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Composition and Variation in Moisture Content of Municipal Solid Waste (MSW) in District Shopian Kashmir, J&K, India

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Abstract

The present study deals with the composition, characterization and management of municipal solid waste (MSW) generated in Shopian by analyzing the waste at 5 different study sites chosen randomly. The mean composition of waste was determined by spreading, hand sorting, and segregation of samples on the ground to determine the proportion of different components of the waste. In the current study, the proportion of compostable, recyclable, and inert waste was roughly 66 %, recyclable %, and inert 1 %. The proportion of moisture content in various waste categories ranged from 52.24 % for food waste to 0 % for rubber and leather. The moisture content percentage values indicate that the food waste in the study area is highly wet at all study sites and rubber and the leather fraction are not wet at all. Paper and cardboard fractions showed high wetness at site II. Seasonally, the food waste fraction displayed higher percentage of moisture content followed by a paper fraction, cardboard, wooden chips, and inert fraction. Analysis of variance showed insignificant variation in percentage moisture content across different seasons (F=0.0128, P=0.998) and sites (F=0.0081, P=0.9998).

Human activities are the primary source of solid waste. Due to an increase in the human population and a rise in the standard of living, the amount of this substance is rapidly expanding. Waste generation, collection, storage, transportation, and disposal, as well as reuse, recirculation, incineration, or any other acceptable disposal option, are all included in solid waste management[23]. Solid waste had not been a worry until 1950; nevertheless, the development of viral infections to pigs caught the attention of various sanitary engineers between 1953 and 1955, and trash feeding to hogs was forbidden in the United States; yet, rubbish feeding to cattle continues unabated in India. The Public Administration Department most likely began and published the first scientific research on waste management in Chicago. The fourth research on resource recovery from solid waste was published by the US Environmental Protection Agency in 1977. The characteristics and amount of solid wastes produced in a region are a result of not just the region's population,

living standards, and lifestyles, but also the richness and nature of the region's natural resources[12]. Municipal solid waste output rises as income rises from low to middle to high, and solid waste management requirements rise with it, making collection, classification, disposal, and management more complex[19]. The quantity of waste produced is increasing as a result of rapid population growth and urbanization. This has surpassed municipalities' financial and manpower resources for providing and managing solid waste services. Solid waste's physical and chemical qualities alter as population density rises[12]. In most developing-world cities and towns, improper solid waste processing and disposal is the most apparent source of environmental deterioration, whether it be air pollution, soil contamination, surface, and groundwater pollution, or other forms of pollution caused by improper solid waste disposal[24]. In Shopian Solid waste management is the duty of the Shopian Municipal Committee. Mismanagement of solid waste produced in the area is due to lack of financial and human resources, as well as organizational inefficiencies in adhering to established standards and legislation within municipal organizations. Studies on the composition, characterization, and generation rate of municipal solid waste distribution in the Kashmir Himalayan region and particularly in Shopian district appears to be a neglected area of research. A limited number of researches are available on municipal solid waste and most of them are related to the Srinagar city at the selected sites. The reports accessible on the municipal solid waste in Kashmir have been reported by Ahmed and Bhat[3] and Akhter and Najar[4]. Till date, no scientific analysis on solid waste generation and composition have been carried out so far in the area, which is the most significant hurdle in the path of proper solid waste management in the district. The current research is an attempt to assess the composition, characterization, and generation rate of municipal solid waste in the Shopian district.

Location and extent of the study area :

Shopian district of Kashmir, India is located between Latitude: 33° 43' 2.03" N and Longitude**:** 74° 50' 2.87" E at an elevation of 2146 meters above sea level. It is located on the ancient route famous as Mughal Road, and most of its land is covered with forests. The Pir Panjal Range runs through Shopian, making it quite frigid in the winter. In March 2007, Shopian was granted district status by the Government of Jammu and Kashmir. The Shopian district has a population of 265,960 people, according to the 2011 census. This places the Shopian district in 577th place in India (out of a total of 640). The population density of the district is 852 people per square kilometer (2,210 people per square mile). Its population grew at a rate of 25.85% between 2001 and 2011. The sex ratio of Shopian is 951 females per 1000 males, with a literacy rate of 62.49 percent.

