

Estimating the Scope of Recycling Benefits for Hotels in India

Hima Gupta*

Abstract *The paper explores the inherent aspects and imperatives of recycling in hotel industry. It aims to establish the relationship of such imperatives with business strategic and sustainable development of the industry. The research is empirical in nature where data is collected through local survey from Delhi-NCR region. It is duly supported by pertinent qualitative work and quantitative analysis. The findings so far suggest that frugal innovation and efforts at incremental level to address the recycling-of-wastage can bring-out tangible and sustainable results. This can also reap monetary benefits in terms of efficient processes and substantial profits. The paper highlights two main implications. The first option includes quick responsiveness with providing provision of Bio-digester which relatively small area for establishment and low cost generating considerable profit. The study enhances understanding the need to encourage developing a systemic approach of waste recycle along with frugal innovations in hotel industry pertaining to address the emerging issue of waste management.*

Keywords: *Recycling, Hotel Waste, Waste-Audit, Greenhouse Gases, Cost Benefit Analysis*

INTRODUCTION

The new business environment today is typically cautious on saving as well controlling the advent of environmental damage. Business organizations are accumulating know-how on handling and disposing diverse types of waste. Hotel industry here particularly possesses a substantial challenge as well opportunity. The study aims at estimating the recycling benefits in hotels as an environmental concern which can also reap monetary benefits in terms of efficient processes and substantial profits. The study identifies the amount of waste produced by hotels as a part of their hospitality service and the extent to which it can have negative impact on the environment. The amount of CO₂ and GHG emission is huge if calculated for all the hotels on per year basis and thus cannot be ignored.

The study is empirical in nature. Hotels included in the study were randomly selected based on the prior permission and expert opinion which included star rated hotels in NCR (national capital region) region, India. The data obtained was from primary source, wherein the audits were done using a

structured format stated by author and was pilot tested and reviewed by professionals.

The interpretation for finding a solution to this problem of waste management is important to have a better environment and to increase the effectiveness and efficiency of hospitality industry as a service. It is found that the cost benefit analysis has shown profitable results (Rs. 21, 90,000 + Rs. 76,500 - Refer Table 7) that can be a motivating factor for hotels to implement the waste management techniques for recycling waste although initially it would incur some cost but gradually the investment will turn fruitful in terms of substantial profits as the economies of scale come into play.

The paper is unique as it has been conducted for Indian Hotels, where maximum amount of food wastes generated is not treated and creating an environmental hazards. The limitation however, is that it is region specific majority done in Delhi NCR - India.

India has been a large market for travel and tourism and hotel industry indeed a most critical auxiliary sector. By 2030, Indian hospitality and tourism sector is expected to be the third

* Professor, Indira Institute of Management, Pune, Maharashtra, India. hima.gupta@indiraiimp.edu.in

largest foreign exchange earner, worth \$ US 15 billion, after gems and jewellery and readymade garments (Mukherjee, 2012). This industry contributes 6.4% in Indian GDP with annual increment of 7.8% per annum while its contribution in world's GDP is 9.1% which is increasing at the rate of 4.3% per annum (WTTC, 2012). The tourism industry is significant because this industry provides the world's largest employment, generating 254,941,000 jobs implying nearly one out of every 12 jobs is from this sector (WTTC, 2012). This clearly indicates the economic importance of the sector, but still country's tourism potential is untapped. The requirement of hotels is though economically beneficial but has negative consequences on the environment because of the improper management of the waste generated from these hotels. From the perspective of environment and human health, generation of waste has become a biggest problem.

The environment is being affected largely by Hotel Industry; and its growth rate is 17% in India and waste is also increasing in the same proportion (IHMR, 2010). As per the recent report of Central Pollution Control Board, each hotel room in India is generating 1 to 6 kg/day waste. Nielson's report had clearly indicated that two metro cities, Delhi and Mumbai having 14,757 hotel rooms generated approximately 147.57 to 885.42 tons of solid waste per day, and it will increase to 27,438 rooms in near future, so the amount of waste will also increase in the same proportion. Waste generation leads to groundwater contamination through formation of leachate, surface water contamination through run-off, and air contamination due to emission of harmful gases. Other problems are due to litter, dust, bad odour, rodents, pests, fire, bird menace, slope failure, erosion, etc. (Singh et.al, 2013). When the waste from hotel industry is dumped directly to the landfill sites, it contaminate with other metals and thus produce methane, a most hazardous greenhouse gas (GHG). Numbers of studies on GHG emission from hotels have been on the emission related to infrastructure such as design and construction of building, transportation, energy, water usage, but none has been studied it from waste material. Hospitality industry is one of the major contributors of the waste with as much as 45% of all municipal solid waste coming from this sector only (Bacot et.al, 2002). Thus, this study is focused on estimating the hotel waste in India. Recycling and Composting are the basic two ways of reducing the waste in hotel industry. In one of the study carried out by Wrap (WRAP, 2006) on the benefits of recycling in the UK found that recycling saved 10-15 million tonnes of CO₂ equivalent per year from hotel waste. Recycled material helps to reduce use of virgin materials, thus saving immense energy and emissions (POSTNOTE, 2005). Composting the biodegradable waste stream especially food and garden has been viewed as having a great potential in diverting biodegradable waste from landfill and has been encouraged

so as to derive compost which is a form of fertilizer and soil conditioner. The carbon emissions level will be going to decrease from 33% to 35% in comparison to its GDP as assured by India.

