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Hotel waste characterization and disposal in various hotels of Kurukshetra City, India

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Abstract

Hotels are one of the major sources of municipal solid waste and food waste. Different practices regarding solid waste management (SWM) were investigated in randomly selected 17 main hotels of Kurukshetra city in Haryana, India. Information on current waste disposal and management practices was collected from concerned hotel staff using a semi-structured questionnaire. The amount and composition of solid waste generated in the hotels were assessed along with the conditions and practices at the main solid waste disposal site of the city. About 80% of the collected hotel waste was organic in nature including peels and spoilage. Other waste included plastic bottles/polythene/plastic bags (11%), metal waste (1%), glass waste (2%) and paper and cardboard waste (3.0%) and the rest waste (3%) included textile material, rubber, cigarette butts, cellulose bags, and other waste. On an average basis, the hotels in Kurukshetra city generated 30.44 kg of solid waste/day. About 77% of the hotel managers were of the opinion that more sustainable waste practices like recycling and composting should be implemented in the city. For the disposal of waste, there was a common dumping site of the city that was improperly managed. The site lacks proper fencing and boundary due to which scavengers like dogs, pigs, crows, eagles and rag pickers approached the disposal site freely causing the problem of waste scattering. Greater attention needs to be focused towards devising an appropriate and effective mechanism for waste treatment and disposal.

1. Introduction

Municipal solid wastes (MSW) are discarded material or wastes primarily generated from households including the offices, hotels, shops and shopping complexes, schools, institutions, and from municipal services, such as, street cleaning and maintenance of parks, gardens and other recreational areas (Mohan *et al*., 2017). The World Bank reported a global MSW production of 2.01 billion tonnes in 2016, with a projected generation of 3.40 billion tonnes in 2050 (Kaza*et al*., 2018). Solid waste management in Indian cities has emerged as a major concern over the past few years; the quantum of waste generated in cities is expected to increase even in smaller ones with high population and high consumption. Hospitality waste is a significant societal challenge and causes detrimental implications for global ecosystem services (Hu *et al*., 2016; Filimonau & Delysia, 2019). It is estimated that 1 kg of waste is produced on an average on daily basis by per EU consumer of hospitality services (Bohdanowicz, 2006). Hotel industry is resource intensive in terms of water and energy consumption, utilization of plastics, paper and chemicals, and biodiversity affectation (Trung *et al*., 2005; Erdogan and Baris, 2007; Cingoski and Petrevska, 2018). According to the International Tourism Partnership Report (2008), around 30% of a hotel's solid waste can be sorted, reused, recycled and recoverable in nature. Waste audit is considered the first and the most important step in a hotel's solid waste management programme to track waste generation and determine quantities and types of waste generated and identify the best ways to deal with the waste reduction, reuse or recycling (Kirk 1996; Tang, 2004). Environmental damage not only results from the amount of waste generated but also from the way it is disposed. (Choe and Fraser, 1999; Pirani and Arafat, 2014). However, the rate of waste production depends on the type, size, and waste management facilities of the hotel (Abdulredha et al., 2018).

According to the new Solid Waste Management rules 2016, all hotels and restaurants will have to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilised for composting / biomethanation. According to Down to Earth (DTE) the rules mandate, all hoteliers to segregate waste at source into material like plastic, tin, glass, paper and others and hand over recyclable material either to authorised waste-pickers and recyclers or to the urban local body (DTE, 2016). In view of environmental degradation, governments, hotel and tourism industries have adopted environmental protection measures to act in an environmentally responsible manner (Bohdanowicz, 2006). Accordingly harmful impact of hotels on the environment has attracted customers' attention. Additionally, over the past few decades, guests' demands for enviro nmentally responsible lodging have rapidly increased. Adoption of a 3Rs strategy of waste management leads to recovering the efficiency of resources, reduction in operational cost and capital expenditures. Hotels can also profit by raising their revenues as a result of having eco-friendly customer base for consumers (Ionnidis *et al*., 2021). Therefore, the hospitality and tourism sector has become increasingly concerned about its impact on the environment (Gonclaves et al., 2016).

