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RESEARCH ARTICLE

MUNICIPAL SOLID WASTE GENERATION AND PRESENT SCENARIO OF WASTE MANAGEMENT DURING YATRA SEASON IN PAHALGAM: A TOURIST HEALTH RESORT OF KASHMIR VALLEY

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ABSTRACT

The increasing municipal solid waste (MSW) generation along with high fraction of organic, recyclable and other types of wastes is the current scenario in religious places and many tourist resorts of Kashmir valley in India. As a response to this problem, we carried out a study on municipal solid waste (MSW) generation and present scenario of municipal solid waste management (MSWM) during Yatra season (July-August 2011) in Pahalgam. The purpose of study was to evaluate the quantity, composition of MSW generated by Yatries, to recommend appropriate management practices. The study was based on three sites with marked differences in their physical and biotic features. The generation of municipal solid wastes (MSW) during Yatra season was too high, which could alter all environmental parameters if proper disposal could not occur at right time. The maximum net weight of MSW was observed at site3 (442.17 Kg/day), while as minimum was observed at site1 (55.92Kg/day). Among the constituents of solid wastes the net weight (%) was dominated by Food wastes (43%) followed by glass (19%), cardboard (13%), while as rubber and leather contributed almost 0 %. Analysis also showed that the maximum (382.07Kg/day) total net weight was contributed by compostable wastes followed by recyclable (221.14Kg/day), combustible by 37.91Kg/day and inert material contributed 12.11Kg/day. The average net weight observed during study period was 108.87 Kg/day/site. Increasing MSWM problems and its disposal strikes environment and health hazard prevailing scenario of waste handling practices and disposal is exhibited along with its associated problems. These insights into generated waste and management practice in Pahalgam health resort allow making suggestions for improved collection, transportation and disposal methods. A primary conclusion is that the recyclable and biodegradable waste is a major fraction having suitable properties for recycling and composting.

INTRODUCTION

We currently live in a world where depletion of resources is beyond control. The call for sustainable development both environmentally and economically is spelt out loud and clear. Hence, the current and future generations must ensure that all resources shall be preserved (either soil or water etc.,), fully utilized and well managed. But the Municipal Solid Waste (MSW) is a continually growing problem at global, regional and as well as at local levels. Improper handling and management of MSW would pollute all the vital components of living environment (i.e., air, land and water). With the rapid urbanization and increase in the population the problem of the solid waste has increased day by day. Asian cities generated approximately 0.76 million tons (2.7 million m^3) per day of MSW, a number that will jump to 1.8 million tons (5.2 m^3) per day by 2025 (World Bank 1999). However, (Abbasi and Ramasamy, 2001) estimated that India generated about 210 million tons of MSW each day and the quantum of wastes produced increases at a rate of 15% per year. In addition, other factors may affect the amount and composition of waste. These are climate, living habits, level of education, religious and cultural beliefs, and social and public attitudes. Tourists and religious movements add significantly to the quantity as well as quality of MSW. Al-Maaded *et al.,*2011 reported that migration directly impacts to the increase of MSW studying the municipal solid waste management in Qatar. Though generation of MSW is not a new phenomenon, it has acquired a danger status of being "third pollution" after air pollution and water pollution with progress in industrialization and population explosion. Earlier the major constituents of MSW were domestic wastes and agricultural residues which are both biodegradable. Since there was much fallow land, SW could be conveniently disposed off on ground or in pits covered with layers of earth. However, since 1960s, not only has the quantity of SW increased but its quality has also changed. Though rural wastes continue to be mainly made of domestic and agricultural wastes, wastes from urban areas, tourist resorts especially mountainous regions and the industrial units contain diverse types of materials which include toxic and hazardous materials. Davis (1965) proposed that the environmental impacts of waste often are magnified by virtue of increased human densities resulting from urbanization, the net effect of which is not only increased domestic waste, but

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decreased areas of the natural environment available for waste discharge. Forster (1973) warned that "increasing numbers and densities of visitors and increasing pressures for more accommodation of tourism are threatening some of the most meaningful natural and historic resources of the world's national parks and equivalent resources". Jain and Kuniyal (1994) studied the SW problem in the Himalayan regions and found that both religious and recreational tourist resorts are going to be extensively and intensively polluted by SW due to inadequate and poor infrastructural carrying capacity. This turns the management and disposal of solid waste into a problem, due to the lack of the necessary facilities and equipment, as well as the lack of the economic management and financing capacity. In any material process, by product recovery or recycling can substantially alter waste quantity and quality, but all processes eventually produce some waste (Swarup *et al.*, 1992).