LITERATURE REVIEW

Managing waste positively affect social, economic and environmental issues of county and organisation (Rohweder, 2007). To reduce volume of waste, Kirk (Kirk, 1995) recommended three strategies for hotels to reduce the burden of waste on the environment: hotels should work on purchasing policies (develop partnership, sensible packing of the product), waste management (minimize waste in operation, reuse, and recycle), and waste disposal (partnership with disposal companies, sound disposal method). Thus, lack of segregation of waste at source by the hotel industry is one of the main reasons of waste generation. Similarly, Bohdanowicz (Bohdanowicz et.al, 2007) studied resource consumption in 184 Hilton International and Scandic hotels in Europe, and suggested options for decreasing resource consumption and improving efficiency in hotel facilities by behavioural changes and mechanical and building system modifications.

Cheung (Cheung et.al, 2013) studied the Langham Place Hotel, Mongkok, Hong Kong which successfully reduced CO₂ emission by implementing a range of sustainable designs. Similarly, Gossling (Gossling et.al, 2011) studied the consumption of food and its affect on the climate change due to growing tourism. He concluded that by managing the food production chains and foodstuffs, GHG emissions can be substantially reduced.

In another study by Liqin (Liqin, 2011) in his paper "Relative analysis of the carbon footprint of the high-stared hotels during operation" targeted six hotels including four 4 star hotels and two 5 star hotels. He suggested three main strategies to reduce emission by creating products of low carbon; for example, the operators of hotels should create new vegetables, such as leafy and salad vegetables, fungous or mixed grain rice, and so on, which can be cooked by using less energy. Second, reinforcing the practices of energy saving and environment protection in operations, and finally, advocating the idea of low-carbon consumption among the guests.

Hotel industries consist of lodging, restaurant, bars etc. having large number of operations, which consumes energy, water, food, paper and other resources. It adds pollutants like solid and wet waste e.g. plastic and aluminium cans, kitchen waste, smoke, smell, noise and chemical (Kirk, 1995). Kirk (Kirk, 1995) reviewed some of the development within the industry of responsible environment management and

investigate attitude of manager in hotel industry in Edinburg. Waste management and waste disposal has been another area of concern. The importance of differentiating between waste minimization and waste disposal management is critical (Kirk, 1995).

Many countries undertake the principle of “pay as you throw” to encourage waste reduction activities (Fullerton et.al, 1996). Composting is considered an effective way for disposing of waste with high organic content, i.e. food waste (DETR, 1999). Some hoteliers described the difficulties associated with reducing different waste streams, particularly food waste and packages. Very few hoteliers reacted positively towards the idea of reducing the volume of their waste. They involved themselves personally in SWM to reduce disposal costs. They implemented different measures to minimise waste including cooking to order, efficient use of resources and employing experienced people.

Similarly Maineri (Maineri et.al, 1997) found that customers are less likely to adopt green purchasing practices. This is an important issue of research which will be address in our next paper, but has strong reason for hoteliers to recycle or not i.e. to go in for green strategies or not?

Maclaren (Maclaren et.al, 1997) and Horobin (Horobin et.al, 1996) studied various barriers in relation to recycling, e.g. cost, space and time. All of them agreed that the lack of a “doorstep” collection service was the biggest challenge to recycling. The majority felt that it was difficult to separate waste materials as they had no space to locate different bins. Others felt that the process of segregating waste materials was very time consuming and costly. It takes time for staff to sort out rubbish and thus was an additional cost to the hotels. Likewise, some types of waste materials need to be treated, e.g. by washing, before they can be put out for collection.

The literature has shown that food waste can potentially be recycled and used for feeding animals (Bacot et.al, 2002) (Farell, 2000). However, none of the hoteliers were following this route. The majority indicated that the quantity of food waste produced by small hotels was too small to make farmers interested in collecting it. A few were feeding the food waste stream to animals believing that it was more sustainable than disposing of it into landfill. However, this is not always possible as countries like UK banned it due to animal by-product regulations (Statutory Instrument 2347/2005) to prevent the occurrence of foot and mouth disease (DEFRA, 2014).

Many researchers studied that improving hotel environmental performances would lead to the reduction of energy consumption and operational costs (IHEI, 1996) (Kirk, 1998) generate an environmentally-friendly environment for

both staff and customers (Cooper, 1998) and help raise the company’s corporate image for gaining a competitive edge (Mensah, 2006) (Taylor, 1992).

