

**Full Length Research Paper****Magnitude and Seasonal Variations of Solid Waste Generation in Tourist Accommodation of Dal Lake****Muzafar.Ahmad Wani.¹, Shamim Ahmad Shah.*²**

1. *Research Scholar, Department of Geography and Regional Development, University of Kashmir, Srinagar (Email: waniyawer88@gmail.com)*
2. **Senior assistant professor, Department of Geography and Regional Development, University of Kashmir, Srinagar (Email : shamimcrocus@gmail.com)*

Corresponding Author: Shamim Ahmad Shah**Abstract**

Increasing living standards and consumption of different natural and man-made resources, particularly in urban areas of developing countries, an enormous quantity of garbage and other waste material are being produced. Dal Lake located in the center of Srinagar city receives enormous number of tourists aggravating its sanitation especially peak tourist season. Tourist accommodation sector is one of the main sectors of the tourism leading to the waste generation in lake. The lake has also suffered a lot over the years due to the lack of solid waste management. Direct Waste Analysis Method was used to examine the magnitude as well as seasonal variations of waste generated from different units of tourist accommodation sector. The magnitude of waste generation varies across accommodation sector depending up the profile of services and category. Therefore 10% representative sample of the each category of house boats was identified to measure magnitude as well as seasonal variation of the solid waste generated from the tourist accommodation sector. The result shows that 72% of the solid waste generated by the deluxe house boats while as rest of 28% of volume weight is generated by other category of house boats like A, B, C and D respectively. The result also shows that there is direct correlation between the quantity of compostable waste generation and category of house boats and room occupancy level as well. The data set generated through this pilot study could be indispensable for envisaging an integrated solid waste management plan for tourist accommodation sector of the lake.

Key words: House Boat, Integrated Solid Waste Management Plan, Room Occupancy, Direct Waste Analysis Method, Compostable Waste, Dal lake

Introduction

Solid waste is regarded as one of the most adverse types of pollution. It needs to be managed in a sustainable way to reduce the overall burden on the environment [1]. The International Hotel Environment Initiative [2] reported that waste generation is one of the most visible impacts that hotels have on the environment. The problems of littering and improper solid waste management, in addition to the production of waste, have a very high negative environmental impact. Land filling of solid waste from hotels has a number of deleterious effects on the environment. Environmental impact of small businesses is cumulative, in which, the negative effects of their activities can build up and become a significant problem [3]. On aggregate, small hotels, undoubtedly, generate extensive amounts of waste, much of which is handled with the easiest, cheapest and the most accessible way of disposal (landfill) which threatens the sustainability of the environment [2]. The improper management of hotel waste can contribute to the emergence of local and global problems e.g. global warming, ozone depletion and climate change [4]. Once the waste material is buried under ground (landfill) it breaks down and gives off landfill gases which often contributes to air pollution and adversely impacts on human health and the environment. The biodegrading process causes also the formation of *leachate* which has the potential to pollute underground water [5]. It also causes problems to the surrounding communities in the form of odor, flies, litter and noise [6]. The physical and environmental costs of solid waste escalate every year [7]. Indeed, solid waste should be managed in a way that enhances environmental and financial benefits to businesses [2]. The waste management hierarchy developed by the European Union (EU) revealed that waste “is not only a potential source of pollution – it can also constitute secondary raw material” [8].

Disposal of solid waste has always been a problem for the hospitality industry and for many hotel operators there is no route for recovery. Indeed the success of the hospitality industry worldwide depends largely on the presence of a clean natural environment [9]. In order to understand the challenge of tourism related waste at the global scale, it is useful to evaluate the order of magnitude from the perspective of total weight.

Hotels often generate large quantities of solid waste, in the form of packaging materials, kitchen and garden waste, old furniture and equipment, and potentially hazardous waste such as asbestos and solvents [10]. Improper waste management can cause environmental degradation and loss of aesthetic appeal, through litter on beaches and streets, and illegal dumping and burning of garbage.

Management of solid waste is a major challenge these days for the administrators, engineers and planners. Huge volumes of solid wastes are generated and need to be collected transported and finally disposed of. These operations have to be carried out speedily and efficiently without incurring excessive cost or damage to environment. Unfortunately in many developing countries, the system for managing wastes is primitive and cannot cope with the huge volumes of wastes being generated [11].

The developing countries normally spend about 20 to 40 percent of urban revenues on waste management; but, however, they are unable to keep pace with the scope of the problem [12]. Today, the Dal lake of Srinagar city faces the problem of improper solid waste management which is becoming more and more difficult. This is due to (1) lack of effective national authority of Environmental Protection, (2) ever-increasing urbanization and tourism (3) low environmental awareness of the citizens, (4) low level of services presented by local municipal authority (5) poor mechanical equipment (6) lack of funds.