Study sites :

Present research was conducted in randomly selected wards of shopian district during the period of March 2019 to December 2020. Fieldwork of the entire district was carried out to visualize the existing scenario of solid waste collection and disposal by the Shopian Municipal Committee. Five sites of the district were randomly selected. These sites were selected in consultation with the help

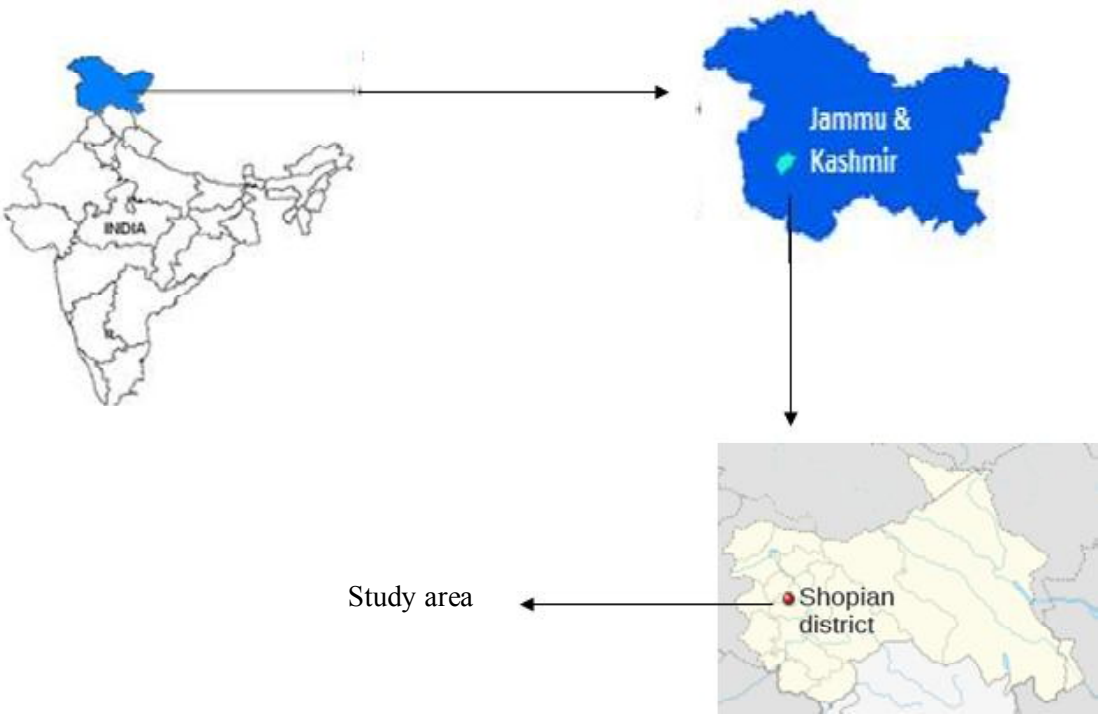

Fig.1. Map of study area

of secondary data and suggestions provided by the authorized person of the Shopian Municipal Committee.

Sampling and data collection :

Sampling of solid waste in Shopian district of Jammu and Kashmir, India was carried out on monthly basis from 2019 and 2020. Monthly waste data was converted into seasonal data by averaging over three consecutive months of a particular season. A sampling of solid waste was done at each selected site of the study area by the following methods.

Solid waste samples were collected from dustbins and open dumping sites at five randomly selected sites. Every month, at the end of the day, samples were collected from dustbins, dumping sites and placed in 5-kilogram polybags. Weighing waste using a digital balance/spring balance was used to estimate the amount of solid waste generated. The compositional study was carried out after the total waste generated at each location was estimated independently. Spreading, hand sorting and segregation of samples on the ground into distinct waste components were used to determine the mean composition of waste. The total weight of each waste component/constituent was recorded after each component/constituent was weighed individually. Finally, the components identified were classified as biodegradable or non-biodegradable[6,13,18].