Waste disposal and its regulation are both important as well as complex. The enforcement of these laws needs to be practiced and properly implemented for the protection of the Environment. There are many studies that have reviewed the typical types of waste produced by hotels. Kirk, 1995 (Taleb, 2005) indicated that hotel waste is generated in the form of aluminium, plastics, glass, steel, cardboard and food. Food waste, as noted by Sherman (Sherman, 1998) and Ibrahim (Ibrahim, 2003) can affect the environment in several ways. For example, food scraps discarded in dumpsters / rubbish skips rather than bins can cause odour and generate methane at disposal facilities.

Bohdanowicz (Bohdanowicz, 2005) also estimated that a typical hotel produces in excess of 1 kg of waste per guest per day, which results in tons of waste each month. More specifically, Potts (Potts et.al, 2002) reported that a large hotel property can generate as much as 8 tons of waste per day and up to 60 per cent of this waste is recyclable, which introduces the importance of recycling itself. Snarr (Snarr et.al, 2000) indicated that, the amount of recyclable waste produced is affected by variables that differ from one business to the other. These variables include the hotel type, occupancy, number and size of meal functions, lounge / bar business, conventions, guest and employee activities and purchasing practices. However, (Bohdanowicz, 2005) confirmed that best practices in waste minimization and recycling can limit waste generation to 50 g of unsorted waste per guest night and, hence, there is a need for environment friendly operation of hotel facilities.

A waste audit is a formal, structured process used to quantify the amount and types of waste being generated by an organisation. Information from audits will help to identify current waste practices and how they can be improved. The type of audit you use depends on the type of waste, where it is and what you want to get out of the audit. Such audits help determine potential savings due to waste disposal and cost reduction. Reduction in the cost of production can be an on-going activity through action to reduce waste thereby the cost of treatment and disposal and increasing productivity in the long term. This also reduces the risk of regulatory non-compliance and public liability. It is more important and vital that the waste audit programme or procedure is planned and has management commitment.

The study of Zein et al, 2008 have characterized the non – hazardous hotel wastes into various categories along with its source from where it is generated by a large (Table 1).

Table 1: Types of Non-Hazardous Waste in the Hotel Industry

Non – Hazardous Waste Type	Components	Source
House hold wastes	Food/kitchen waste, used or dirty paper and wrapping or bags, composted wrappers	Hotel's different departments
Cardboard	Packing	Hotel's purchasing and other departments
Paper	Printed documents, brochures, menus, maps, magazines, newspaper	Administration, reception, guests room, restaurants
Plastic	Bags, bottles (that did not contain hazardous materials) household goods, individual portion wrappers for various products	Kitchen, restaurants, bars, guests room, Administration
Metal	Tin cans, jar lids, soda cans, food containers, mayonnaise, mustard and tomato puree tubes, aluminium packing	Kitchen, restaurants, bars, guests room
Glass	Bottles, jars, flasks	Kitchen, restaurants, bars, guests room
Cloth	Table cloth, bed – linen, napkins, clothes, rags	Kitchen, restaurants, bars, bathroom, guests room
Wood	Wooden packing pallets	Purchasing department
Organic waste	Fruit and vegetable peelings, flowers and plants, branches, leaves, grass	Kitchen, restaurants, bars, guest rooms, gardens.

Source: Zein et al., 2008

The amount of wastes and its percentages varies as per the location of the wastes available, and the food wastes and paper are contributing the highest proportion out of the total wastes generated as a whole.

RESEARCH METHODOLOGY

The methodology used in this study includes secondary data from literature review and primary data from waste audit of eight hotels in Delhi national capital region (NCR) of India. The hotels belong to star rated categories. Waste audit is done using structured format developed by the author. The format before administering was pilot tested and reviewed by expert professionals in the field. The time and day of waste audit were selected on the basis convenience of the hotel administration. Instrument used for collecting data

is structured audit form consisting of 10 different waste materials generated in hotels. Further it is extrapolated on all star rated hotels in Delhi NCR. The 5 - star category hotels selected for waste auditing are based on prior permission and expert opinion, as mentioned here:

- La – Shangri – la Hotel
- Hilton Hotel
- Country INN
- Park Plaza
- Jaypee Vasant Continental
- Jaypee Greens Golf & Spa Resort
- Jaypee Siddhartha
- Lemon Tree hotel

DATA ANALYSIS

The model for hotel industry to manage their waste effectively and efficiently is developed in the paper was already pre tested by United State Environment Protection Agency (USEPA) in some other sector like household, industry etc. These tools are:

