



RESEARCH ARTICLE

SPATIO TEMPORAL TRENDS OF SOLID WASTE GENERATION IN RESTAURANTS OF KARGIL TOWN OF LADAKH, INDIA

*Muzafar Ahmad Wani and Shamim Ahmad ShahandSajad N Dar

Department of Geography and Regional Development, University of Kashmir, Srinagar

ARTICLE INFO

Article History:

Received 23rd January, 2016
Received in revised form
15th February, 2016
Accepted 27th March, 2016
Published online 26th April, 2016

Key words:

Ladakh, Integrated, Solid Waste,
Analysis, Kargil, Halt point.

ABSTRACT

Tourist destinations in the Indian Trans-Himalayan region of Ladakh are facing acute solid waste management problem which gets aggravates particularly in peak tourist season in the summer. On account of the mass flow of tourist to the region, an enormous quantity of garbage and other waste material are being produced from the restaurants daily. Kargil town located at the junction where roads from Leh, Srinagar and Zaskar meet. Therefore acts as a halt point and serves food to tourists who visit Ladakh as a result enormous quantity of waste is generated. Therefore in order to estimate the magnitude of spatiotemporal trends in solid waste generation in the restaurant industry of the town, Direct Waste Analysis Method was used and 10% representative sample was selected through random sampling technique. The result shows that restaurants in the town generate about 0.630 per day in summer season and daily waste generation is only 0.062 Metric Tonnes in the winter season. The result has shown that there is significant variation in quantity waste with regarding the space and time. The data set generated through this pilot study could be indispensable for envisaging an integrated solid waste management plan for restaurant industry of the town.

Copyright © 2016, Muzafar A. Wani and Shamim Ahmad Shahand Sajad N Dar. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Muzafar Ahmad Wani and Shamim Ahmad ShahandSajad N Dar, 2016. "Spatio temporal trends of solid waste generation in restaurants of Kargil Town of Ladakh, India", *International Journal of Current Research*, 8, (04), 30033-30038.

INTRODUCTION

The hospitality industry in the Ladakh region is growing at an enormous rate. The region being a popular tourist destination in the south Asia (Shah 2014) attracts a huge number of tourists annually. The restaurant industry is mainly concerned with the preparation and serving of food and drinks to customers. Restaurants generate a tremendous amount of solid wastes including paper, cardboard, plastics, wood, food wastes, glass, metals and hazardous wastes (Festijo and Yuzon 2013). For successful operation of tourism business, restaurant owners and managers need to continually look for new and better ways to reduce costs and minimize overhead expenses including waste management while meeting customers' demands (Saarinen 2006). Restaurants are also considered to be an important component of the global food industry and the issue of food waste has implications for food security, environmental sustainability and global hunger (BSR 2014). A study in (2013) conducted by Business for Social Responsibility (BSR), on behalf of the Food Waste Reduction Alliance, indicated that more than 84 percent of the food waste generated by restaurants ended up in the landfill (BSR 2013).

*Corresponding author: Muzafar Ahmad Wani,
Department of Geography and Regional Development, University of Kashmir, Srinagar

Globally, we will need to feed 8 billion people by 2030 and 9 billion by 2050 (BSR 2014). The UN Food and Agriculture Organization (FAO) projects that, under current production and consumption trends, global food production must increase 60 percent by 2050 in order to meet the demands of the growing world population (FAO 2013). Also according to the FAO, without accounting for greenhouse gas emissions from land use change, the carbon footprint of food produced and not eaten is approximately 3.3 gig tons of CO₂ equivalent, and the water footprint is estimated to be about 250 cubic kilometers of water (FAO 2013). Therefore, the restaurant industry has to employ sustainable options like reduction, minimization, reuse, recycling and composting in their waste management operations. A major issue concerning waste generation from the restaurants is attributed to the high level of the solid pollutant levels and improper treatment and disposal (Singh *et al.*, 2014). There is no official record about quantity and quality of waste generation in the Kargil town, neither any kind of research has been undertaken with regards to the components of solid waste management in the town except a study on the magnitude of hospital solid waste generation in Kargil Town by (Quari *et al.*, 2013). Therefore, the present study is a pioneering attempt to understand the magnitude and spatiotemporal variations in the quantity of solid waste generation in the restaurants industry of the Kargil town.

