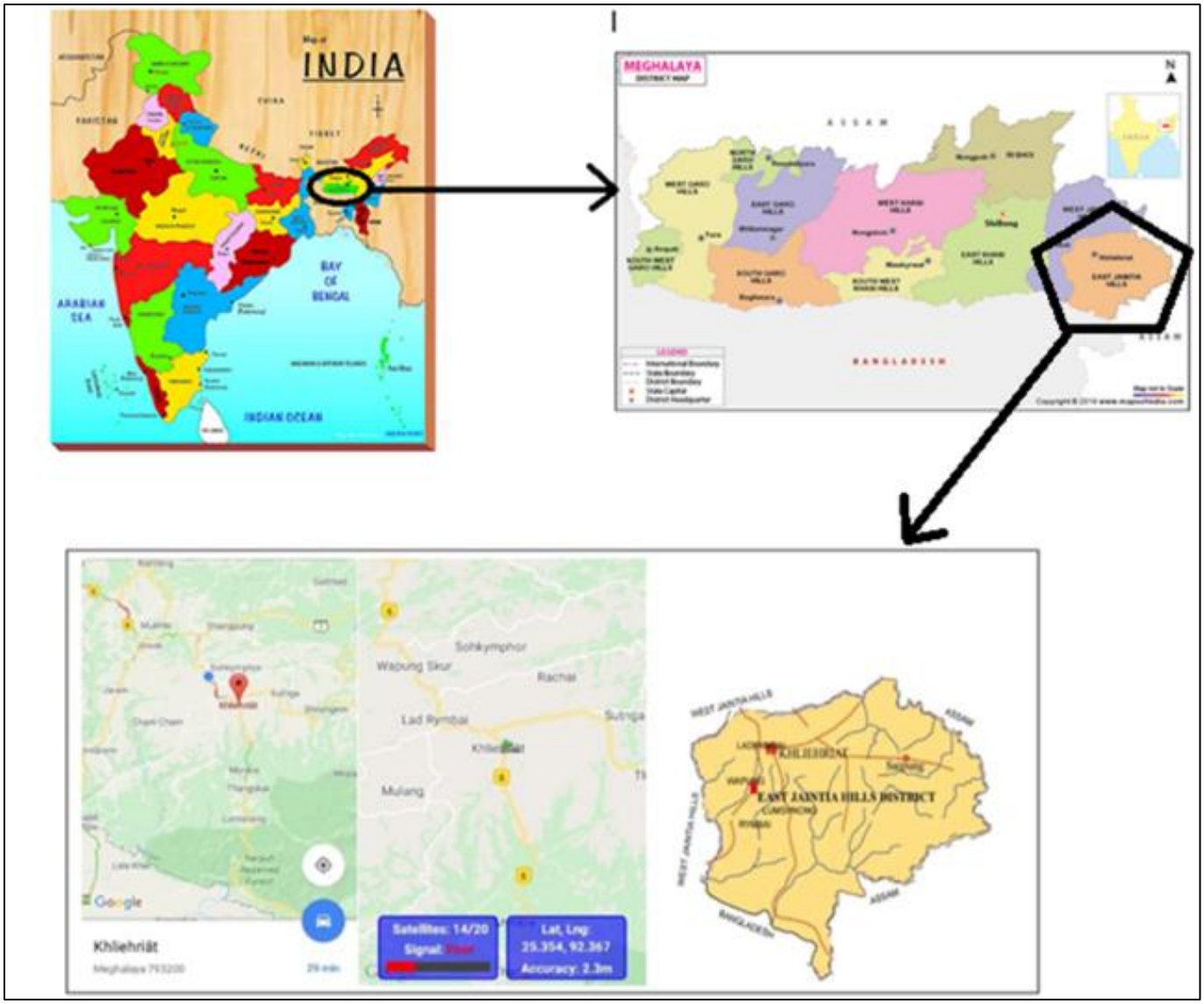

Fig 1: Location map of the Study area

The study was conducted in East Jaintia Hills District (Fig 1), one of the district of the state Meghalaya. With the bifurcation of erstwhile Jaintia Hills District into East and West Jaintia Hills District, East Jaintia Hills District came into existence on 31st July 2012 with its Head Quarter at Khliehriat. It was located at the Eastern Part of Meghalaya and stand at an altitude of 1200 meters above sea level and is located between 25˚17˜30:25˚˜40 latitude and 92˚,15˜ 20:92˚,23˜30 longitude. The district shares borders with West Jaintia Hills District of Meghalaya and DimaHasoa district of Assam in north and Cachar District of Assam in South and East and Bangladesh in the South.