MATERIAL AND METHODS

Study Area

Pahalgam, in Kashmir's Anantnag district, is about 96 km from the state capital of Srinagar. It is a quaint little village sitting on the banks of river Lidder. It is located at an average elevation of 2740 meters (a.m.s.l).Arguably one of the most beautiful places on earth, the town of Pahalgam (Village of Shepherds) offers you breathe taking views. It is situated amidst lofty deodars, fir, pine, junipers and by soaring, fir-covered mountains with bare, snow-capped peaks rising behind them and many other conifers. The place gets lively during the tourist months of the summer, as well as during the weeks before the Amarnath Yatra, as the base for a big annual pilgrimage to a cave of an 'ice-lingam' (The shrine of Lord Shiva at Amarnath). The Yatra (Hindu pilgrimage) is organized every year in the Hindu month of Sawan (July to August).

There is something about the pure and re-vitalizing air of Pahalgam. Perhaps dense pine and cedar forests make it oxygen rich with soaring mountains, glistening glaciers, gushing silvery streams of ice water, dense pine forests, whistling winds and refreshing cool air. The most beautiful of these is the huge, undulating meadow of Baisaran, surrounded by thickly wooded forests of pine. Pahalgam is probably the most popular hill resort in the Kashmir valley, the nighttime temperatures do not drop so low and it has the further advantage of the beautiful Lidder River running right through the town. The weather in Pahalgam is alpine; hill resort experiences rains in July and September and heavy snowfall during winter months from December to February. During the summers temperature remains in range of between 12°C and 22°C, but during the winter heavy snowfall results in subs zero temperatures.

Study Sites

Information was gathered using a variety of methods to gain a better understanding of the situation, issues, perspectives and priorities. Site survey for three representative sites (Aru, Nunwan Yatra Base Camp and Chandanwari) in Pahalgam town was carried out during Yatra season (July and August 2011).

Aru (site 1)

This site situated at 34° 05' 31.69"Nlatitude and 75° 15' 47.55"E longitudes and at an elevation of 7991ft. above mean sea level. It is a quite small village consisting of few houses, shops, medical stores, Big and small hotels, is about 12-13 Km away from Pahalgam.

Chandanwari (Site 2)

This site situated near the glacier edge at 34° 04' 47.19"Nlatitude and 75° 25' 01.52"E longitudes and at an elevation of 9299ft. above mean sea level, is 16-Km from Pahalgam. It is the starting point of the Amarnath Yatra. It is famous for snow sledging on a snow bridge**. T**his is the site where Yatra spend more time for food consumption before leaving for Amarnath Cave. The site is occupied by temporary Shops, Temporary Gujar (nomad) tents including pony sheds and Yatries Bandaras (Restaurant) .There were about 15-17 such Bandaras functional, which prepared plenty of food for the huge number of pilgrimage.

Nunwan Yatra Base Camp (Site 3)

This site situated at 34° 00' 01.71"Nlatitude and 75° 19' 06.36"E longitudes and at an elevation of 6932ft. above mean sea level, is a base camp for the annual Amarnath Yatra. About 600-650 tents had been placed by Shrine Board Amarnath Yatra to facilitate the long travelled Yatries for one or two day stay before leaving for Amarnath Cave via Chandanwari. Here also few big bandari were placed for preparing food and other daily requirements for the pilgrimages.