Study area

Dal Lake is a natural lake situated in the north-east of Srinagar at an altitude of 1583mt. above the sea level. It lies between $34^{\circ} 5' - 34^{\circ} 6'$ North latitude and $74^{\circ} 8' - 79^{\circ} 9'$ East longitude. This beautiful lake is bounded on the east by Mahadev mountain range, on the south by Kohi Suleiman and on the west by Hari Parbat Hill with old fort. The lake is multi basined with an average depth varying from 1.4 to 1.8 meters. The total surface area of the lake is 11.7 sq. kms and the total volume is estimated at $9.83 \times 10^6 \text{ m}^3$. However the present surface area of Dal Lake is estimated to be 10.5 sq.kms lake is 6 meters and measure 3.87 Kms in length and 2.15 kms in breadth. The length of shore of the lake is 15.5 kms. The Dal Lake has been shown in the fig.1. A perennial inflow channel enters the lake from the north called Telbal Nalla supplies about 80% of the water.

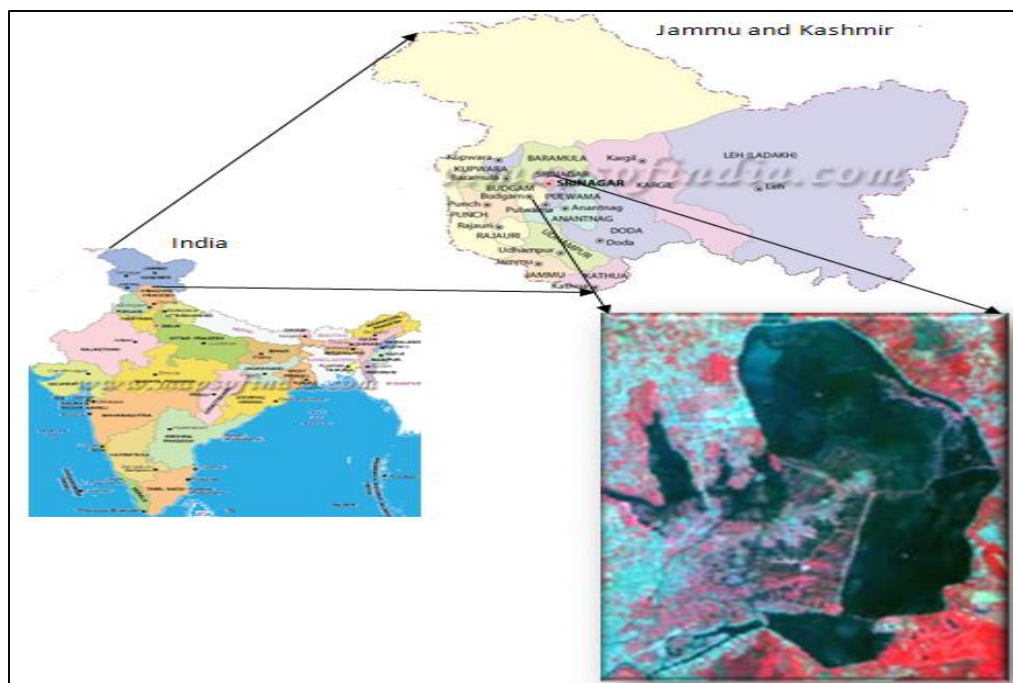


Fig. 1 Study area

Materials and Methods

The present study applied Direct Waste Analysis method for direct examination of the waste stream, characteristics, such as weight, composition, and existing waste management practices prevailing in Dal lake. This method is very flexible as compared to other methods like Material Flow Analysis and Survey Analysis, but material flow analysis may be tailored to suit the goals of a specific study [12,13]. Direct Waste Analysis is used to measure total amount of waste generated from different house boat categories of Dal lake namely A, B, C and D. Generation rate of solid waste for each hotel, for example, was reported as per guest per unit of time (e.g. kg/guest/day). Therefore, 10% representative samples of the each type of tourist accommodation were purposefully because of homogeneity of population identified as shown in table 1. Therefore broadly speaking 88 house boats were selected to categorize and

measure solid wastes generated from them. Since, there was no waste segregation provision in any of the house boat of the lake. Therefore it was thought worthwhile to supply plastic bags of 50 kgs capacity to all the houseboats selected for the study, so that they can put solid waste in them, that it made possible to take the estimate of waste accurately. Daily room occupancy of each category of house boat was used to determine the per capita waste /tourist and per capita waste/room, and annual room occupancy levels has been used for the showing the seasonal variations of the solid waste generation. Solid waste was estimated with help of a spring weighing scale of a 100kgs capacity.