The district has total geographic areas of 2,126sq.km with a population of 295,124 lakh (Census 2011) residing in 206 villages. It is the home of one of the major tribes of the state of Meghalaya popularly known as “Jaintia” or the “Pnar” and other sub tribes like the “War” and the “Biates”.

East Jaintia has a very pleasant climate. The area experiences a tropical monsoon climate.

Methodology

For selection of dumping sites field survey was performed for two months. In-depth personal interview was undertaken to collect firsthand information about the dumping sites and the characteristics of wastes. In order to ensure the representativeness of the survey samples, this study adopted apre-stratification method to determine the sample structure to be investigated. Stratified sampling is a method that randomly extracts samples (individuals) from different layers in a specified ratio from a population that can be divided into different subpopulations or called layers of waste. Four dumping sites were selected for the present study Umshyllih, Khliehriat, Ladrymbai and Rymbai in East Jaintia Hills District, Meghalaya.

Waste samples were collected for a period of one year from December-2018 to November-2019, from the four villages.

Collection of sample

10kg of waste have been taken from four different sides of each dumping site in every season of the year and physically sorted out and analysis was done. Physical separation methods are simple and economically sound but they suffer from metal losses and ineffectiveness at fine sizes.

To determine the moisture content, the entire sample was weighted to obtain the Wet weight (W^w) and after drying, the dry weigh (W_d) was measured.

Therefore,

$$M.C = \left(\frac{W^w - W_d}{W^w}\right) \times 100$$

The value of hydrogen ion-concentration (pH) of water was determined by using pH meter. Organic carbon and organic nitrogen were analyzed by standard method (Walkley and Black method, 1934).

Data was verified and analyzed statistically through SPSS.

Result and Discussion

At the onset of research the area was surveyed for selection of dumping sites and observation was done for determining the composition of solid waste. The major components of waste in EastJaintia Hills District are of various composition in nature which include food waste, leaves, papers, wood scraps, textiles, plastics, metals, glass and rubbers ash and dust was collected after separation of other waste particles. The present study was conducted to know the physical composition of the solid waste in East Jaintia Hills District. Growing developments and rising incomes lead to greater usage of resources and waste composition is influenced by factors such as extent of urbanization, standard of living and climate change (Endolse and Habtom 2014) [6].

Table 1: Number of Sample and period of Testing from each Dumping Sites

Sl. No	Place	No. of Sample Taken	Period for Testing			
			Winter	Spring	Summer	Autumn
1	Umsyllih	16	Dec 2018 To Feb 2019	March 2019 To April 2019	May 2019 To Sep 2019	Oct 2019 To Nov 2019
2	Khliehriat	16				
3	Ladrymbai	16				
4	Rymbai	16				
Total		64				

Total number of samples taken for the characteristics of solid waste was 64. The physical characteristics of solid waste were analyzed for four seasons during the period of one year, from Nov-2018 to Nov-2019. Table 1 shows the sample's Location (Umsyllih, Khliehriat, Ladrymbai and Rymbai) and period of collection of all the samples. 16 samples were taken from every dumping site to identify the different parameters of Physical composition of Solid Waste.