Sample collection technique for municipal solid waste (MSW) generation

For the collection of samples houses, shops, hotels, tents and dustbins established in the area by Pahalgam Development Authority (PDA) at the three sites were selected for the present study. During each sampling wastes produced during whole day were collected in polythene bags of 5kg capacity provided to each house-hold, shopkeepers and hotel owners. Wastes were also collected from dustbins after 24 hours and weighed on spot as per the methods of Gaxiola *et al*. (1995); Rampal *et al*. (2002) and Benitez *et al*. (2003).Samples of the generated wastes were collected from all sampling areas once a day at a fixed time for eight consecutive days and in all months mentioned tables. To investigate the generation of municipal solid wastes (MSW) the samples collected were manually sorted and segregated into compostable, recyclable, combustible (fuel) and inert categories. In addition, given the origin of the waste (mainly untreated waste from food), vegetable, food stuff peelings, paper, grasses and leaves were considered as biodegradable waste.

Laboratory analysis

For each type of waste, triplicate samples were analysed for moisture content, net weight composition (%) and net weight (Kg) or dried weight (Kg). The moisture content of the samples was determined following the standard procedure and formula (Aarne *et al*. 1994). It was determined after drying the waste material at 105°C for 24 hours (and at a temperature of 70 to 75°C in case of combustible material) and expressed as a percentage of total weight. The formulas used for the measurement of above mentioned parameters are:

Table 1: Estimation (Kg/Day) of Municipal solid waste (MSW) generation at Pahalgam during 2011 Yatra Season

MATERIAL WASTES	SITE 1							SITE 2							SITE 3							TOTAL NTW	ANTW Kg/Day/Site
	July			August				July			August				July				August				
	NTW Kg/Day	MC %	NTWC %	NTW Kg/Day	MC %	NTWC %	TNTW Kg/Day	NTW Kg/Day	MC %	NTWC %	NTW Kg/Day	MC %	NTWC %	TNTW Kg/Day	NTW Kg/Day	MC %	NTWC %	NTW Kg/Day	MC %	NTWC %	TNTW Kg/Day		
Food Wastes	15.16	43.21	39.32	7.11	47.11	40.92	22.27	50.82	56.81	38.05	10.11	55.18	46.88	60.93	296.1	56.99	68.86	2.77	48.23	22.72	298.87	382.07	63.68
Plastic	1.72	3.1	4.46	0.68	2.19	3.91	2.40	4.33	3.71	3.24	0.11	3.15	0.51	4.44	18.43	3.92	4.29	0.26	3.1	2.14	18.69	25.53	4.26
Paper	1.79	12.13	4.63	0.99	16.12	5.70	2.78	10.50	19.72	7.86	0.99	21.72	4.6	11.49	22.79	25.17	5.3	0.12	20.11	1.00	22.91	37.18	6.2
Rubber& Leather	0.15	0	0.39	0	0	0	0.15	0.09	0	0.06	0.21	0	0.97	0.30	1.28	0	0.3	0	0	0	1.28	1.73	0.29
Glass	2.72	2.1	7.06	2.72	1.21	15.65	5.44	20.73	3.21	15.55	3.12	3.1	14.46	23.85	15.75	2.1	3.66	6.78	2.99	55.59	22.53	51.82	8.64
Cloth Rags	0.8	8.1	2.07	0.067	3.9	0.39	0.87	5.84	4.91	4.37	0.33	6.71	1.53	6.17	8.21	4.9	1.91	0.25	3.2	2.00	8.46	15.5	2.6
Cardboard	7.40	19.71	19.21	2.34	15.29	13.44	9.74	19.64	21.71	14.71	2.11	22.91	9.78	21.75	35.21	18.11	8.19	1.23	21.87	10.08	36.44	67.93	11.32
Metals	1.33	1.93	3.45	0.13	0.19	0.75	1.46	3.57	2.12	2.68	0.89	3.15	4.11	4.46	9.11	1.12	2.19	0.22	2.1	1.84	9.33	15.25	2.54
Bones	4.97	18.11	12.9	1.21	10.73	6.96	6.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.18	1.03
Wooden Chips	1.6	4.4	4.15	1.22	25.1	7.02	2.82	14.50	29.19	10.86	3.15	35.21	14.60	17.65	16.90	21.71	3.93	0.54	12.34	4.44	17.44	37.91	6.32
Inert Materials	0.91	4.5	2.36	0.91	3.77	5.2	1.82	3.53	0.01	2.64	0.54	0.02	2.5	4.07	6.20	2.11	1.44	0.02	5.2	0.16	6.22	12.11	2.02
Total	38.54		100	17.38		100	55.92	133.56		100	21.57		100	155.13	429.97		100	12.2		100	442.17	653.22	108.87

