Suitable Selection of Napkins in Hotel Industry for Sustainable Development

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ABSTRACT

This paper deals with the greenhouse gases (GHG) estimated emission from the napkins used in a hotel industry along with the selection of transportation mode vehicle (diesel or petrol vehicle). This study helps us to find whether a reusable or disposable napkin should be used to make a lesser GHG impact on environment. In the present scenario, most hotels are using paper napkins because they are light weighted, cheap and hygienic. The fact, that the relevant data is scattered, and is not available in literature and databases, compelled the data, to be acquired from various sources like journal articles and online blogs with few assumptions. Some critical data that has been collected is mainly from U.S and may vary when applied in India. A hypothetical assumption is used to derive the final conclusion. Cost is calculated for both the napkins associated with their mode of transportation per year. Finally, this paper suggests that reusable napkins should be used to deplete the rate of GHG emission.

Keywords: Carbon Footprint; GHG Emission; Sustainable Development; Napkin.

1.0 Introduction

Sustainable development is an emerging aspect in which technology and innovation is seen under the umbrella of ecosystem. We are required to sustain the nature while developing anything. The name of carbon footprint comes from the study of ecological footprint discussion and is based upon life cycle Assessment (LCA). The carbon footprint reveals how much CO_2 or CO_2 equivalent (CO_2e) in total is emitted along with the complete value chain of a product. It is calculated for the time period of a year and expressed in terms of the amount of carbon dioxide, or its equivalent of other GHGs emitted [1]. As the number of usage of a non-ecofriendly napkin is increased greenhouse gases concentration increases in the atmosphere and this causes global warming. In this study all the harmful emitted gases are taken into one form i.e. CO_2 equivalent.

Global Warming Potential (GWP) is a measure of greenhouse gas emission, such as CO_2 and methane which are causing an increase in the absorption of radiation emitted by the earth, magnifying the natural greenhouse effect [2]. This factor is considered because it is one of those vital factors which are immensely responsible for the comparison of the napkins.

There are 3 stages of carbon footprint emission chain from napkin:

1. Production; 2. Usage; 3. Disposal

For this research only production stage of the material used in making napkins have taken in consideration.

The napkin is divided into two vital categories: Disposable and Reusable.

Under disposable category we have paper napkins and in reusable we have used PET (Polyethylene terephthalate), Cotton, and Linen.

2.0 Literature Review

Disposable napkins are made from paper tissue derived from virgin and recycled pulp, but for this study we have considered the whole manufacturing of paper and neglected the process of making napkin from pulp only. Most of the hotels in today's time use paper napkin as they are cheap and easy-to-dispose but the effect of using it on environment is somewhat not taken into account. The raw material required for per Kg of paper napkin producing makes around 7.5 KgCO2e which reaches up to 15.799 KgCO2e

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(approx.) when manufacturing and end of life of the napkin is also considered [3]. Generally 24 trees are required to make one ton of paper, 1.5 tons of coal are required to produce the electricity for one ton of paper and this is responsible for emitting around five tons of carbon dioxide [4].

Polyethylene terephthalate is a most common thermoplastic polymer resin of the polyester family and is used in fibers for clothing. It contributes around 5.283 Kg CO_2 per kg in the environment [3] which constitute raw material, manufacturing and washing all together. Weight of these napkins is around 50.8 gm and uses 0.22 MJ of energy per napkin.

Cotton is a kharif crop which requires 6 to 8 months to mature. Cotton is widely used as a napkin in bulk now a days because of its tendency to absorb the waste and get nearly all stains washed out after coming from laundry. Cotton production contributes between 0.3% and 1 % of the total global emission of greenhouse gases [5]. Cotton farming requires large amounts of water varying from 7-29 tons per kg of raw cotton fibers [6]. Estimation is that 60.38 kg CO_2 were produced by energy usage for ginning one bale of cotton [7].