Moisture content (%) was determined by weighing the entire sample of a specific category; this is called wet weight (W_W). It was then dried in an oven at 105°C till its mass became constant. In the case of combustible material, the temperature was not exceeded 70 to 75°C. After drying the dry weight (W_d) was measured.

$$\text{Moisture content} = \frac{(W_w - W_d)}{W_w} \times 100$$

The study reveals that the food waste was the biggest waste fraction (33 %), followed by cardboard (14 %), plastics (10 %), paper products (10 %), textile rags (8 %), metals (5 %), bones (6 %), wooden chips (7 %), and glass (7 %), according to the waste composition analysis. Rubber, leather, and inert each accounted for less than 1% of the total (Figure 2). The high food waste concentration shows the necessity for regular collection and disposal, as well as promising organic waste resource recovery opportunities. Plastic, paper goods, cardboard, metal, glass, rubber, leather, and textiles made up on average 7.2 % of all reusable and recyclable materials. The types and volumes of waste differ by city, and these differences are attributable in large part to the impact of consumption patterns, waste production index, demographic composition, socioeconomic and cultural level, and in large part to the impact of consumption patterns[7,9]. The features of municipal solid waste were similar to those found in previous studies conducted across India[2,5,16]. In India, around 40–60% of municipal solid waste is biodegradable, 30–50% is inert waste, and 10% to 30% is recyclable[5,14,16].

In the current study, the proportion of compostable, recyclable, and inert waste was roughly 66 %, recyclable %, and inert 1 %. Food waste dominates the composition of municipal waste, according to the data (mixed). The composition of MSW has a considerable influence on the use of appropriate waste management strategies in municipal solid waste management (MSWM). Creating a sustainable waste management scenario in India is a difficult challenge due to the varying waste composition and waste production rates. Climate change and environmental destruction are examples of how ineffective waste management may have local, regional, and global implications[1]. According to studies from other nations, food waste accounts for a considerable amount of solid waste in poor countries[20,22].

The moisture content of a substance is one of the most important elements in determining its burning properties. The proportion of moisture in the various waste categories ranged from 52.24 % for food waste to 0 % for rubber and leather. The graph (Figure 3 and 4) shows the comparison of moisture contents of the waste types at different sites. The moisture content percentage values indicate that the food waste in the study area is highly wet at all study sites and rubber and the leather fraction are not wet at all. Paper and cardboard fractions showed high wetness at site II. Seasonally, the food waste fraction displayed higher percentage of moisture content followed by a paper fraction, cardboard, wooden chips, and inert fraction. Analysis of variance showed insignificant variation in percentage moisture content across different seasons ($F=0.0128$, $P=0.998$) and sites ($F=0.0081$, $P=0.9998$).

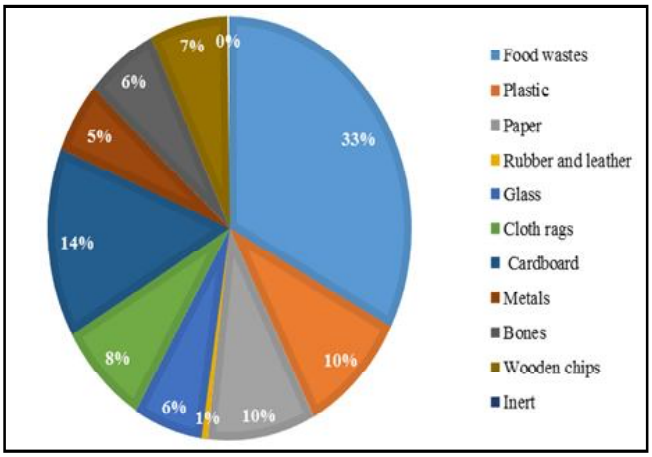

Figure 2. Composition of municipal solid waste at the 5 sites of the Shopian Municipality (%)