Kurukshetra is one of the holy cities of India with a place of great historical and religious importance. The battle of Mahabharata was fought and Lord Krishna preached his philosophy of Karma as enshrined in the Bhagavad Geeta, to Arjuna at Jyotisar in Kurukshetra. In the very first verse of Bhagavad Geeta, Kurukshetra is described as Dharamkshetra i.e. "Region of righteousness". As per Indian Ministry of Tourism, the country received 6,290,319 international tourists (Statistics, India Tourism, 2012) whereas, Haryana received 130,423 foreign and 6,825,459 domestic tourists. Every year lakhs of people visits Kurukshetra from various parts of a country for which many hotels have been constructed for their accommodation and comfort. The tourists and pilgrims mostly visit here on the occasion of solar and lunar eclipse, Geeta Jayanti fair (International Geeta Mahotsav) or in the peak season i.e. November to March. People reside in the hotels near by the places of their interest. The city experiences tremendous pressure on its existing waste management system due to a considerable increase in its population during these religious gatherings. As per literature search no significant work has been carried out on solid waste management of Hotels in Kurukshetra city. Therefore, the present study was carried out.

2. Materials and Methods

Kurukshetra is the ancient places of religious travel in the world. Kurukshetra city- the land of Bhagavad-Gita is situated at a distance of 160 km north of Delhi on the national highway-NH-I and 91 km south from Chandigarh. Census 2011, reported the total area of Kurukshetra district is 1530 square km and its population is 964, 231 (Census of Haryana, 2011). The district lies between latitude 29^0 52' to 30^0 12' N or S and longitude 76^0 26' to 77^0 04' N or S in the north-eastern part of the state and at about 260 m above the mean sea level. The city experiences an extreme continental climate due to the fact that it is far away from the sea with average annual temperature of 23.9ºC and an average annual precipitation of about 582 mm.

For the study, 17 main hotels (Table 3), scattered all over the city, having accommodation and restaurants facilities were selected. From the selected hotels, only two were governmental i.e. managed by Haryana Tourism while rest were private. Primary data was collected through a semi-structured questionnaire and onsite observations. The questionnaire was designed to get quantitative data about the wastes generated, composition of waste, and characterization of waste, information about collection, segregation, storage, transportation and disposal of waste practices in hotels. For waste characterization and composition, out of 17 selected hotels, solid waste was collected regularly for seven days during peak season in the months of February from two Hotels namely Mejbaan and Pearlmark. The collected waste was then segregated manually into different physical components like paper, plastics, rubber, leather, glass, metals, and textiles by using personnel protective equipments like gloves, shoes and face masks. Each of these recyclable materials was separately weighed by using pan balance of capacity 50kg to determine its fraction in the total solid waste sample. The remaining material was a uniform mixture of organic material including garden waste and kitchen waste and other inert materials that were not manually separable, and is termed as mixed residue.

3. Results and Discussion

3.1 *Solid Waste Generation, Characterization and Composition*

For efficient solid waste management, the study of the sources of waste generation and its rate is very important. In the present study waste generation sources are mostly hotel rooms, kitchen area. Similar results have been reported by Bacot et al. (2002) and Rohweder (2008). The solid waste generation was ranged between 5-120 kg/day with a mean value of 30.44 kg/day (Table 1). As per the survey, Hotel Silver Sand and Hotel Kimaya generated maximum while Hotel Empire and Hotel Richi Rich produced minimum amount of solid waste (Fig. 1). The generation of solid waste in hotels depends on many factors like culture and nature of people, the socio-economical conditions and its commercial factors. It may be due to that Hotel Silver Sand and Hotel Kimaya located on the main road near old bus stand of the city and provides accommodation for the visitors while Hotel Empire and Hotel Richi Rich have comparatively less capacity for accommodation and far away from places of interest. According to report of Kasim, it is not the size of the hotel that makes the difference but also the type of functions being held at the hotel and other important events taking place at a particular time (Kasim, 2007).