Study Area

The present study was carried out in Kargil, which is a small town located in south-western part of the vast Ladakh plateau and north of the greater Himalayan range. Historically, the town used to be an important stopover for the historical trans-Himalayan silk route (Rizvi 1995). The town is located at an altitude of 2,676 meters above the sea level on the banks of Suru River. Geographically it falls at the center of four important destination, viz Leh, Zaskar, Srinagar and Sakardu and Leh (Dar, 1999). Though the region is basically a climatic desert (Hussain 2000, Shah 2013), harsh climatic conditions and topography have posed severe check over the agriculture and other basic activities (Sagwal 1991). The total population of the town is 16400 persons (2011 census) and people mainly belong to the Shiasect of Islam. The region from hydrological point of view is a source of some of the subcontinent's major waterways like Indus river system, therefore environmental management in the region is of vital importance for the long lasting growth and development of the subcontinent. Strategically the area is very volatile owing the international boundaries with Pakistan and China.

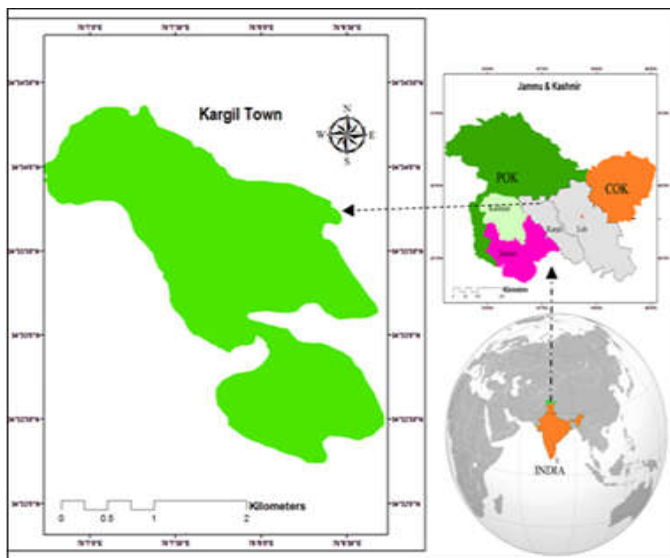


Fig. 1. Location Map of Study Area

MATERIALS AND METHODS

The present study has applied direct waste analysis method for the examination of the solid waste stream characteristics, such as weight, composition and magnitude of waste generation. Such type of methodology has been widely used in solid waste estimation studies (Byer *et al.*, 2008, Chi P Houg, 2006). Therefore, in order to estimate the magnitude and spatiotemporal trends in the amount of solid waste generation in the restaurant industry of Kargil town, direct waste analysis method was applied in which 2 restaurants of the total of 16 the restaurants were selected that accounts about 12% of the total population. Sample restaurants were selected using random sampling technique. For the ease of the waste estimation the researchers supplied polythene bags of 50 kg capacity to sample restaurants and waste were estimated early

in the morning before it would be disposed of and the activity was carried out for 7 consecutive days in the month of July 2015. For the purpose of sorting and estimation of solid waste, *Safaikaramcharies* were hired from concerned Municipality, which made it possible to determine the composition by weighing each item of solid waste stream like fruit waste, leftover food, vegetable waste, paper, plastics etc. using weighing scale which is a widely used procedure (Staley and Barlaz, 2009). Details of each item of waste stream were recorded and magnitude of solid waste generation were calculated as kg/guest/day. In order to work out the seasonal variation in the amount of solid waste the researchers employed other indicators like number guests served per restaurant per day during tourist season and off tourist season. Besides that GPS survey was carried out to record the spatial location of restaurants. The ward map supplied by the concerned municipality, was georeferenced with SIO topo sheet Number I43K02, in ESRI's ArcGIS 9.2.2 software, helped to make the spatial analysis.