- Audit form
- WARM Model
- Equivalency Calculator
- Cost benefit analysis

RESULTS AND DISCUSSION

Average Waste Generated Across Eight Hotels

After completing the entire waste audit process the next logical step is to take the average of all audited hotel to know the volume of waste generated from hotel. The average generation of plastic pet bottles from audited hotel is approximately 6.51 kg per day and yearly it was 2343.06 kg. Similarly averages of other mixed plastic waste material from all hotels were 8.99 kg per day and 3235.23 kg on yearly basic. Tetra pak from the entire hotel was approximately 4.05 kg per day whereas 1458.9 kg in a year. The averages of aluminium that is 3.69 kg would become 1327.5 kg in a year. Glass wastes are one of the major portions of waste and average generation from hotel is 115.56 kg in a day. This shows that this waste has large chunk of waste. While considering yearly basis it would become 41602.5 kg. There is a variation in a hotel regarding newspaper because it is mostly depend on the number of rooms available in a particular hotel. Approximately in a day a hotel generate 48.13 kg of waste per day and yearly it would be 17325 kg. Mixed office paper is estimated as 5.80 kg per day and

it would become 2086.2 kg per year. Cardboard are also one of the major portion of overall waste. On an average it generates 107.58 kg per day and in a year it would be approximately 38729.7 kg.

Food waste or organic waste is one of the high portions of waste because of consumption pattern, habit and restaurants

in hotels. On an average it is 478.17 kg of waste per day and yearly it would increase and become 172141.2 kg. Trash material is very less in nature but unfortunately mixed with other material and sent to landfill sites. Currently only 1.69 kg of waste generated in a day and yearly it is only 608.13 kg of waste (refer table 2).

Table 2: Average Waste Generated from All Eight Hotels

Material	Shangri-la Hotel	Hilton Hotel	Jaypee Vasant Continental	Country INN	Park Plaza	Jaypee Greens Golf & Spa Resort	Jaypee Sidharth	Lemon Tree	Avg/day (Kg)	Avg/Yr (Tons)
Plastic pet bottle	5.90	7.58	6	6.76	6.58	5.84	6.26	7.16	6.51	2.34
Other/mixed plastic	7.82	6.63	26.2	6.7	6.76	4.14	7.3	6.34	8.99	3.24
Tetra pak (laminated paper)	5.4	5	2.1	4.7	4.58	2.04	3.46	5.14	4.05	1.46
Aluminum	2.62	4.48	3.3	2.9	3.64	5.58	3.68	3.30	3.69	1.33
Glass	194.2	127.94	61.56	131.22	113.8	56.78	92	147.00	115.56	41.6
Newspaper	80	60	60	65	20	20	35	45.00	48.13	17.33
Mixed office paper	10.78	4.14	9.4	5.3	3.76	5.16	3.6	4.22	5.80	2.09
Cardboard	249.9	133.9	53.4	190.7	37.84	25.72	26.2	143.00	107.58	38.73
Food/wet waste	1559.16	291	493	900	121	117.6	112.6	231.00	478.17	172.14
Trash (laminated plastic)	2.24	2.78	0.82	1.64	1.8	0.76	1.334	2.14	1.69	0.61
Total	2118.02	643.45	715.78	1314.92	319.76	243.62	291.43	594.30	780.16	2,80.86

Source: Prepared by the authors

With the help of audited hotel waste, we are able to find the waste generation ratio from a single hotel and can extrapolate it to the Delhi NCR hotel to know the approximately waste amount generated in this region. A single hotel can generate approximately 280.86 ton of waste per year. This is a huge amount of waste generated from a single hotel, located in single metro city. But if consider the entire hotels of Delhi-NCR the amount of waste increased to 26400.60 ton of waste per year. This is an unexpected figure came out from a single service sector. As there are many literature articulate that there is a scarcity of land. In this scenario we can't expect more or more landfill sites for waste dumping. In metro cities there are some other sources also that generate same amount of waste daily. In Delhi there are few landfill sites like Okhla, Bhalaswa and Ghazipur sites, which are almost full. So the best option to get rid of this problem is to solve it either by recycling or reuse the waste generated by hotels all across the Delhi NCR at large. Table 3 below shows the detail of waste generation.

Table 3: Waste Generate in Delhi-NCR

Waste generate in Delhi NCR hotels		
Material	Waste generated from one hotel/year (Tons)	Total waste generated from Delhi NCR hotels (tons/year)
Plastic pet bottle	2.34	220.25
Other/mixed plastic	3.24	304.11
Tetra pak (laminated paper)	1.46	137.14
Aluminium	1.33	124.79
Glass	41.60	3910.64
Newspaper	17.33	1628.55
Mixed office paper	2.09	196.10
Cardboard	38.73	3640.59
Compost/wet waste	172.14	16181.27
Trash (laminated plastic)	0.61	57.16
Total	280.86	26,400.60

Source: Extrapolation of hotel waste

Emission from Single Star Rated Hotel and All Star Hotels in Delhi - NCR

This value shows that only a single hotel can save 606 metric ton of CO₂ equivalent, at present this value is negligible but further the same process use with all-star rated hotels of Delhi-NCR, this value become a meaningful interpretation.

