A study on plastic waste generation in Aizawl city, Mizoram

Anil Pratap Singh¹ and Dr. Angom Sarjubala Devi²

^{1,2}Department of Environmental Science, Mizoram University,
Aizawl, Mizoram-796004, India

Abstract

Plastics waste assessment was carried out during year 2017-20. Maximum plastic waste generation per capita per year was observed in Central locality with 5.56 ± 0.99 Kg and least in South locality with 4.34 ± 1.14 Kg. Maximum plastic waste generation per capita per day was found in Central Locality 20.03 ± 1.76 g and least in South locality 15.71 ± 1.61 g. Result of ANOVA analysis shows significant difference among various localities in terms of plastic waste generation per capita per year ($F_{4,10}=20.07, P<.005$), and plastic waste generation per capita per day ($F_{4,10}=18.33, P<.005$). Maximum amount of plastic waste/household was generated during winter season with 10.30 Kg/household. Minimum amount of plastic waste/household was generated during rainy season with 8.13 Kg/household. The result of ANOVA test reveals that there was significant monthly variation in household generation of plastic waste during year 2017-18 ($F_{8,664}=3.41, P<.005$), 2018-19 ($F_{8,664}=3.43, P<.005$), 2019-20 ($F_{8,664}=3.42, P<.005$).

Keywords: waste, plastic waste, waste management, waste generation

1. Introduction

In India approximately 9.4 million TPA plastic waste is generated per year, which amounts to 26,000 TPD out of this, about 60% is recycled, most of it by the informal sector. While the recycling rate in India is considerably higher than the global average of 20%, there is still over 9,400 tonnes of plastic waste which is either landfilled or ends up polluting streams or groundwater resources. While some kinds of plastic do not decompose at all, others could take up to 450 years to break down.

Most common use of plastics is packaging which is discarded after use. Around 50% of plastic is discarded as waste after single use. Single use plastics (SUP) like cups, plates, straws, stirrers, bottles, food containers are substantial sources of plastic pollution.

Around 8 million tonnes of plastics enters in ocean every year. Microplastics are rising in oceans and is being ingested by marine creatures. Certain chemical are added to make plastics more flexible, fire resistant and durable. These chemical are Polybrominated Biphenyls, Bisphenols, Phthalate esters etc. once released from plastic, upon degradation these chemicals can have serious

health implications thereby affecting reproductive, endocrine system and central nervous system. Unmanaged plastic waste gets littered everywhere destroys aesthetics of place. Solution to present problem can achieved through concerted means of stringent legislations, enhancing collection and recycling, suitably substituting plastics with biodegradable alternatives, raising public awareness and taking up cleanup measures. In light of growing concern over plastic waste problem and lack of reliable data and statistics regarding plastic waste, assessment was done in various localities of municipal area during 2017-20

2. Materials and Methods

Aizawl the capital of Mizoram is selected as study area. It is located in the northern part of Mizoram at north of the Tropic of Cancer. It is situated on a ridge 3715 feet above the sea level. Aizawl is geographically located at $23^{\circ}43'59''$ N latitude and $92^{\circ}43'00''$ E longitude. The total geographical area of Aizawl city is 3,576,000 hectare which is about 16 % of the state area of Mizoram with a population density of about 112 persons per sq. km as per 2011 census. The population of Aizawl city is 404,054 as per Census 2011 with a decadal growth rate of 24.07 per cent. The city is divided into 19 wards for administrative purposes. The civic administration in the city of Aizawl falls under the jurisdiction of Aizawl Municipal Corporation.

Waste quantification and characterization of plastic waste in residential area focused on measurement of plastic being generated and further assessment of physical categories and chemical characteristics of plastic waste. 385 households representing North, South, East, West and Central Aizawl were surveyed during 2017-18, 2018-19, 2019-20. Every year survey was conducted for 9 months duration and data was collected monthly, covering 3 seasons Winter (November, December, January), Summer (March, April, May), Rainy (July, August, September). Plastic waste assessment in residential area was conducted according procedure followed Thanh et al., 2011. Plastic waste assessment and characterization in residential and commercial area were done according to Plastic waste assessment guidelines established by UNEP (2009), Household survey guidelines (2005) by Department of Economic and Social Affairs while Identification of

plastic polymer type was done according to procedure established by Harris and Walker, 2010.