Results and Discussion

Magnitude of Waste Generation

Dal lake is one of the leading tourist attractions of Srinagar city. There are 880 tourist accommodation units in Dal lake comprises over 2281 rooms. It can be notice from the table 4.1 that highest per capita waste generation /room/day is in deluxe category house boats i.e. 2.24kgs. This is because the high standard service offered by this high end accommodation type, which results into the generation of huge quantity of solid waste. Besides, they also possess good provisions of kitchens. It is also evident from the table that there is a close bearing between category of house boat and rates of waste generation i.e. higher the category of accommodation type, higher is the rate of waste generation and vice versa. However the other tourist accommodation facilities generate relatively low per capita waste/room. On an average deluxe category house boats generates 39.6 metric tons of waste/month and 476 metric tons/ year, with a per capita waste generation of 2.24 kgs/day/room. On the other hand A category house boats generate 7.7 metric tons of solid waste/ month, and 92.65 metric tons/year, with a per capita waste generation of 1.88kgs /room/day. However B category house boats generates 47.7 metric tons of solid waste annually with a per capita waste generation 1.66/kgs, C and D category house boats produce 16.17 and 28.88 metric tons of solid waste annually. The table makes it clear that the magnitude of waste generation less in lower end house boats end house boats, which could be attributed services and facilities level of services.

On the average tourist accommodation sector of Srinagar city has a capacity to generate 5362 metric tons of solid waste annually with a per capita waste generation of 1.80kgs/ room/day. However C and D category hotels have relatively lower per capita waste generation/room/day, because they cater the need of budget category tourist. Therefore we can infer here per capita waste generation/room of the tourist accommodation sector of the city will increase in the coming years, because increase in the purchasing power of tourists and increase of accommodation in high end accordingly. That means there is a close bearing between the quality of service and waste generation i.e., higher the quality of service, higher the rate of waste generation and vice versa.

Patterns of House Boat Room Occupancy Levels in Dal Lake

The table 1.3 explains that house tourism of Srinagar city is subject seasonality which could be attributed to climatic factor. During the month of the June and July almost all the tourist accommodation have maximum room occupancy, because there is a scorching heat in the North Indian plains and tourist throng to the Srinagar to enjoy the natural beauty and adventurous topography, invigorating climate and beautiful lakes. During, the months of January, February, November and December the room occupancy levels in all categories of the house boats are significantly low, because during these months the temperature is below freezing point, and also heavy precipitation takes place especially in the form of heavy snowfall, therefore the tourism business gets closed down and room occupancy rate varies between 0-40 percent. This is because of the biting cold and harsh climate during these months. High standard tourist accommodation has higher room occupancy levels especially deluxe house boats and A category house boats.

There is very sharp and pronounced seasonal pattern of tourism and tourism related activities in Dal Lake, which is particularly because of the climatic factor. Tourism industry reaches to the boom during summer and reaches to generally low ebb during winter season. The main reason of this seasonality in the tourism industry can be attributed to the severe winters and lack of infrastructure to cope up the situation. On the other hand has winter tourism is yet to develop. That is why our tourism is subject to the seasonality and this seasonality is not only manifested in the hotel room occupancy levels but in the waste generation from the accommodation of the city as well as depicted in table 1.4.

Seasonal Variation of Solid Waste Generation in Tourist Accommodation of Dal Lake

The table 1.4 shows on an average tourist accommodation sector of Dal lake generates 661.4 metric tons of solid waste annually. The table further depicts however rate of waste generation is also subject to the seasonal variation, during the month of January and February waste generation rate are 34 and 30.36 metric tons. There is a rapid upward swing in the waste generation up to the month of June. Pressure on the environment from the tourism sector reaches to its high during the month of June when accommodation of Dal lake generates 117.46 metric tons; it is the month when the tourist accommodation sector has maximum occupancy. It can be noticed from the table that the waste generation starts decline with respect to the onset of the cold season in the valley, so in the months of October, November and December waste generation is only 35.5, 16.93 and 10.27 metric tons.

Deluxe category house boats are real culprits when the quantity of solid waste generation is taken into the consideration they individually generates 476 metric tons solid waste annually that accounts 72% of the total waste generation of the house boats. This is because this is high end type tourist accommodation with more services and facilities. Similarly 92 metric tons of solid waste is

generated by A category house boats and B, C and D category house boats produce 47,161, and 28 metric tons respectively, which roughly accounts about 28 percent of the total waste generation from house boats. This is because these house boats have low per capita solid waste generation/room and the room occupancy is also lower.