This value shows that the entire star rated hotel can save approximately -56,756 metric ton of CO₂ equivalent, earlier we saw a single hotel can save -606 metric ton of CO₂ equivalent whereas the entire hotels save a huge amount of emission, which is really a substantial saving the earth atmosphere [Source: Report generated from United States Environmental Protection Agency (USEPA) (WARM Model), 2013].

Emission Conversion from One Hotel and All Delhi-NCR Hotels

With the help of equivalency calculator all emission generated from waste utilize to the other sector it means the same amount of GHG emission can be used to other segment like -606 metric ton of carbon dioxide is equivalent to 126 passenger vehicles and so on.

With the help of equivalency calculator all emission generated from waste coming out of all hotels situated in Delhi NCR, it means the same amount of GHG emission can be used to other segment like -56756 metric ton of carbon dioxide can be converted into various segments as described in the Table 4.

Table 4: Utilization of Emission from One Hotel and All Star Hotels in Delhi- NCR

Equivalent to:	Emission from one hotel	Emission from Delhi-NCR hotels
Passenger vehicles or	126	11949
Tons of waste send to landfill or	217	20343
Garbage trucks of waste recycled instead of landfilled or	31.1	2909
Gallons of gasoline consumed or	67937	6,386,407
Pounds of coal burned or	650913	60962406
Oil consumed or	1409 barrels	131,991 barrels
Tanker trucks 'worth of gasoline or	8	751
Electricity consumed or	83.4 homes	7,807 homes
Wind turbines installed or	0.167	15.6
Energy consumed or	30.3 homes	5,178 homes
Incandescent lamps switched to CFLs or	15851	1484593

Equivalent to:	Emission from one hotel	Emission from Delhi-NCR hotels
Propane cylinders for home bar-beques or	25250	2,364,833
Burning rail cars' worth of coal or	2.6	304
Recycling of waste instead of sending it to the landfill or	227 tons	2,909
Coal fired power plants or	0.0002	0.015
Tree seedlings grown for 10 years	15538	1455282

Source: Report generated from United States Environmental Protection Agency (USEPA) (EPA Calculator) - 2014

Cost Benefit Analysis

Cost benefit analysis (CBA) is the key objective of the study. It is the main gap, which needs to be bridged so that the hotel industry may be shown the potential of waste management and its positive implementation to them as well as to the environment. The data gathered from waste audit was used for analysing the cost benefit associated with implementing cost versus benefits of implementing the green practices in hotel (*Net benefit = Benefit – Cost*) (refer Table 7).

Before going to the depth of calculation, first of all we need to know the various methods for waste treatment according of the nature of waste. There are two categorization of waste treatment:

- Treatment of recyclable waste
- Treatment of compostable waste

Calculation of Saving from Recyclable Material

Before going for calculation of saving, we need to know the cost associated in implementing green practices or any strategies. There are many costs associated with implementing any green practices like labour cost, cost of extra bin, miscellaneous expenses, salvage value etc.

Below the following facts and logic were made to this analysis based on the experience of the waste audit, discussions with practitioners like hotel managers, waste supervisors and NGO associated with waste hotel's waste dealing:

Labour Cost for Waste Handling

As per the estimation from waste audit we are able to find that on an average a single star rated hotel can generate approximately 780 kg of waste daily. When all waste is collected from hotel industry, segregation of entire waste is most important because of its well treatment. In one of the survey (Devi et.al, 2014) conducted by Central

Pollution Control Board (CPCB) and New Delhi Municipal Cooperation (NDMC) on waste segregation, it was found that a single labour can segregate 100 kg of waste in a day (Nilofour et.al, 2013). So taking it as a base for hotel industry wastes that is 780 kg, we required at least eight labour for waste segregation (CERAG, 2004) as one labour can handle 100 kgs per day [Source: Estimated by Chintan (NGO) as per research project with CPCB and NDMC in Delhi].

Apart from the facts of literature review and published reports, a separate individual interview have been conducted with three different Non-profit organisation (NGO) i.e. Indian Pollution Control Association (IPCA), Chintan and Vatavaran to know how much cost or salary they are paying to their worker for waste handling [(Nilofour et.al, 2013)].

In cost benefit calculation we took the average of all four labour cost and consider Rs 7000 as labour cost.

Cost of Dustbin

For waste storage and segregation process, some different size dustbins are required. Initially minimum 2 bins of 50 litter size are required to segregate all waste in recyclable form and compostable form at hotel dumpster. Then 8 more bins of 120 litters are required for waste segregation by eight labours. All waste audited items like paper, plastic, newspaper, cardboard, glass, trash, aluminium, tetra pak, compostable items etc. are required 10 different waste dustbins of 80 litter.