Fig 2: Location of four Dumping site

Table 2: Percentage of Physical Composition of Solid Waste at Umsyllih dumping site

Sl No.	Parameters	Site I	Site II	Site III	Site IV	Average
1	Physical Appearance	Light Brown	Light Brown	Light Brown	Light Brown	Light Brown
2	Texture	Mixed	Mixed	Mixed	Mixed	Mixed
3	Food Waste (%)	24.3876959	25.51292454	37.33816107	34.77508651	30.503467
4	Leaves and Litter (%)	10.6326175	12.51883621	13.40794382	9.630911188	11.54757719
5	Ash And Dust (%)	49.9245502	40.63985163	35.85692341	34.79815456	40.30486995
6	Papers (%)	6.99941962	10.15416715	2.205398288	4.209919262	5.892226079
7	Plastic (%)	3.15728381	3.315173293	4.388852315	3.517877739	3.594796789
8	Wood Scraps (%)	3.56355194	6.027587806	6.671055519	11.64936563	6.977890224
9	Textiles (%)	0.03482298	0.04636606	0.010972131	1.211072664	0.32580846
10	Metals (%)	1.1027278	1.460530891	0.021944262	0.046136101	0.657834764
11	Glass (%)	0.19733024	0.2318303	0.098749177	0.14994233	0.169463011
12	Rubbers	0	0.09273212	0	0.011534025	0.026066536
13	Total	100	100	100	100	100

Values are in Percentage on wet weight basis

[6] Endalu, L., and T. Habatom, "Characterization and disposal of Municipal Solid waste": A Case study, Hosanna Town American Journals of Environmental engineering 4:62-168,2014.

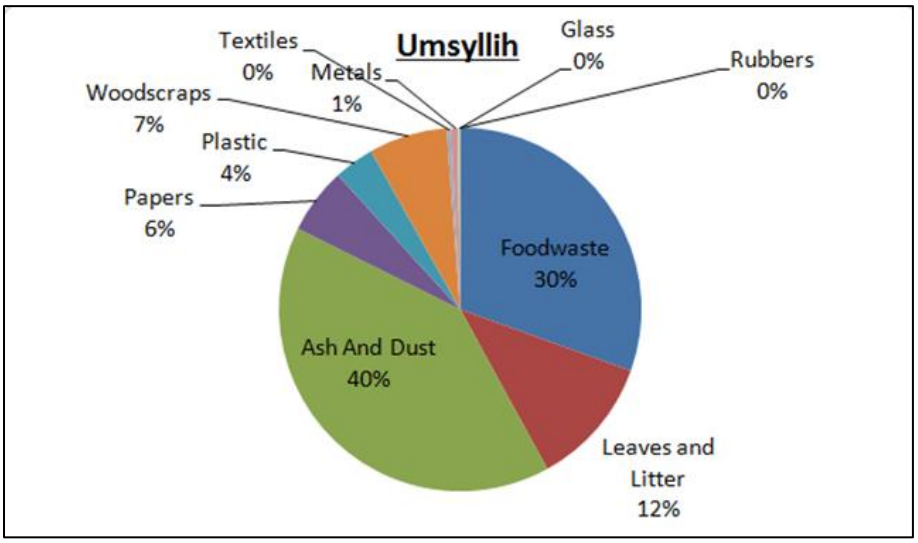

Fig 3: Pie chart of Physical Composition of Solid Waste at Umsyllih

Physical appearance of the waste in Umsyllih is light brown in color, ash and dust contributes the highest proportion 40.30% this is due to large amount of debris from demolition and construction of road and buildings

Deposited in the area, followed by food waste (30.50%), woodscrap (6.97%), papers (5.89%), leaves and litters (11.54%), plastics (3.59%) metals (0.65%), glass (0.16%) and rubbers (0.02%) (Table 2 and Fig 2).

Table 3: Percentage of Physical Composition of Solid Waste at Khliehriat dumping site