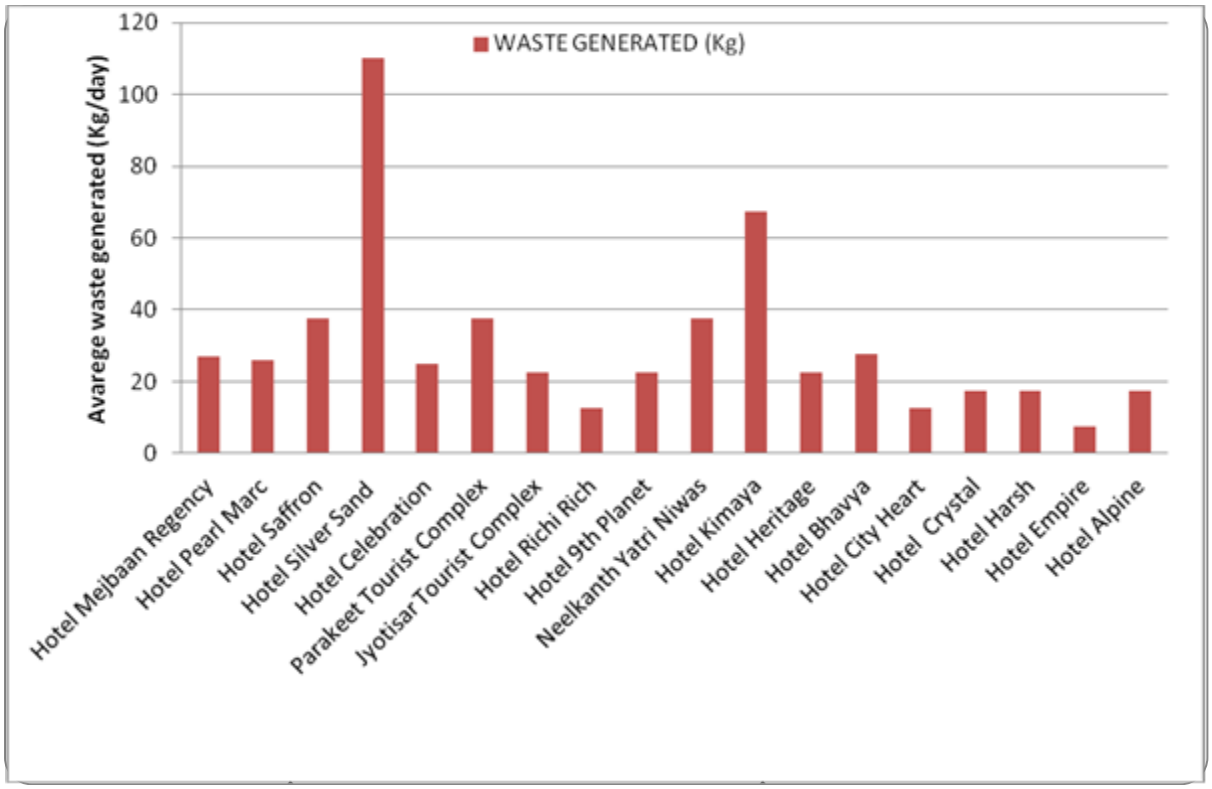

Fig. 1 Average waste generation rate (kg/day) in different hotels of Kurukshetra city

Table 1. Waste generation rate (kg/day) in different hotels of Kurukshetra city

Sr. No	Hotels Name	Location in Kuruksetra	Amount	Average waste Produced
1.	Hotel Mejbaan Regency	Railway Road	24-30	27
2.	Hotel Pearl Marc	Pipli Road	23-28	26
3.	Hotel Saffron	Near Birla Mandir	35-40	37.5
4.	Hotel Silver Sand	Pehowa Road, Jyotisar	100-120	110
5.	Hotel Celebration	Pipli Road	20-30	25
6.	Parakeet Tourist Complex	Railway road	35-40	37.5
7.	Jyotisar Tourist Complex	Old bus stand	20-25	22.5
8.	Hotel Richi Rich	Pipli Road	10-15	12.5
9.	Hotel 9th Planet	Pipli Road	20-25	22.5
10.	Neelkanth Yatri Niwas	Pipli Road	35-40	37.5
11.	Hotel Kimaya	Red Road	65-70	67.5
12.	Hotel Heritage	Pipli Road	20-25	22.5
13.	Hotel Bhavya	Pipli Road	25-30	27.5
14.	Hotel City Heart	Jyoti Nagar	10-15	12.5
15.	Hotel Crystal	Near Birla Mandir	15-20	17.5
16.	Hotel Harsh	Near IIIrd Gate of Kuruksheta University	15-20	17.5
17.	Hotel Empire	Opposite new bus stand	5-10	7.5
18.	Hotel Alpine	Near bus stand	15-20	17.5
Total				548
Average				30.44

3.2 *Composition of Waste from Hotels*

On the basis of waste generation and Segregation studies from selected hotels, Food waste represents a major fraction of hospitality waste. It has been recognised as critical for the long-term sustainability of hospitality sectors across the world (Grandhi and Singh, 2016). 80% of the generated solid waste was organic constituting mainly food and kitchen wastes, flowers, leaves whereas, remaining 20% include packing material like polythene, packaging material and refined oil pouches, used aluminium foil, mineral water/cold drinks bottles, cigarette, cans, etc (Fig 2). The reported values are quite high from that of Dangi et al. (2013)who observed 53.4% organic waste from the hotels of Kathmandu, Nepal. Paper and food waste were the greatest amounts of waste generated by the Turkish hotels reported by Erdogan and Baris (2007). Similarly a study from hotels of Malaysia reported 71.73% organic waste, 8.06% cans, 5.77% paper, 5.07% plastics including bottles/bags, 2.68% glass, 5.13% yard wastes, and 1.56% other (Mazid, 2007).