NTW= net weight, **MC**= moisture content, **NTWC**= net weight composition, **TNTW**= total net weight & **ANTW**= average net weight.

Table 2: Category wise Net weight (Kg/Day) of Municipal Solid waste (MSW) generation at different sites at Pahalgam

Category	Material (wastes)	Net Weight (Kg/Day)						TNTW Kg/Day	ANTW Kg/Day/Site
		Site 1		Site 2		Site 3			
		July	August	July	August	July	August		
Recyclable	Metals, Paper, Plastic, Cardboard, Rubber & Leather, Cloth Rags, Glass and Bones	20.88	8.14	64.7	7.76	110.78	8.86	221.14	73.71
Compostable	Food wastes	15.16	7.11	50.82	10.11	296.1	2.77	382.07	127.36
Combustible (Fuel)	Wooden Chips	1.6	1.22	14.50	3.15	16.90	0.54	37.91	12.64
Inert Materials	Ash	0.91	0.91	3.53	0.54	6.20	0.02	12.11	4.04

TNTW= total Net Weight, **ANTW**= average Net Weight

$$\text{Net weight composition (\%)} = \frac{\text{Weight of constituent of solid waste}}{\text{Total weight of constituents}} \times 100$$

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

$$\text{Net weight (Kg)} = W_w - \frac{(\text{Moisture content} \times W_w)}{100}$$

RESULTS AND DISCUSSION

The present research is an attempt to assess the composition and generation of Municipal Solid Waste (MSW) in Pahalgam: A health resort of Kashmir valley during Yatra (Hindu pilgrimage) season. The research analysis of data as presented in table 1, revealed that at site 1, the total net weight of solid wastes was highest in July (38.54Kg/day) and lowest in August (17.38Kg/day). At site2 the net weight of MSW was recorded maximum (133.56Kg/day) in July, while as minimum (21.57Kg/day) was recorded in August. Similarly, at site3, the total net weight was again recorded highest (429.9Kg/day) in July and lowest (12.2Kg/day) was recorded in August.

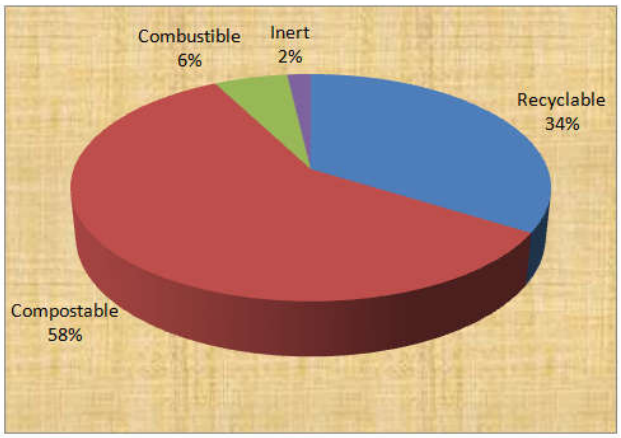

Fig. 1. Total contribution of categorized MSW generated at different sites in Pahalgam