Sl. No	Parameters	Site I	Site II	Site III	Site IV	Average
1	Physical Appearance	Light Brown	Light Brown	Light Brown	Light Brown	Light Brown
2	Texture	Mixed	Mixed	Mixed	Mixed	Mixed
3	Food Waste (%)	47.787766	46.4784191	39.0466956	34.0884574	41.8503346
4	Leaves and Litter (%)	5.9344285	5.76949652	9.75568882	7.59439051	7.26350108
5	Ash and Dust (%)	35.24543	34.7551707	38.4242468	42.0280475	37.6132236
6	Papers (%)	3.5626092	5.96526786	4.26138064	8.22006472	5.50233061
7	Plastics (%)	0.1854509	1.4510111	0.14364204	0.17259978	0.48817595
8	Wood Scraps (%)	6.4419783	4.57183657	8.13971583	4.85436893	6.0019749
9	Textiles (%)	0	0.01151596	0.05985085	1.72599784	0.44934116
10	Metals (%)	0.0029282	0.00690958	0.00119702	0.5609493	0.14299602
11	Glass (%)	0.5856344	0.81763324	0.03591051	0.5609493	0.50003186
12	Rubbers (%)	0.2537749	0.17273942	0.13167187	0.19417476	0.18809024
13	Total (%)	100	100	100	100	100

Values are in Percentage on wet weight basis

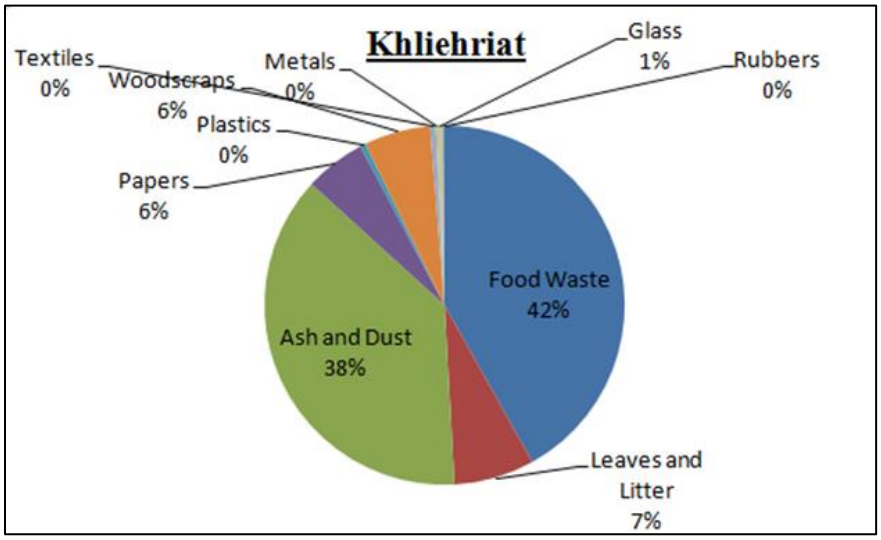

Fig 4: Pie chart of Physical Composition of Solid Waste at Khliehriat dumping site

At Khliehriat dumping site, physical analysis (Table 3 and Fig 3), revealed that the organic waste, such as food waste is of (41.85%), wood scrap (6.00%), paper (5.50%), leaves and litter (7.26%), textile (0.44%), shown higher value in comparison with other inorganic like metal (0.14%), glass (0.50%), Rubber (0.18%), ash and dust (37.61%).

The reason of the increasing of organic matter than the inorganic matter is due to the increase of human activities and population in the area. At the same time Khliehriat being the head quarter of the district, migration and settlement of people is increasing, more institution of both government and private sector was set up.

Table 4: Percentage of Physical Composition of Solid Waste at Ladrymbai dumping site

Sl No	Parameters	Site I	Site II	Site III	Site IV	Average
1	Physical Appearance	Light Brown	Light Brown	Light Brown	Light Brown	Light Brown
2	Texture	Mixed	Mixed	Mixed	Mixed	Mixed
3	Food Waste	42.33260938	26.1915173	47.1128609	35.356793	37.748445
4	Leaves and Litter	4.269458521	9.61958898	13.8582677	2.49647627	7.5609479
5	Ash and Dust	36.29039743	28.6510713	26.4566929	42.1175852	33.378937
6	Papers	6.357780624	10.0131176	0.31496063	5.16018061	5.4615099
7	Plastics	6.357780624	9.02929602	2.09973753	7.22664182	6.178364
8	Wood Scraps	2.032633513	5.58592042	9.97375328	7.46553907	6.2644616
9	Textiles	0.003712573	9.45561871	0.03937008	0.00238897	2.3752726
10	Metals	2.320357892	0.06558811	0.11811024	0.00716692	0.6278058
S11	Glass	0.027844295	1.37735024	0.02624672	0.0955589	0.38175
12	Rubbers	0.007425145	0.01093135	0	0.07166918	0.0225064
13	Total	100	100	100	100	100