RESULTS AND DISCUSSION

The per capita waste generation per guest served in restaurants of Kargil town is 0.39 kgs. It is reported, cafeterias generate 0.45 kg of waste per meal served; and restaurants generate 0.68 kg per meal served (Shanklin, 1993), therefore, the magnitude of solidwaste generation in the restaurants of Kargil town is significantly lower, because the region is in the initial stages of development. The table 1 also depicts that during the peak tourist season more solid waste is generated on account of serving more guests and less quantity of waste during the winter season. Because less number of guests are served during the winter season which is off tourist season in the region.

Composition of Solid Waste Generated In Restaurants

The base of successful planning for a waste management programme depends up on the availability of reliable information about the quantity (Gidakos *et al.*, 2005). Effective waste management through municipal solid waste composition studies is important for numerous reasons, including the need to estimate material recovery potential, to identify sources of waste generation, to facilitate design of processing equipment, to estimate physical and chemical properties of the waste (Parissakis *et al.*, 1992; Parizeau 2006, Wani and shah, 2013).

The Table 2 shows that the highest proportion in the waste stream generated in the restaurants is constituted by food waste, which account about 52.06% followed by vegetable with 25%. The other types of waste constitute minor proportion of solid waste composition. In restaurants, organic materials make up an average of 74% of the total waste stream (UNEP 1999). The Table also shows that restaurants in Kargil town generate about 145.63 metric tonnes annually, in which food waste make up about 75.82 metric tonnes followed by vegetable waste with 37.78 metric tonnes annually. Among the recyclables paper is major item i.e. 7.35 metric tonnes, plastics 4.12 metric tonnes and glass make up 41.97 metric tonnes. The non-vegetarian food is widely served in the restaurants of the town as a result 9.26 metric tonnes bones and other residues are annually generated.

Table 1. Magnitude of Solid Waste Generation in Restaurants of Kargil Town

No of Restaurants	16
Guests Served/Restaurant/Day In Tourist Season (April-October)	102
Guests Served/Restaurant/Day In Winter (November-March)	10
Per Capita Waste Generation/Day/Per Guest	0.39 Kgs.
Daily Waste In Summer Season	0.630 Metric Tonnes.
Daily Waste Generation In Winter Season	0.062 Metric Tonnes.

Source: Field survey 2015

Table 2. Category wise Annual Quantity of Solid Waste Generated in Restaurants of Kargil town

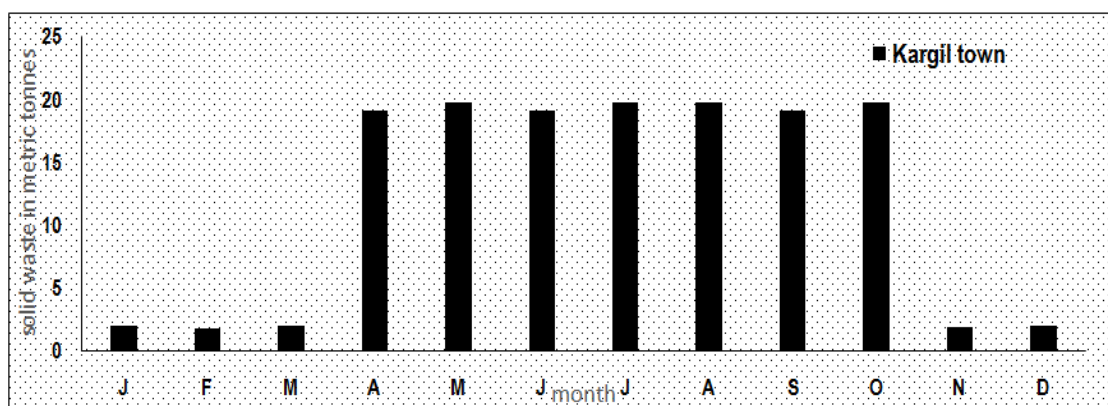
Material Category	Item	Metric tonnes	Kargil Town
Compostable	Food	75.82	52.06
	Vegetable	37.78	25.94
Recyclable	Metal	1.76	1.21
	Glass	1.97	1.35
	Paper	7.35	5.04
	Plastics	4.12	2.83
Miscellaneous	Non-Recyclable Plastics	1.15	0.79
	Non-Recyclable Paper	2.10	1.44
	Bones	9.26	6.36
	Ash and Dust	4.33	2.97
Total		145.63	100