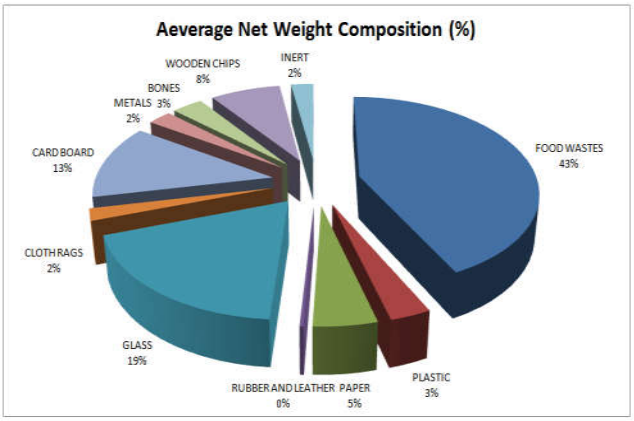

Fig 2. Average Net Weight composition (%) of Municipal solid waste (MSW) generation

This increased generation of MSW in the July was due to the heavy influx of Yatries and as well as local tourists. However the lowest generation of MSW in August was due to the absence of Yatries, i.e., closure session of Yatries,only local tourists contributed to the generation of MSW. It has been observed that seasonal tourists inflow adds significantly to the demands on resource base and contributed considerably to the amount of MSW generated (Jain 1994). Among the constituents of MSW, the total net weight was highest (298.87Kg/day) for food wastes at site3, followed by 60.93Kg/day at site2 and lowest 22.27Kg/day at site1. The highest quantity of food waste generated attributed to the preferences of Yatries to consume food items (including food cooking, peeling and food washing) before leaving for Amarnath Cave Temple for Darshan (Prayers). These activities have been reported to contribute significantly to the production of biodegradable wastes (Patil *et al.,* 1985).

Category wise net weight of constituents of MSW generated at different sites are depicted in table2, the data revealed that on an average compostable waste material dominated 127.36Kg/day/site to the over-all MSW generated, followed by recyclable 73.71Kg/day/site and least 4.04Kg/day/site was recorded for inert materials. The reason could be that food consuming activity dominated during Yatra session among Yatries, prepared by Bandari Wala's (Tempory Dabas or Restaurant). Besides this pilgrimage preferred to drink mineral water sealed in plastic bottles and also prefers packed juices, soft-drinks contained in plastic, tin as well as in cardboard materials, which belongs to the recyclable waste material category. The results are in consonance with the findings of Yousuf and Rehman (2007) while monitoring quantity and characteristics of municipal solid waste in Dhaka City. As for as total contribution of categorized MSW generated at different sites in Pahalgam are concerned (Fig.1), the data shows that compostable material contributed 58%, recyclable 34%, combustible 6% and 2% contributed by inert wastes. The average net weight composition of constituents of MSW generated at different sites was dominated by food wastes 43%, followed by glass 195, cardboard 13%, wooden chips 8% and rubber & leather 0% (Fig.2) The reason could be that, Yatries mostly enjoys food consuming activity prepared by bandari walas for them. Ahmad and Bhat (2007) also observed that food wastes, glass and cardboard are the major proportion of MSW while conducted a survey of Srinagar city.

Present Scenario Of Solid Waste Management

The problem of municipal solid waste management (MSWM) at Pahlagam during Yatra (Hindu Pilgrimage) is becoming more and more complicated and requires long-term and sustainable practices and planning programmes for its solution, in order to protect green treasure of nation and other resources like glaciers and fresh water bodies as well. This region of Kashmir valley is the origin point of river Lidder that feds water to plenty of near-by and far away villages including parts of Srinagar city when met with river Jhelum at Sangam area of district Anantnag. For the safety of natural resources and human health, we have to follow scientific procedures for the safe disposal of municipal solid waste (MSW) generated at Pahalgam during Yatra Season. Yatri count is increasing year by year and tourist influx is increasing as well, which adds heavy quantity to the solid wastes. More yatri and more tourists mean more production of municipal solid wastes. Municipal solid waste management (MSWM) at Pahalgam was insufficient to manage such a huge quantity of wastes generated daily. The reasons could be lack of equipments and modern tools, lack of public awareness and properly skilled manpower. The solid waste management situation is approaching crisis levels. There is poor management of wastes in all aspects of waste management, ranging from the generation, storage, collection, transportation right through the disposal of waste. This evidenced by the illegal dumps at all sites, poses threat to environmental well being and human health. Unscientific disposal causes an adverse impact on all components of the environment and human health, Rathi, (2006) Sharhaly *et al.,*, (2005) Ray *et at.,* , (2005) Jha *et al.,* ,(2003) Kansal (2002), Singh and Singh (1998) Gupta *et al.,* , (1998).