Values are in Percentage on wet weight basis

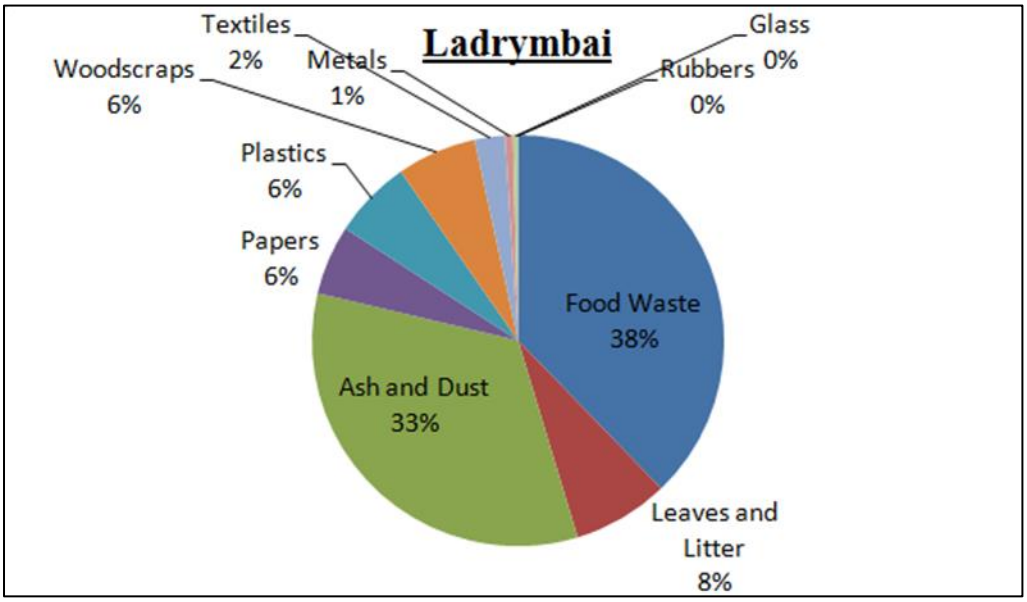

Fig 5: Pie chart of Physical Composition of Solid Waste at Ladrymbai dumping site

At Ladrymbai dumping site, (Table 4 and Fig 4), all the parameters including organic matter like food waste (37.74%), papers (5.46%), wood scraps (6.26%), textile (2.37%) and inorganic matters like plastics (6.17%), ash and dust (33.37%), metals (0.62%), glass and rubbers (%) found to be higher in percentage.

When compared to the parameters of the other dumping site. Since, the oldest and the biggest daily market are located in this region, which include more than 300 shops, 3 shopping malls, 6 institutions, 5 restaurants and hotels and few factories are being set up. Being the transit point in the District the percentage of waste is comparatively higher in Ladrymbai.

Table 5: Percentage of Physical Composition of Solid Waste at Rymbai dumping site

Sl No	Parameters	Site I	Site II	Site III	Site IV	Average
1	Physical Appearance	Light Brown	Light Brown	Light Brown	Light Brown	Light Brown
2	Texture	Mixed	Mixed	Mixed	Mixed	Mixed
3	Food Waste (%)	28.7763513	38.1249524	38.08974	43.07325	37.0160734
4	Leaves and Lither (%)	8.35522793	7.47025848	11.4355201	7.04514765	8.57653855
5	Ash and Dust (%)	48.4379086	35.1698247	32.0833282	36.9870252	38.1695217

6	Papers (%)	4.05932087	2.60000507	5.65020328	5.18601147	4.37388517
7	Plastics (%)	7.11003748	10.1590442	4.31135077	1.80042662	5.84521477
8	Wood Scraps (%)	3.23749517	6.4175735	8.35247442	5.83181667	5.95983994
9	Textiles (%)	0.0124519	0.03804885	0.0736983	0.00587096	0.0325175
10	Metals (%)	0.00249038	0.00760977	0	0.00195699	0.00301428
11	Glass (%)	0.00871633	0.01268295	0.00245661	0.00978493	0.00841021
12	Rubbers (%)	0	0	0.00122831	0.05870956	0.01498447
13	Total	100	100	100	100	100

Values are in Percentage on wet weight basis.