Source: Field survey 2015

Table 3. Seasonal Variation in the Solid Waste Generation in Restaurants

Month	J	F	M	A	M	J	J	A	S	O	N	D
Kargil town	1.93	1.75	1.93	19.09	19.73	19.09	19.73	19.73	19.09	19.73	1.87	1.93

Source: Field survey 2015

**Fig.2. Seasonal Variation in the Solid Waste Generation in Restaurants****Table 4. Spatial Variation in the Solid Waste Generation in Restaurants**

Ward Name	No. of Restaurants	Metric Tonnes		
		Annual	Daily summer	Daily winter
Chanchik				
Chanchik Baqpa Lunba	0.00	0.00	0.00	0.00
Thankshan	6.00	54.61	0.23868	0.0234
Grong	7.00	63.71	0.27846	0.0273
Lankoor	0.00	0.00	0.00	0.00
Dragrtang	0.00	0.00	0.00	0.00
Pishu	0.00	0.00	0.00	0.00
Dass	0.00	0.00	0.00	0.00
Balti Bazar	0.00	0.00	0.00	0.00
Yangti Hitoo	0.00	0.00	0.00	0.00
Yabgo	0.00	0.00	0.00	0.00
Shatoo	0.00	0.00	0.00	0.00
Gurba	0.00	0.00	0.00	0.00
Poyen	0.00	0.00	0.00	0.00
Bagh Khumima	0.00	0.00	0.00	0.00
Baroo	3	27.31	0.11934	0.0117
Total	16	145.63	0.63648	0.0624