Miscellaneous Expenses

During auditing, we find out some fact and figure of miscellaneous expenses that would keep in the petty cash book, officially these figures below was not to disclose. In miscellaneous expenses there are some cost also include like cleaning, logistic, waste storage etc. each hotel have some amount, which they spent on waste handling. On an average hotel spent approximately Rs 7500 on their monthly expenses whereas Rs 90000 on yearly basis.

Calculation of Salvage Value

Estimated salvage value of a depreciable asset or property at the end of its economical or useful life. When the cost of an asset less its accumulated depreciation equals its salvage value, no more depreciation may be taken. Thus, salvage value is used as a component of the depreciation calculation. It is also called residual values.

All waste material has some value. In generally waste is treated as useless or no value but when it processed systematically it will generate handsome amount of revenue. Here in table 6, below show that each waste material has some value if it would resale to recycler or scrap dealer. In cost benefit analysis we took the average rate offer by all four scrap dealer i.e. Rs 30.

Table 5: Salvage Value

Salvage value					
Material	Rates from Indian Pollution Control Association (IPCA)	Rates from recycler 1	Rate from recycler 2	Rate from recycler 3	Average rate (Rs/kg)
Plastic pet bottle	35	30	30	25	30.00
Other/mixed plastic	15	15	14	16	15.00
Tetra pak (laminated paper)	6	4	3	3	4.00
Aluminium	100	95	80	85	90.00
Glass	2	1	1	0	1.00
Newspaper	18	11	10	9	12.00
Mixed office paper	10	10	9.5	10.5	10.00
Cardboard	10	8	7.5	7	8.13
Compost/wet waste	0	0	0	0	0.00
Trash (laminated plastic)	0	0	0	0	0.00
Total					Rs.170.13/kg Eqv. \$0.003per ton

Source: Data collected from surveys

With the help of these analyses it can be proved that waste can also add profitability.

Calculation of Savings

The average waste generation of pet plastic bottle in a month is 195.26 kg and yearly it will become 2343.06 kg, if this

waste resale to scarp dealer, we will generate Rs 5857.65 per month and yearly it will become Rs 70291.8. Similarly the average salvage value of mixed plastic is Rs 15 and if it is resale, it can generate Rs 48528.45 yearly on selling of yearly waste i.e. 3235.23 kg. Refer table 6 for detail analysis of each waste generated monthly and yearly along with its salvage value or profit.

Table 6: Revenue Generation from Salvage Value

Material	Avg waste/month (Kg)	Avg waste/yr (Kg)	Salvage value (Rs/kg)	Income from salvage (Rs/mon.)	Income from salvage (Rs/year)
Plastic pet bottle	195.26	2343.06	30.00	5857.65	70291.8
Other/mixed plastic	269.60	3235.23	15.00	4044.04	48528.45
Tetra pak (laminated paper)	121.58	1458.90	4.00	486.30	5835.6
Aluminium	110.63	1327.50	90.00	9956.25	119475
Glass	3466.88	41602.50	1.00	3466.88	41602.5
Newspaper	1443.75	17325.00	12.00	17325.00	207900
Mixed office paper	173.85	2086.20	10.00	1738.50	20862
Cardboard	3227.48	38729.70	8.00	25819.80	309837.6
Compost/wet waste	14345.10	172141.20	0.00	0.00	0
Trash (laminated plastic)	50.68	608.13	0.00	0.00	0
Total	23404.79 kg eqv. 23 tons	280857.42 kg eqv. 281 tons	Rs 170.00 eqv. \$2.65	Rs 68694.41 eqv. \$ 1073	Rs 824332.95 eqv. \$ 12880

Source: Calculated from surveys

Calculation of Saving from Compostable Material

There are mainly two ways of composting based on amount of waste generation and hotel premises. These two feasible solutions of organic waste are bio-digester for small scale and multi-pit for large scale.

Bio-digester for Small Scale

Bio-digester is usually related to the reduction of waste volume that converts waste into useful gas and manure. It provides a relatively simple solution for waste management and energy production. India has many examples of successful small-scale bio-digesters, including the floating drum model and the fixed dome model. As a cleaner alternative to wood stoves, these bio-digesters are popular in rural India and other countries, and are typically designed for single families or small communities. As more communities are driven to investing in “greener” technologies, bio-digesters provide a relatively simple solution for waste management and energy production (Hojnacki et.al, 2001). Even in countries like the United States, that have a climate least suited for this technology, the use of bio-digesters is growing.

Cost of Implementing Bio-digester

The cost of bio-digester equipment i.e. Rs 1050000 as per market rate [Source: Calculated from survey and published paper (Ananthakrishnan et.al, 2013)]. Apart from equipment minimum two labours are required for waste churning and filtering that would be cost around Rs 16776 per year along with the cost of 2 bins having dimension 32 gallon, costing Rs 4200. As it is already explain that it is best suited for small scale so cost of land, electricity, transportation cost and maintenance cost are almost negligible.