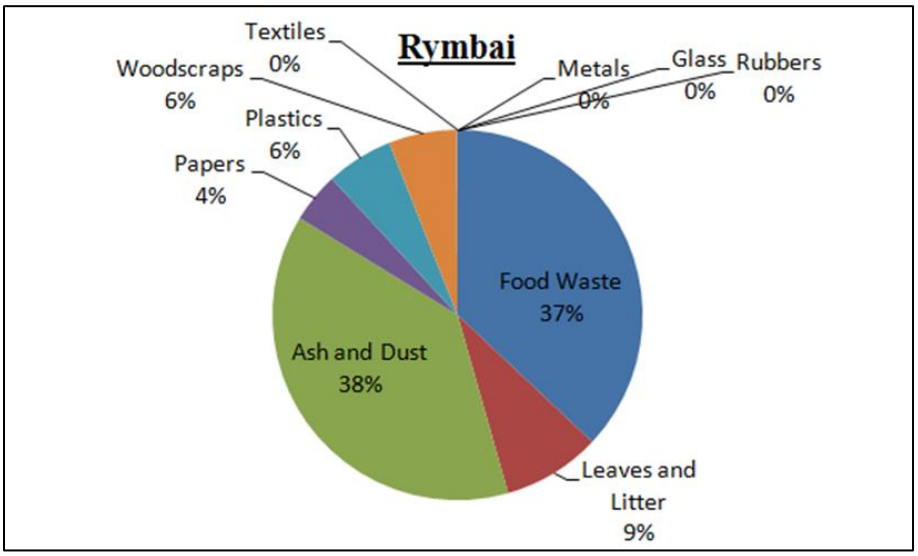

Fig 6: Pie chart of Physical Composition of Solid Waste at Rymbai dumping site

At Rymbai dumping site, (Table 5 and Fig 5), revealed that leave and litter (8.57%), paper (4.37%), wood scrap (5.95%), textile (0.03%), plastic (5.84%) shows increasing in percentage due to the increasing of population and their activities which consisted 4788 population residing in 764 house hold. Food waste (37.01%) shows less content comparing to other dumping site like Khliehriat (41.85%) due to the fact that most of the house hold practiced compost pit within their garden. Other tested parameters like metal (0.03%), glass (0.08%), and rubber (0.01%) shows slightly to zero percentage as the village authority prohibited from setting up of any factories and small cottage industries in and around their jurisdiction. Whereas ash and dust shows (38.16%) higher percentage mainly due to construction and demolition.

Table 6: Average Percentage of Physical Composition of Solid Waste in all the dumping sites

Sl No.	Parameters	Umsyllih	Khliehriat	Ladrymbai	Rymbai	Average of East Jaintia Hills District
1	Physical Appearance	Light Brown	Light Brown	Light Brown	Light Brown	Light Brown
2	Texture	Mixed	Mixed	Mixed	Mixed	Mixed
3	Food Waste (%)	30.503467	41.85033455	37.748445	37.01607343	36.77958003
4	Leaves and Litter (%)	11.54757719	7.263501081	7.5609479	8.576538548	8.737141172
5	Ash And Dust (%)	40.30486995	37.61322363	33.378937	38.16952168	37.36663799
6	Papers (%)	5.892226079	5.502330606	5.4615099	4.373885175	5.307487932
7	Plastic (%)	3.594796789	0.488175955	6.178364	5.845214771	4.026637879
8	Wood Scraps (%)	6.977890224	6.0019749	6.2644616	5.959839941	6.301041659
9	Textiles (%)	0.32580846	0.449341164	2.3752726	0.032517505	0.795734928
10	Metals (%)	0.657834764	0.142996016	0.6278058	0.003014284	0.357912713
11	Glass (%)	0.169463011	0.500031859	0.38175	0.008410206	0.264913779
12	Rubbers (%)	0.026066536	0.188090237	0.0225064	0.014984467	0.062911915
	Total	100	100	100	100	100