Source: Field survey 2015

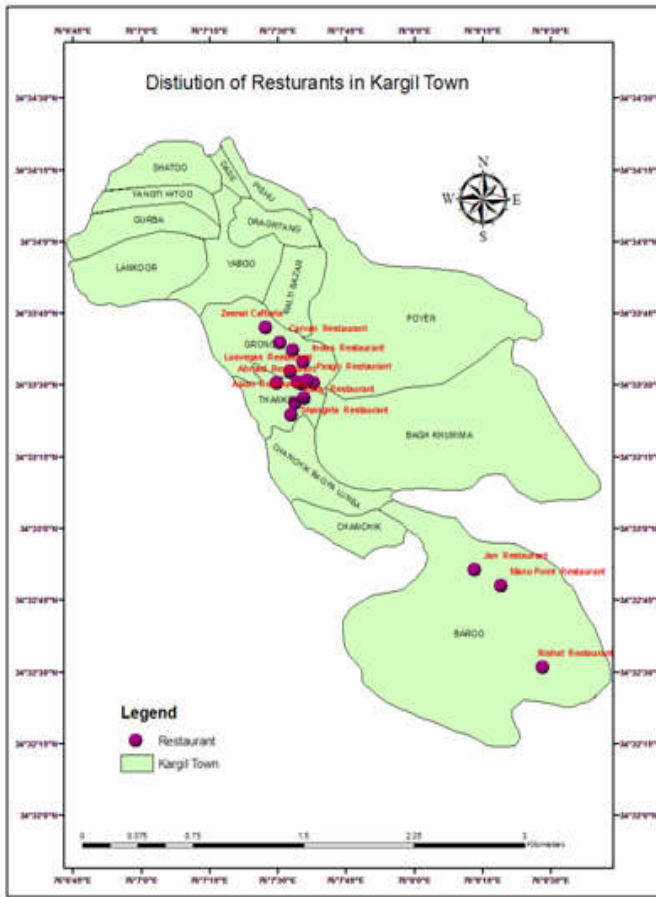


Fig. 3. Distribution of Restaurants

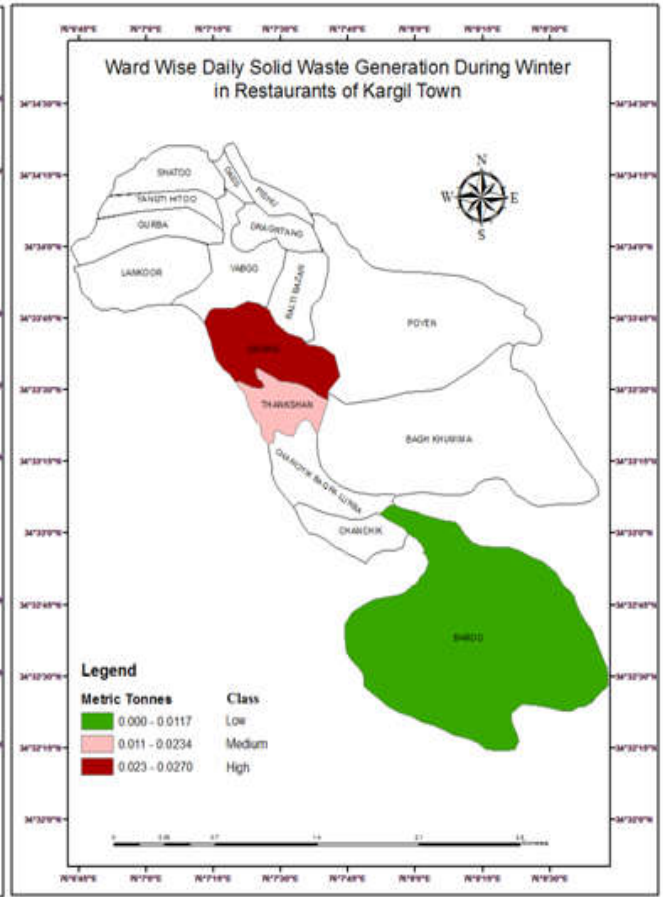


Fig. 4. Daily Solid Waste Generation

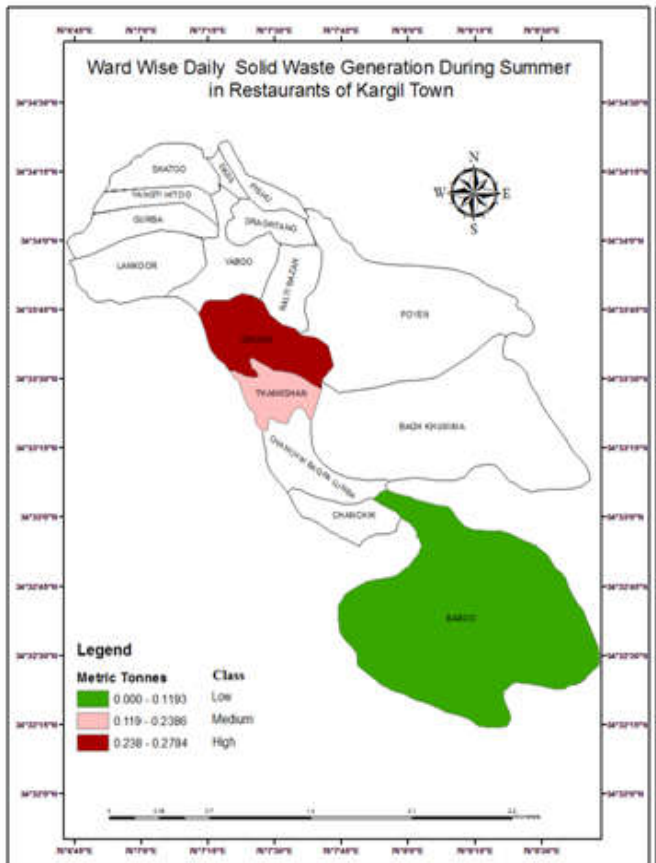


Fig.5. Solid Waste Generation in peak Tourist Season

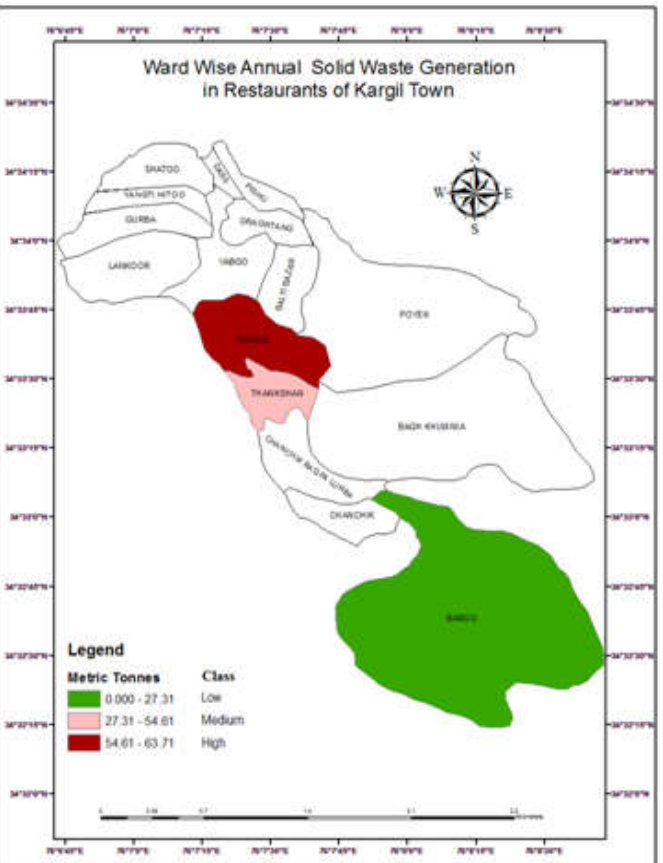


Fig.6. Solid waste generation in off Tourist Season

The table 3 shows that there is a sharp seasonal variation in the amount of waste generation from the restaurant industry of the town. It is clear from the table, during the winter month i.e. October, November, December, January and February solid waste generation is below 2 metric tonnes. This lowest solid waste generation is attributed to the fact that during these months there is chilly weather in the entire region of Ladakh and mercury plunges below freezing point. Also during this season Ladakh receives heavy snowfall as a result the entire region remains cut off from rest of the world. Therefore, very few guests are served in the restaurants.

However during the summer season solid waste generation reaches to climax because huge number of tourists, migratory laborers, shopkeepers and businessmen throng to the area which result in the generation of huge quantity of solid waste. Subsequently the number of daily guests served in the restaurants increases dramatically. During peak tourist season the restaurants of the town generate about 19 metric tonnes of solid waste monthly. The table 4 highlights that out of 16 wards of the Kargil town only three wards have restaurants namely Thankshan has six and generates about 54.61 metric tonnes, Grong has seven and generates 63.71 metric tonnes and Baroo has three and generates 27 metric tonnes of solid waste annually. Spatiotemporal trends in the amount of solid waste generation from the restaurants is shown in the Figure 4, 5 and 6; While as the figure 3 shows spatial distribution of restaurants in the town and it is clear they are located along Leh Srinagar national high way.

Conclusion

A comprehensive assessment of the solid waste generation and seasonal variation in Restaurant industry of Kargil town was carried during 2015 through field study. The magnitude of solid waste generation is subject to the seasonal variation, which is primarily because of the climatic phenomena. The dynamics of quantity of solid waste generation and its magnitude forms one of the central themes of integrated sustainable solid waste management. The study has successfully generated the monthly data base of solid waste generation from the restaurants of the town and such type of data is a prerequisite for devising planning measures for the integrated waste management. This assessment identified that an enormous quantity of solid waste is being generated during the months of June and July, in which nearly 77% of the total waste is compostable in nature that can be used as feed for livestock or as manure in agriculture, which presently is being disposed of with general waste stream. The data set could be highly beneficial for developing ecofriendly strategies for ameliorating environmental problems to ensure sustainable tourism in Ladakh. The methodology can be successfully applied with some modification to estimate the magnitude of solid waste generation from other sources of the town like tourist accommodation, household, military camps, hospitals and institutions.