Saving from Bio-digester

On an average a hotel generate 450 kg to 500 kg of wet waste daily and with the utilization of this material, waste can convert into biogas. In a day, bio-digester can generate 150 m³ to 180 m³ of biogas, which is equivalent to 80 kg of LPG. The cost of LPG in market is about Rs 70 to Rs 80 per kg, so with the utilization of wet waste hotel can save Rs 6000 of LPG daily. In a year a single hotel can generate approximately Rs 2,190,000 from all organic waste [Source: Calculated from survey and published paper (Anant hakrishnan et.al, 2013)].

Multi pit for Large Scale

- *Windrow Composting:* In this method, refuse is delivered on a paved/unpaved open space but levelled and well drained land in 246 about 20 windrows with each windrow 3m long x 2m wide x 1.5m high, with a total volume not exceeding 9.0 m³ (MSW Manual, 2000).
- *Vermicomposting:* The term “vermicomposting” had recently been coined to mean the use of earthworms for composting organic residues.

Cost of Implementing Multi pit

For multi pit based composting like windrow and vermicomposting required at least 100 sq. yard to 150 sq. yard of land, which cost around Rs 400000. One full time labour is required for waste churning. Two bins are required that would cost Rs 4200. One of the major costs is transportation cost because this type of composting is ideally centralized; the cost of transportation is Rs 90000 per year. In this composting no electricity is required so the overall cost of this type of composting is Rs 578200 [Source: Calculated from survey and published paper (CERAG, 2004) (Papiya and (Hojnacki et.al, 2001).]

Saving from Multi pit composting

On an average 450 kg to 500 kg of wet waste generate daily. As per the estimation of solid waste manual at least three week is required for converting wet waste to compost. Currently the cost of composting is Rs 30 per kg, so for every 130 kg to 150 kg of waste can generate approximately Rs 4500. In a year there are 17 weeks and entire waste can generate Rs 76,500 [Source: Calculated from survey and Municipal Solid Waste (MSW manual, 2000)].

After completing all cost and benefit calculation, a final table (Table 7) of cost benefit analysis has been shown below for easy understanding of interpretation. Cost benefit analysis is the key objective of the study.

First column of the table represent requirement and cost of extra labour for waste segregation. Here we see eight labours are required at Rs 7000 per month, so it would cost Rs 672000 per year. Second column shows the numbers of bins required and its cost i.e. Rs 42954. These costs are one-time expenses. Miscellaneous expenses are around Rs 90000 per year. Fourth column articulate the salvage value of each waste material, adding all waste material the salvage value become Rs 824333 per year.

Table 7: Cost Benefit Analysis

Cost Benefit Analysis									
Extra labours cost (a)	Extra bins cost (b)	Miscellaneous expenses (c)	Salvage value (d)	Expense in 1st Year	Expense in 2nd Year	Earning in 3rd Year	Earning in 4th Year	Earning in 5th Year	Saving from compost
8 Labour * Rs 7000/month* 12	50 Liter - 2 qty 80 Liter - 10 qty 120 Liter - 8 qty	waste storage/cleaning/transportation etc- Rs 7500/month* 12	Income from salvage Rs 68694 per month* 12	Currently hotel doesn't adopt any waste management practices like segregation	Hotel adopt waste segregation practices and sell scraps to vendor. Expenses on bin also reduced	In this year only half of the labours required because 50% labor cost is reduced due to experiential learning	Again in the 4th year only 50 percent labour are required because of experiential learning	Neither extra labour cost nor any miscellaneous expenses paid because segregation at source implemented	Option 1: Through biodigester - Hotel save around Rs 21,90,000. Option 2: Through multi pit - Hotel save around Rs 76,500 by selling @ cost of Rs. 30/Kg
a= Rs 6,72,000	b= Rs 42,954	c= Rs 90,000	d= Rs 8,24,333	a+b+c= Rs 8,04,954	a+c-d= Rs (+ 62,333)	a/2+c-d= Rs (+ 3,98,333)	a/2+c-d= Rs (+ 3,98,333)	Rs (+ 8,24,333)	Rs (+ 21,90,000)/ Rs (+ 76,500)

Source: Calculated from all surveys

Expense in 1st year: Hotels need to invest approximately Rs 8 lakh in very first year for implementing green practices in their premise. This includes cost of extra labour for waste segregation i.e. 1 labour segregate 100 kg of waste, so 8 labour required to segregate around 800 kg of waste per day, as per the source of Chintan (NGO) along with an working project with NDMC and CPCB. Similarly cost of bins and miscellaneous expenses also include in first year.

Expense in 2nd year: In the second year of its operation the hotel will not be paying any cost for bins again because it is onetime expense, therefore Rs 42,954 will not be added in the second year. Salvage value is deducted from overall cost i.e. Rs 824333 because it is the additional revenue generated from selling of recyclable items to scrap dealer. Thus, in the second year hotel will start earning profit of approximately Rs 62,333 per year.