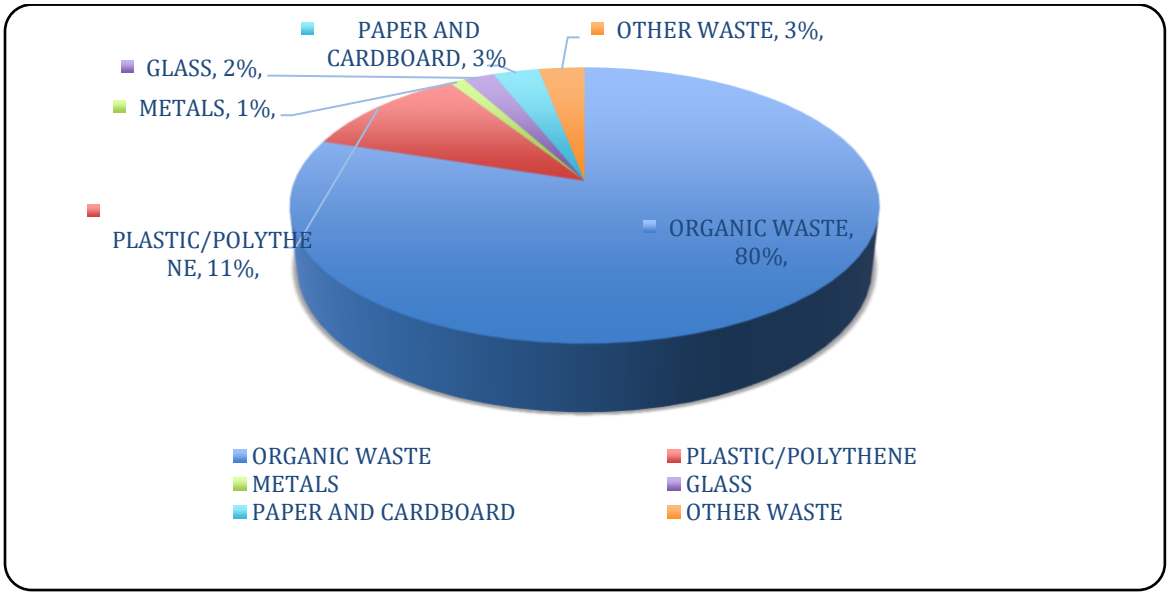

Fig. 2: Waste composition of hotels of Kurukshetra

3.3 ***Waste Characterization***

Waste characterization and analysis was done using both methods – hand sorting and visual estimation. For seven days, the solid waste was collected for hotels, mixed properly and for waste characterization was carried out for a representative portion. Based on the estimations, it was found that the waste generated in hotels of Kurukshetra was mainly unused food items and others were thin film plastic carry bags and packaging material, plastic bottles, silicon board, glass, paper and other plastic products like bottles, milk packets etc. The waste was segregated and categorized into different categories (Fig. I) such as 1.Organic materials: including all wastes from preparation, cooking, spoilage, serving food**,** and left over food after consumption; 2.Plastics: all varieties; 3.Metals: Tins, cans and metal (ferrous and non-ferrous); 4.Glass: non-returnable bottles, soft drink bottles, broken glass, ceramics etc; 5.Paper and cardboard: all kind of waste paper, newspapers, and cardboard; Rubber; Textiles and Rugs; Other wastes like cigarette butts, leather rags, electronics waste etc. According to estimation of waste by Worldwide Responsible Accredited Production (WRAP, 2013), avoidable food waste in the UK hospitality sector generates while preparation (45%) and consumption (34%) stages, but is also (21%) due to spoilage in the process of handling (table 2 and 3).