3. Results and Discussion

Several factors influence the quantity, physical and chemical characteristics of waste generated at various sources. Factors such as employment status, household size, seasons, income level and population influence the variation in the composition of MSW waste streams. One of the major factors leading to variation in the quantity and morphological composition of municipal solid waste is the season. Changes in weather conditions at different seasons in a year affect consumption pattern and human activities and influences the fractions of the waste stream such as plastics, paper, metal, textile and organic waste (Denafas et al., 2014). Seasonal variations in generation of waste have been observed in various studies done previously by Kamran et al., 2015; Gomez et al., 2009; Jadoon et al., 2014; Al Khatib et al., 2010; Zeng, 2005; Gidaragos et al., 2006; Aslani and Taghipou, 2018; Denafas et al., 2014). Possible reason for maximum plastic waste/household generation in winter season could be winters being festival season in Aizawl city it is a time when people tend to consume more evidenced by crowded markets, ongoing sales and online shopping at its peak and least plastic waste/household was generated during Rainy season. It has been observed peoples consumption pattern didn't change considerably during survey period (2017-20) as family size, yearly income and attitude and perception remained unchanged. The difference in plastic waste generation observed is due to different demography of various localities (S, N, E, C, W) as waste generation have been found to depend upon economic status, family size, cultural factors and level of awareness among members different households Buenrostro (2003); Ashley et al., 2006; Agarwal et al., 2013; Rhyner (1992).

Table1. Plastic waste (PW) generated Kg per capita per year in different localities during three years

	PW/Capita/Yr	PW/Capita/Yr	PW/Capita/Yr
Locality	2017-18	2018-19	2019-20
South	4.34±1.20	4.00±.94	4.66±1.30
Central	5.56±.86	5.47±.82	5.66±1.30
West	4.56±1.30	4.61±1.4	4.85±.83
North	4.30±.73	4.26±.98	4.59±.95
East	4.82±1.2	4.75±1.4	4.94±.94

Table2. Seasonal plastic waste generation (Kg)/household

Year	Season		
	Winters	Summer	Rainy
2017-18	10.05	8.82	7.88
2018-19	10.49	9.23	8.31
2019-20	10.37	9.14	8.2
Total	30.91	27.19	24.39
Avg	10.30	9.06	8.13

Fig.1 Physical characteristics of plastic waste at residential area 2017-20

Fig.2 Chemical characteristics of plastic waste at residential during 2017-20

In residential area plastic waste is dominated by packaging material (72.6%), Bottles (11.20%), containers (3.82%) and plastic waste belonged to PET (15.21%), LDPE (27.23%), PVC (3.17%), HDPE (22.95%), PP (16.21%), PS (9.10%).

6. Conclusions

By comparing between the five localities it was observed that during year 2017-18 maximum plastic waste was generated in West locality (2134.68Kg) and minimum in North locality (2045.94 Kg), during year 2018-19 maximum plastic waste was generated in South locality (2157.93Kg) and minimum in North locality (1994.18Kg), during year 2019-20 maximum plastic waste was

generated in West locality (2164.70Kg) and minimum in North locality (2040.34 Kg). During 2017-18 central locality generated maximum $5.56 \pm .86$ Kg plastic waste/capita/yr while minimum was observed in North locality which generated $4.30 \pm .73$ Kg plastic waste /capita/yr. During 2018-19 Central generated maximum $5.47 \pm .82$ Kg plastic waste/capita/yr while minimum was observed in South locality which generated $4.00 \pm .94$ Kg plastic waste /capita/yr. During 2019-20 central locality generated maximum 5.66 ± 1.30 Kg plastic waste/capita/yr while minimum was observed in North locality which generated $4.59 \pm .95$ Kg plastic waste /capita/yr

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