Generation

At generation stage quantity of waste that produced by Yatries, tourists, residents and commerce was unsustainably too high i.e., 653.22 Kg/day at all sites and at an average of 108.87 Kg/Day/site table1, as there is little in the way of integrated waste management that is practiced. As a result, the local authority i.e., Pahalgam Development Authority (PDA), which has the mandate for providing safe storage facilities, collecting and disposing of waste , fails to cope in all sites. The data showed that about 58% of what is discarded as waste

can be composted, 34% can be recycled, 6% can be directly used as a fuel and only 2% is inert which needs to be a safe disposal (Fig.1).

Segregation

Another major problem with the current waste generation patterns is the failure to separate waste at the point of generation. If waste is not separated at source, it becomes difficult to apply any integrated or sustainable waste management techniques, such as composting and recycling.

Storage

For the storage of waste, Pahalgam development authority (PDA) has the responsibility to supply bins in which waste is temporarily stored before collection. But the PDA have been unable to provide adequate number of bins at all sites, as a result littering has become one of the biggest problem turning some aesthetic places into annoying to watch. Tourist throw waste indiscriminately on the ground and into fresh water streams flowing in Pahalgam especially at site 3, where heaps of municipal solid waste (MSW) have been thrown into river Lidder.

Collection and Transportation

The collection and transportation of waste is also the responsibility of PDA. The authority again failed to cope with the situation of this service, due to inadequacy of resources. In most of the cases, there are in adequate vehicles. Only few tractors are servicing to collect and transport of MSW. Improper collection of MSW has resulted mushrooming of illegal dumps either in parks or near to fresh water streams.

Disposal Sites, Methods and Techniques implemented by PDA

One of the biggest threats of waste related to the environment is the unscientific waste disposal. Waste has been dumped illegally or we can say crude dumping of municipal solid waste (MSW) occurred into near-by forests (Bisaraan Forest area at Pahalgam 3-4Km away from main Pahalgam Market). The waste dumping site is simply an earthen forest base without any lining of fiber to resist leaching of toxic chemical compounds that directly or indirectly effects the environment especially soil, near-by water stream and base line forest cover too. It has been observed that crude dumping of MSW damaged more than 20 trees in an area of $300\times400m^2$ due leaching and by traditional burning of municipal solid waste. And one of the critics of dumping of MSW at Pahalgam is uncovered solid waste which attracts flies, vermin and cause unpleasant odours emanating.

Conclusion

The study showed that the current scenario of municipal solid wastes in Pahalgam health resort and Religious Destination of Kashmir valley is due to open dumping practice that is being followed by the residents, tourists, shopkeepers, and hoteliers for MSW disposal. Reliable estimates of solid waste generation along with estimation of their physical and chemical characteristics are very important for designing appropriate waste treatment, management and disposal strategy.

How to deal the present situation?

There are three global options for dealing with waste.

1. The first option is to collect the waste and transport it to a legal and well-protected dumpsite, where it can be disposed off. In this case waste remains as waste.
2. The second option is to re-use waste or recycle it. This includes composting of any waste that can rot. In this option waste becomes something useful again. Composting is a stabilization process through aerobic decomposition of waste, which has been widely used for different types of wastes Cai *et al.,* (2007). Likewise, Recycling is resource conservation activity and it may offer a greater return for many product in energy saving. The recyclable materials such as paper, plastic and metal are often collected at the source (Shapkota *et al.,* 2006).
3. The third option is the treatment of waste. This includes controlled burning and controlled burying of waste. In this case waste can become a source of useful energy for example in the form of heat or gas for cooking.

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