Table 2. Waste Characterization of Hotel Mejbaan

Days	Polythene (gm)	Aluminum foil (gm)	Cellulose hand bag (gm)	Refined and packingpouches (gm)	Bottles (gm)	Tissue and butter Paper (gm)	Organic waste (Kg)	Cigarette butts (gm)	Other Waste (gm)	Total (kg)
Sunday	225	100	250	250	800	200	24.5	100	550	26.97
Monday	300	200	225	150	700	125	25	75	7650	27.42
Tuesday	225	125	250	220	880	125	24	150	7550	26.52
Wednesday	200	150	220	130	650	100	23	125	800	25.37
Thursday	250	175	180	150	760	100	22	100	66650	23.6
Friday	270	160	190	290	670	140	22	80	580	24.38
Saturday	240	150	160	220	850	220	21	100	6600	23.54
Min.-Max. Mean ± SD	200-300 244.28±32	100-200 237.14±32	160-250 210.71±34	130-290 201.42±59	650-850 757.58±89	100-220 141.42±47	21-25 25±1.4	75-150 104.28±25	550-800 625.71±125	23.54-27.42 25.48±1.6

Table 3. Waste Characterization of Hotel Pearl Mark

Days	Polythene (gm)	Aluminum foil (gm)	Cellulose hand bag (gm)	Refined and packingpouches (gm)	Bottles (gm)	Tissue and butter Paper (gm)	Organic waste (Kg)	Cigarette butts (gm)	Other Waste (gm)	Total (kg)
Sunday	225	100	250	250	800	200	24.5	100	550	26.97
Monday	300	200	225	150	700	125	25	75	7650	27.42
Tuesday	225	125	250	220	880	125	24	150	7550	26.52
Wednesday	200	150	220	130	650	100	23	125	800	25.37
Thursday	250	175	180	150	760	100	22	100	66650	23.6
Friday	270	160	190	290	670	140	22	80	580	24.38
Saturday	240	150	160	220	850	220	21	100	6600	23.54
Min.-Max. Mean ± SD	200-300 244.28±32	100-200 237.14±32	160-250 210.71±34	130-290 201.42±59	650-850 757.58±89	100-220 141.42±47	21-25 25±1.4	75-150 104.28±25	550-800 625.71±125	23.54-27.42 25.48±1.6

3.4 ***Collection and Storage of Solid waste***

None of the surveyed hotels have separate bins for collecting different types of solid wastes and the generated waste was collected by housekeeping employees in respective dustbins. None of the hotels was found to practise waste segregation in different categories. After collection of wastes, 16 hotels disposed it directly to privately owned hand driven constrained carts or other small vehicles, which further emptied into in community bins. The waste from the community bins is collected by Kurukshetra municipality on daily basis except Sundays and National holidays. Hotel Mejbaan and Hotel Pearl Mark collected and disposed off their wastes at disposal site on their own expenses and labour. In contrast, in metropolitan cities such as Mumbai the centralized system i.e. collection of waste by municipality only is not successful for collection of waste. In Mumbai and adjoining area of

Thane, Maharashtra various efforts were made to manage their waste in a decentralised manner with help of citizens, organizations, govt. agencies (Iyer, 2016)

3.5 Transfer and Transportation of Solid Waste

In this process, the transfer of waste from the smaller collection vehicle to the larger transport equipment and the subsequent transfer of the waste to the disposal site are being carried out. The waste in the community bins is manually transferred and then community bins are disposed off to a truck/tractor by municipal workers for transportation of MSW solid waste to the disposal site. During the study period, the Kurukshetra municipality has two trucks of 5 metric tons capacity and one tractor of 2.5 metric tons capacity to transport the solid waste to the disposal site. Each vehicle with one driver and 2-3 collection labourers makes 2 trips/ day. One trip usually takes one hour time for hauling the waste and transporting the waste to the disposal site. It has been observed that loading from bins and unloading at disposal site by 2-3 labourers took 90 minutes. The vehicles used for transportation are more than 10–15 years old and are in deplorable condition. While carrying the waste, no cover is provided for the waste, often leading to littering of during transportation and sometime cause nuisance to the nearby vehicles and paddlers. Moreover, the fluid generated from the biodegradable fraction of the waste drips everywhere while transportation. The condition becomes worse during the monsoon season. However, currently door-to-door garbage collection system has been started with the help of 81 tippers and 62 drivers, each accompanied by one helper to collect the municipal solid waste through covered municipal vehicles.