Expense in 3rd and 4th year: From its 3rd and 4th year of operation the labour cost should ideally be reduced to half (50%) as already stated on basis of experience learning. So Rs 336000 is given to 4 labours per year only and the amount of salvage value Rs 824333 is deducted from overall cost. So in this year hotel will earn approximately Rs 3.98 lakh.

Expense in 5th year: From the 5th year onwards hotel will not require to spend any amount on labour or miscellaneous expenses rather they start earning Rs 8.24 lakh subsequently for each successive year only from the selling of sorted recyclable material to scrap dealer.

Revenue through Composting: Revenue through composting is another option for hotel because the contribution of food waste is approximately 61.29% of total waste generated. Proper treatment of organic waste like composting can generate additional revenue by adopting one of the two options.

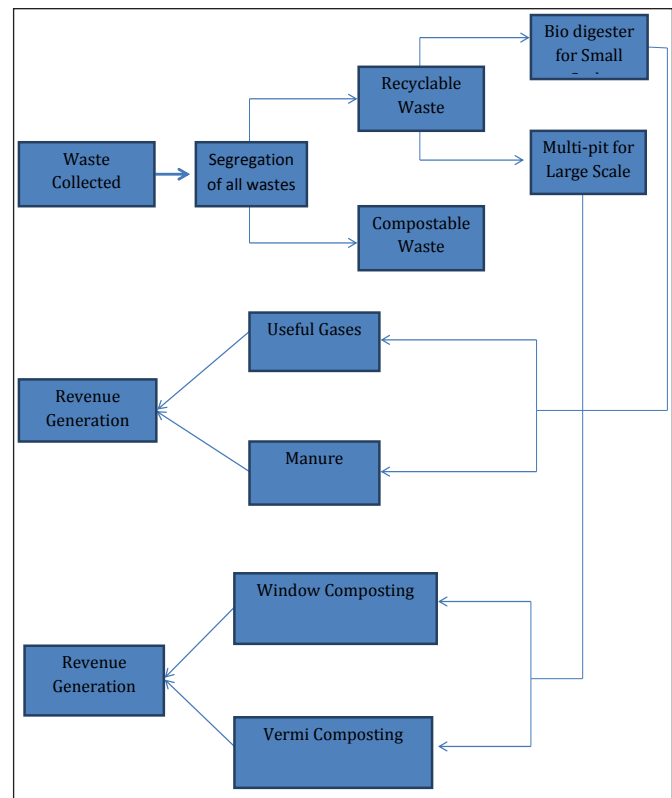
1st option: Bio digester is the 1st option for hotel, it required small area for establishment with on an average cost of Rs 10.7 lakhs that generate profit of approximately Rs 22 lakhs per year depend on the quality of sorted waste material for compost.

2nd option: Multi pit composting is second option, it is suitable for centralize composting of many hotels that required some amount of land, which is given on the subsidy of Government that would cost less than 4 lakh for 100-150 sq. yard and generate Rs. 76,500 per year by selling of compost.

CONCLUSION AND MODEL FRAMEWORK

The cost benefit analysis conducted showed that in the initial year the profits were low due to cost incurred in establishing the setup for waste management but gradually the profits

will increase as economies of scale will be achieved. The methodologies adopted in the study as cost benefit analysis showed that there is considerable difference in cost incurred and benefit received thus stating that profits of good numbers can be received by any hotel if such waste management techniques are applied. Thus we can conclude that implying waste management techniques in Indian hotels will reduce considerable GHG and carbon dioxide emission and will also lead to substantial profit in the business. It is evident from the study that if all the hotels start following the practice of recycling and reusing the waste, the environment can be protected from the hazardous substances which are impending form the hotels.



Source: Authors

Fig. 1: Model for Hotel Waste - Conversion into Revenue

Authors have prescribed a model for hotel waste – how the waste generated at the end of hotels can be converted either into useful manure or by treating the recyclable waste in to bio – gas (equivalent of LPG) in case of small scale and in the form window or vermin composting through the waste. Therefore, it has been suggested here that hotel waste generated in the hotels first of segregated in two categories, one is recyclable and the other is compostable wastes. At a small scale bio digesters are generally being implemented for the purpose of conversion of wastes into bio- gas, as they are capable of producing the bio gas which is measured as equivalent to LPG gas. It was found that a single hotel can generate Rs. 22 Lakhs approximately on an annual basis

(as mentioned in the Table 7). Large scale option is multi pit, in which the hotels are using either window or vermin - composting and will be able to generate Rs. 76,500 in a year after deducting all the costs involved in it (as mentioned in the Table 7).

While inadequate planning and implementation of waste management strategies remains an issue in the hotel industry, there is a need for increased research in this area, regardless of the type and size of the hotel. The study conducted concludes that the effective planning implementation of waste management techniques among various levels can lead to an eco-friendly approach for hotels letting them conduct the business of earning good profit serving people as well as the environment; achieving both environment and business sustainability.

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