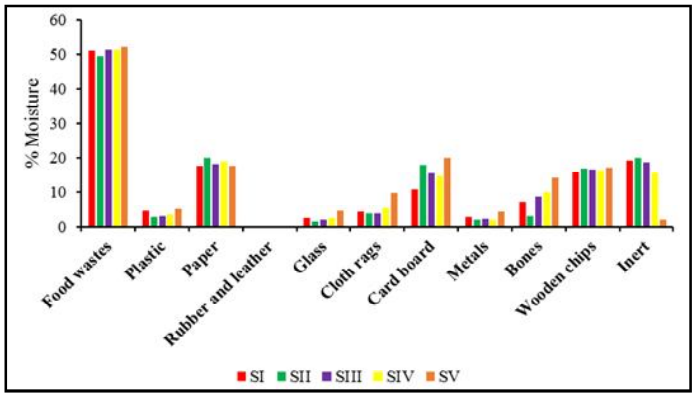

Figure 3. % Moisture content of different municipal solid waste types at different sites.

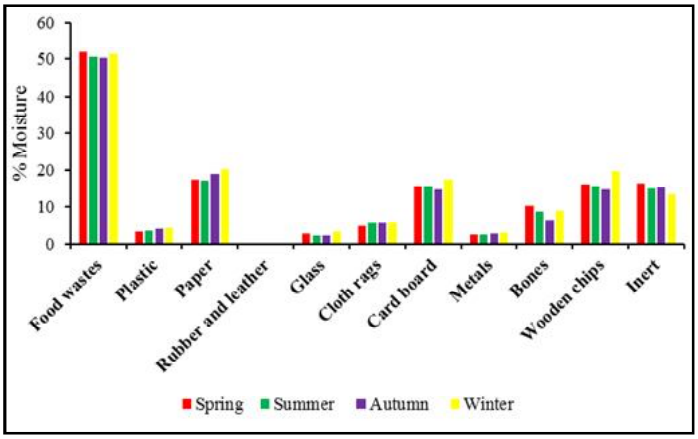

Figure 4. % Moisture content of different municipal solid waste types across different seasons.

The moisture content of the municipal solid waste collected for this investigation ranged from 52.24 % for food waste to 0% for rubber and leather. One of the most critical factors in defining a material's burning properties is its moisture content. Material with higher moisture content takes longer to burn. It will also have an impact on the usable energy derived from garbage[10]. Because of people's eating and cultural habits, garbage in developing nations like India has a high percentage of biodegradable materials (approximately 35-60%) and has greater moisture content and density[15,17]. Organic waste with high moisture content predominates in India, whereas packaging trash with low moisture content, such as paper, cardboard, plastic, and other materials, predominates in other industrialized nations. When comparing trash output trends across Indian states and regions, the volume, quality, and type of garbage produced all differ. The moisture content of most cities and states is high, whereas the calorific value is low. According to most Asian nations' solid waste, which is largely made up of an organic portion with high moisture content, it is highly biodegradable[21]. Food waste, plastic/foam, paper, rubber/leather, wood/ grass, metal, glass, and textiles are all components of MSW. The accumulation of urban solid waste in mountainous places has significant cascading effects on the lower valley. During peak tourist influx (including Hindu Pilgrimage; Yatra), the growth of MSW in forest regions was considerable, endangering all environmental requirements if adequate disposal did not occur at the appropriate time[8].

The study reveals that the solid waste generated in district Shopian is composed of a large proportion of biodegradable and recyclable materials and a small portion of non biodegradable components. The moisture content of these components vary from place to place as well as season to season. As we know that moisture increases the weight of solid waste and thus an increase in the cost of collection and transportation thus needs insulation from rainfall and other extraneous water and is a critical parameter for degradation of solid waste in landfills and the amount of energy needed for incineration. Thus the present study with regard to moisture component (%) can be utilized as a crucial parameter for the determination of economic feasibility of waste processing and treatment methods.

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