3.6 ***Reduce, Reuse and Recycling***

Leftover food, peels of vegetables and spoiled food that has passed its 'use by' date is send to piggeries and some hotel send their unused food to slums that reduced the waste. Similarly, in Vietnam 60% of the surveyed hotels indicated that their food waste is sold to local collectors as animal feed (Iyer, 2016). Food waste can potentially be recycled and used for feeding animals (Cummings, 1997; Farrell, 2000). Salama and Abdelsalam (2021) reported many hotels are practicing waste management practices such as recycling food waste to produce bioenergy or converting into fertilizer by composting process. A compost program was created to help divert organic material from landfill (Von massow and Mc Adams, 2015). Importance of food resource must be understood that wasting food means, wastage of land, water, fertilizer, money, fuel, and energy spent on raising that wasted food on the farm. Waste should be managed properly; otherwise food waste leads to environmental degradation as it is the major contributor to Greenhouse gas in turn climate change. When food is discarded, it goes to the landfills, there it rots to produce Methane- a Greenhouse gas which is 28 times much potent than Carbon dioxide (Balcombe et al., 2018). If we divert food waste from landfills to an innovative food waste treatment system then we can stop almost 11% of Greenhouse gas emissions (Sanciolo et al., 2022).

In the present study, in addition to management of food waste other materials like News papers, bottles, papers, cartoons, cardboards were send to either recycling units or given to labour class. Towels and Handlooms were washed and reused. Han et al. (2018) in his review paper also recommended the reuse and washing of towels. Reusable products instead of disposable such as crockery, utensils, handlooms and linens can reduce a huge burden of waste (Omidiani and Hashemi Hezaveh, 2016). During the study period, none of the waste reduction techniques like composting, vermin-composting, incineration is used in Kurukshetra.

3.7 Condition of Main Solid Waste Disposal Site

During study period, the main solid waste disposal site for Kurukshetra city is situated about 3 Km from the city at Palval Road near Palval Village. Here, wastes are dumped openly and regularly on land which is illegal. This disposal site is unplanned and not far away from habitation clusters. Municipality workers dump the collected waste with truck and tractors at the disposal site. There is no on site segregation. The general condition of disposal site are very poor as there is no fencing and boundary around it due to which several birds and animals (crows, pigs, eagles), rag pickers arrive at the disposal site and cause waste spreading (Fig. 3). Uncontrolled burning was also observed at the site which may cause ambient air pollution. Solid waste filling in these areas interrupt the flow of water during the rainy season. Polythene bags create nuisance when blown by the winds and entangle on trees and shrubs which can cause impact on environment and cattle health (Ramaswamy and Sharma, 2011). Since 2018, the

dumping area is located at Pipli near Pipli Zoo. It occupies 4.5 acres of land. Also, there is no budget fixed in the Municipal council for the collection and management of the waste in the city.

Table 4 Information regarding waste disposal site

Sr. No	Conditions of disposal site	Respondents
1	Distance	3 km
2	Location	Plains
3	Type of dumping	Open dumping
4	Far from the populated area	2 km
5	General condition of disposal site.	
	(i) Ragpickers	Yes
	(ii) Cats	No
	(iii) Dogs	Yes
	(iv) Pigs	Yes
	(v) Eagles	Yes
	(vi) Smell	Yes (foul)
	(vii) Blowing of waste by wind	Yes
	(viii) On site segregation	No
6	Effects on workers health	
	(i) Respiratory problems	20%
	(ii) Allergy	50%
	(iii) Skin/dermal	25%
	(iv) Another disease	30%
7	Facilities provided to workers	
	(i) Gloves	100%
	(ii) Masks	100%

Fig. 3: Conditions of waste disposal site at Palval road, Kurukshetra

4.Conclusion and Recommendations

Instead of the open dumping practice of hotel wastes at the final disposal site, sanitary landfilling and composting would be more feasible and better options for processing waste. The process will create new job opportunities, generate income and finally reduce the waste, which otherwise finds it way in open dumping.

Hoteliers can be made aware of waste segregation to promote composting and recycling techniques. Municipalities or concerned authorities can provide incentives/subsidies to those who adopt these technologies. The present practice of supplying refused food items and other organic wastes to piggery/poultry is appreciable and needed to be continued. The use of polythene or plastic must be restricted and can be replaced by degradable consumables. There is a significant benefit of recycling and reusing is that it prevents valuable things from being landfilled and thus saves energy and natural resource. Food waste, leftover foods, and kitchen waste can be converted into natural fertilizer, as an ideal soil conditioner.

Authors' Contributions*: Dr. Dipti Grover (Assistant Professor) designed the research and the manuscript, and supervised the data collection; Ms. Himani (M. Sc. Student) generated and interpreted the data, Dr. Bhawna Dahiya (Assistant Professor) and Dr. Hardeep Rai Sharma (Assistant Professor), corresponding author, helped in designing the research and manuscript writing.*

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