Values are in Percentage on wet weight basis

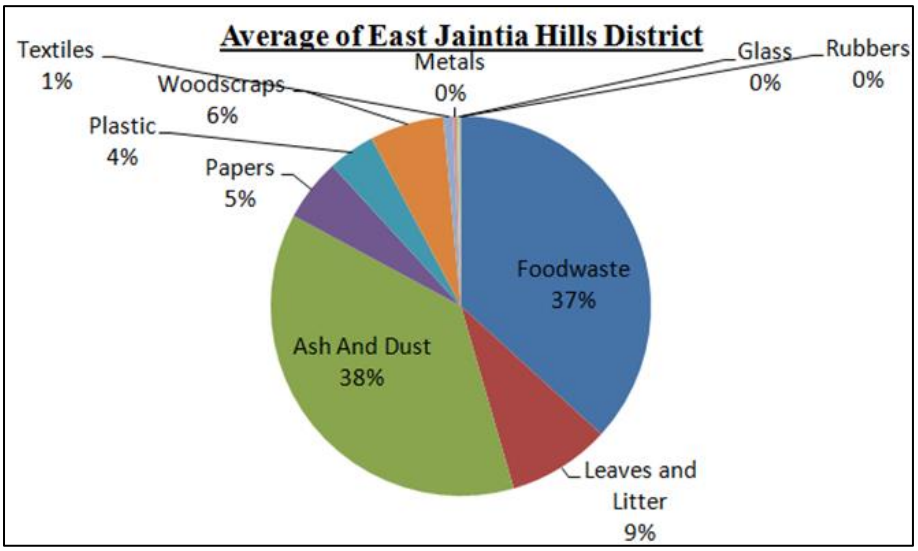

Fig 7: Pie chart of average Physical composition of Solid Waste of all the four dumping sites

It is evident from the table (Table: 6) that organic wastes form the largest percentage of solid wastes in the area. Since there is no previous study conducted in this region, consequently no data is available to compare with the present analysis. As per the result, it is found that the Physical composition of solid waste, both organic and inorganic is comparatively higher than the preceding year, it has now reached an alarming stage, due the negligibility of the district administration towards the management of solid waste. The situation will become more sensitive and vulnerable in times to come. In order to cope with this changing condition, the government must take up steps to intervene into the matter with seriousness.

Table 7: Moisture Content, pH Scale, Carbon, Nitrogen, and C/N ratio of all the four dumping sites

Sl No	Place	Moisture Content	pH Scale	Carbon	Nitrogen	C/N Ratio
1	Umsyliih (%)	52.19	6.72	4.52	0.23	19.44
2	Khliehriat (%)	53.39	6.87	5.53	0.23	23.9
3	Ladrymbai (%)	56.47	6.77	6.37	0.28	22.86
4	Rymbai (%)	54.23	6.83	5.36	0.24	17.14
5	Average (%)	54.07	6.79	5.44	0.24	20.83

Values are in Percentage on dry weight basis**.**

Physical analysis of the solid waste reveals that the moisture content of the waste ranges between 52.19% to 56.47% (Table 7). Since Municipal Solid Waste (MSW) required 50-60% of moisture content for the purpose of composting (Ingle and Mali 2000) [7], the solid waste may be considered for biological composting. Organic carbon, organic nitrogen and pH of waste vary between 6.72-6.87%, 4.52-6.37% and 0.23-0.25% respectively and the C/N ratio ranges from 17.14-23.9%.