Table.1 Detail of Sample Size

S. No.	House Boat Category	No of Establishments	Sample Size
1	Deluxe House Boat	413	41
2	A Category House Boat	141	14
3	B Category House Boat	107	11
4	C Category House Boat	69	7
5	D Category House Boat	150	15
TOTAL		880	88

Table 1.2: Magnitude of Waste Generation in the Tourist Accommodation of Srinagar City

House boat category	No. Establishments	No. Rooms	Per capita Waste/Room in Kgs/Day	Mean Monthly Occupancy in (%)	Mean Monthly Waste Generation in Metric Tons	Annual Waste Generation in Metric Tons
Deluxe House Boat	413	1202	2.24	49	39.6	476
A Category House Boat	141	349	1.88	39	7.7	92.65
B Category House Boat	107	238	1.66	33	3.9	47.7
C Category House Boat	69	153	1.52	18	1.3	16.17
D Category House Boat	150	339	1.2	20	2.4	28.88
TOTAL	880	2281	1.7(average)	31.8	54.9	661.4

Source: Sample Survey, 2011

Table 1.3: Seasonal Variations in the Room Occupancy Levels of House Boats (In Percentage)

House Boat Category	J	F	M	A	M	J	J	A	S	O	N	D
Deluxe House Boat	12	39	45	52	70	100	100	70	39	35	15	10
A Category House Boat	4	20	27	30	60	90	100	60	39	20	15	4
B Category House Boat	4	10	15	50	60	80	80	45	29	15	8	4
C Category House Boat	5	9	9	15	30	50	70	20	6	5	4	4
D Category House Boat	0.8	3	5	10	40	52	60	30	20	10	5	3

Source: Sample Survey, 2011

Table 1.4: Seasonal variation in solid waste generation in the tourist accommodation sector of Dal Lake (Metric Tons)

House boat type	J	F	M	A	M	J	J	A	S	O	N	D	Total
Deluxe House Boat	10	32	36.3	42.3	56.4	80.7	80.7	56.5	32.3	28.2	12.1	8	476
A Category House Boat	0.9	3.93	5.31	5.9	11.8	17.7	19.6	11.8	7.8	3.9	2.95	0.98	92.65
B Category House Boat	0.5	1.18	1.77	5.92	7.11	9.48	9.48	5.37	3.5	1.77	0.94	0.59	47.7
C Category House Boat	0.4	0.69	0.69	1.04	2.09	3.48	4.88	1.39	0.41	0.41	0.34	0.34	16.17
D Category House Boat	0.1	0.36	0.6	1.22	4.88	6.4	7.32	3.66	2.44	1.22	0.6	0.46	28.88
Total	3	3	40	4.3	82.2	117.4	121	76.8	48.3	35.5	16.9	10.27	661.4

Source: Sample survey, 2011

Findings

- On an average tourist accommodation sector of Dal lake generate 661.4 metric tons of solid waste annually.
- The magnitude of waste generation has close bearing with category and class of house boats i.e. percapita waste generation/room/day in deluxe category is 2.24kg, in A category house boats it is 1.88kgs, while as C and D category house boats generate 1.5kgs and 1.2kgs respectively.
- Highest quantity of solid waste is generated by deluxe category house boats i.e. 476 metric tons annually, that is 72% of total waste generation the house boats. This is because the high standard service offered by this high end accommodation type, which results into the generation of huge quantity of solid waste.
- Maximum quantity of solid waste is generated during summer and least during winters.
- There is very sharp and pronounced seasonal pattern of tourism and tourism related activities in Dal Lake, which is particularly because of the climatic factor. The rate of solid waste generation in house boats are directly proportional to levels of room occupancy levels i.e. higher the room occupancy higher the rate of waste generation and vice versa.

Conclusion

A comprehensive assessment of the solid waste generation and seasonal variation in Dal lake was carried during 2011 through field study. The magnitude of solid waste generation and levels of room occupancy of house boats of Dal lake are subject to the seasonal variation, which is primarily because of the climatic phenomena. To understand the quantity of solid generation and its magnitude forms one of the central themes of integrated sustainable solid waste management. The use of house boat room occupancy levels to generate the month wise data of solid waste generation from them has nicely explained the existing pattern of tourism load on the lake. This assessment identified enormous quantity of solid waste is being generated during the months of June and July and contributes significantly to deterioration of lake. The data set could be highly beneficial for developing strategies for ameliorating environmental and ecological problems to ensure sustainable lake tourism in Srinagar city.

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