REFERENCES

- BSR. 2014. Analysis of U.S. food waste among food manufacturers, retailers, and restaurants, *Prepared for the Food Waste Reduction Alliance: Httpwww.bsr.org*
- Byer Hoang, Nguyen, Chopra, Maclaren and Haight. 2006. Household, Hotel and market waste audits for composting in Vietnam and Laos. *Waste Management and Research*, 24 (5) pp. 465-472.
- Chi Phuong Hoang. 2005. Audit of Solid Waste from Hotels and Composting Trial in Halong City Vietnam. Master's Thesis Department of Civil Engineering, University of Toronto, Canada <http://electroniclibraryuniversityoftoronto.com>
- Dar, M. G. 1999. Kargil: Its social, culture, and economic history, *Dilpreet Publishing house*, New Delhi
- Festijo and Yuzon. 2013. Waste management practices among counter service restaurants in Batangas city, Philippines. *International Journal of Academic Research in Business and Social Sciences*, 3(8) pp.362-368.
- Gidarakos, Havas, and Ntzamilis. 2005. Municipal Solid Waste Composition Determination Supporting the Integrated Solid Waste Management System in the Island Of Crete. *Journal of Waste Management*. pp. 1-12, <http://www.elsevier.com/crete/waste/generation>. Pdf.
- Hussian, M. 2000. Systematic geography of Jammu and Kashmir. *Rawat Publications*, Jaipure, India.
- Parisakis, G., Skordilis, A., Andrianopoulos, A., Lolos, C., Andrianopoulos, J., Tsompanidis, X., Lolos, G. 1992. Physicochemical characterization of municipal solid waste of Kalamata Estimation in regard to compost production potential. *NTUA Laboratory of Analytic and Inorganic Chemistry*, Athens.
- Parizeau. 2006. Waste characterization as an element of waste management planning: Lessons learned from a study in Siem Reap, Cambodia. *Elsevier doi: 10.1016/j.resconrec.2006.03.006*
- Quari, Naveed, Para, Altaf, Rangrez and Rihana. 2013. To Study the solid waste generated per bed per day at district hospital Kargil a remote high altitude area. *Journal of Pharmacy*, 3(6). pp. 61-65 61
- Rizvi, J. 1995. Trans-Himalayan Caravans, New Delhi. Oxford University Press.
- Saarinen, J. 2006. Traditions of sustainability in tourism studies. *Annals of Tourism Research*, 33(4) pp1121-1140.
- Sagwal. 1991. Ladakh, Ecology and Environment, publisher A.P.H. Delhi.
- Shah, S.A. 2013. Understanding of Tourists, Experiences and Perceptions in the Trans-Himalayan Cold Desert of Ladakh Region of India. *International Journal of Current Research*, 5(12) pp. 3773-3777.
- Shanklin, Petrillose, Pettay. 1991. Solid waste management practices in selected hotel chains and individual properties. *J. Hospitality and tourism research*, 15(6) pp. 59-74. <http://dx.doi.org/10.1177/109634809101500106>
- Singh, Kaushik, Soni and Lamba. 2014. Waste management in restaurants: a review. *International Journal of Emerging Engineering Research and Technology*, 2 (2) pp. 14-24, www.ijeert.org
- Staley, B. and Barlaz, M. 2009. Composition of Municipal solid waste in the united states and implications for carbon sequestration and methane yield. *Journal of Environmental engineering*, 135(10). pp. 901-909.
- UN Food and Agriculture Organization. 2013. Food wastage footprint: impacts on natural resources. <http://www.fao.org/food/waste.html>.

- United States Environmental Protection Agency. 1999. Organic materials management strategies. Solid Waste and Emergency Response (5306 W) EPA530-R-99-016. pp. 54.
- Wani and Shah. 2013. Magnitude and seasonal variations of solid waste generation in tourist accommodation of Dal Lake, *International Journal of Environmental Sciences*, 2(1) pp. 57-62.