Based on the finding and result of the study, it is observed that the solid waste in East JaintiaHills is not being well collected, segregated, stored and transported. The organic matter can neither be composednor used directly as manure whereas the inorganic matter can be used directly for sanitary land filling or other recycling process as it is not good for the consumption of the living organism. This study is concluded with few suggestions, which may encourage the competent authority and researchers to deal the situation with sincerity towards further improvement of the present scenario.

Conclusion

From our analysis it was found that all the samples were light brown in color. The study revealed that organic matter of waste is highest which depicts that the District is still not technologically very high. From the observation and finding of the present study it is found that the growing population and rising demand for food and other essential needs has tremendously contributed towards the spillingof waste. However, in addition to this, unscientific and ignorance from the concerned authority requires an immediate attention. Waste that is not properly managed may cause serious health hazardand lead to spread of infectious diseases and destroy the aesthetic value and beauty of nature. Therefore it is important to consider this issue from the grass root level.

The present study recommends a very comprehensive policy approach that will take into consideration the specific solid waste management in East Jaintia Hills. As solid waste management is increasingly becoming a problem in the localities, perhaps as a first step, the local government authorities need to integrate the operations of the hitherto neglected solid waste management into an overall solid waste management system. This is because public

[7] Ingle, S.T., and D.S. Mali "Solid Waste Management System for Kolhapur city Maharashtra" Maharashtra,2000

health and the environment cannot be protected without extending basic environmental services to all localities in East Jaintia Hills. However, further research is required to develop new, cost effective and environmentally friendly processes.

Suggestions

Identify the best available technologies to treat waste and where we can we add value to the wastes that are generated through material recycling and reuse.

Carefully planning transportation requirements, making sure that safe, compliant and reliable service execution is maintained.

Government to look after the Waste Management in East Jaintia Hills District, as it is an utmost need of the hour for the higher authority to look into this matter by activating functional environmental or waste management committee/ program in the semi urban as well as the rural setting.

Sustainable solid waste management is essential in the study area. The people residing in East Jaintia Hills District especially in the villages need to be sensitized and educatedregardingSolid Waste Management in the district, through awareness program which should be organized by the concern authority.

Environment friendliness, cost effectiveness, and acceptability to the local community are major attributes to achieve efficient solid waste management in East Jaintia Hills.

Acknowledgement

I would like to express my sincere gratitude to my supervisor and mentor, Dr. Maitreyee Roy (Associate professor Environmental Department, William Carey university) for her patient, motivation, enthusiasm, immense knowledge and also her invaluable guidance, encouragement, comment and good suggestion which has deeply inspired me throughout the course of the study. It was a great privilege and honor to work and study under her guidance and supervision.

References

1. Bhide AD, Sunderasan M. “Solid Waste Management in developing countries”: INSDOC, New Delhi, 1983.
2. Bhuyan MS. Waste management practices in rural households of Assam, Eco. And Envt. And Cons. 1999; 5(4):395-397.
3. Boehlke L. “The effect of improper garbage disposal” Organism which is common harmful and difficult to control/CPCB, “Management of Municipal Solid Waste”. Central Pollution Board, Delhi, 2000.
4. Endalu L, Habatom T. “Characterization and disposal of Municipal Solid waste”: A Case study, Hosanna Town American Journals of Environmental engineering. 2014; 4:62-168.
5. Goswami U, Sarma HP. Study of groundwater contamination due to municipal solid waste dumping in Gauwhati, city, India, Poll. Res. 2007; 26(2):211-214.
6. Gowda MC. “Rural Waste Management in South India village”: A case study Ingle, S.T., and D.S. Mali “Solid Waste Management System for Kolhapur city Maharashtra” Maharashtra, 2000.
7. Ingle ST, DS Mali. “Solid Waste Management System for Kolhapur city Maharashtra” Maharashtra, 2000.
8. Kumar S, Dhar H, Vijay VN, Bhattacharyya JK, Vaidya AN, Akolkar AB, *et al*. Characterization of municipal solid waste in high-altitude sub-tropical regions. Environmental Technology. 2016; 37:2627-2637.
9. Peavy HS, Donald Rowe, George Tchobanoglous. Environmental Engineering McGraw-Hill Company, USA, 1985, 326-560.