Fig 1: GHG (in CO2 equivalent) Emission for Cotton Farming
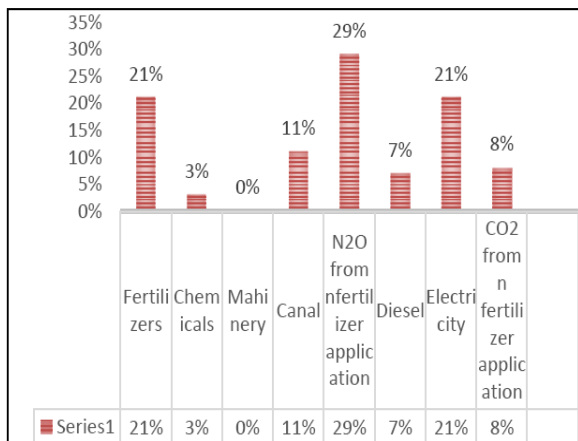
This shows that a total of 4.2125CO2e/kg of GHG emission is there in cotton production [8]. Linen is a natural material woven from the fibers of the flax plant. Flax belongs to the family of blast fibers, which also includes hemp and jute, obtained from the inner bark of the stalk of certain plants. They may be more expensive up front, but will more than pay for themselves by lasting longer than other

materials. Energy required for linen yarn production is 2.7 kWh per kg and carbon footprint allocated in the production of fibers is 0.335 kg CO2e/kg. The yarn production contributes around 3.353 kg CO2e/kg which accumulates to a total of 3.688 kg CO2e/kg [9].
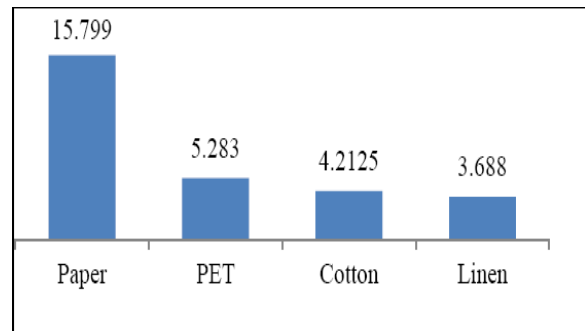
Fig 2: Total GHG Emission for Producing Cotton.
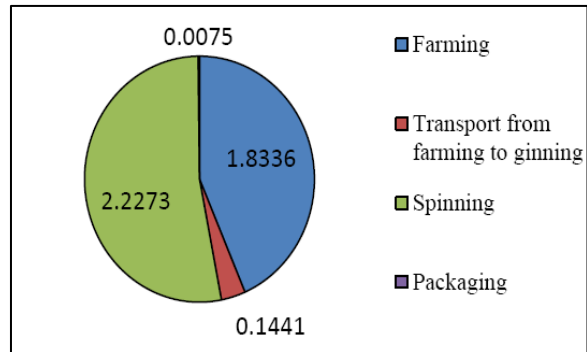
3.0 Methodology

A comparison is drawn by plotting all the GHG emission value on a column chart.

Fig 3: Comparison Between all the Napkins

Here linen is the clear winner amongst all other napkins it produces only 3.688kg of GHG. A hypothetical assumption is considered to have a better understanding about the final result.

3.1 Steps involve

1. Both disposable and reusable napkins are taken for 360 days;
2. According to the blog an average customer uses disposable napkins or 1 reusable napkin per meal which is true in general;
3. Fifty napkins are kept in both categories as safety stock;

4. Disposable napkins are ordered every month whereas the reusable ones are ordered every third month which is assumed by taking care of durability of the napkins;

5. Disposable napkins will be only single time used but reusable napkins can be used 90 times as there durability is around 3months.

Table 2: Assumed Factors for Napkins

Napkins	Ordered quantity (per year)	No. of customers (per day)	Weight per napkin (gm)	Napkin usage (per customer)
Disposable	108050	100	4	3
Reusable	450	100	32	1

After simple mathematical calculations it shows that disposable napkin produce around 432.2 kg of waste per year while reusable napkins make only 14.4kg waste per year.

Table 1: Fuel used for Transportation [10].

Energy Source	CO2 Emissions (kg CO2 exhaust / litre of fuel)
Unleaded Petrol	2.2715
Synthetic Diesel	2.6763

Table 3: Distance Assumption

CO_2 exhaust by Diesel vehicle for disposable napkins = $1/(5) \times 9700 = 1940$litres $\times 2.6763 = 5192.022$ kg
CO_2 exhaust by Diesel vehicle for reusable napkins = $1/5 \times 8500 = 1700$litres $\times 2.2715 = 3861.55$kg
CO_2 exhaust by Petrol vehicle for disposable napkins = $1/7 \times 9700$

	Production house to hotel	hotel to laundry	hotel to landfill	dumping	Total
	(km)	(km)	(km)	(per year)	(km)
disposable	200	n/a	100	73 times	9700
reusable	200	20	100	4 times	8500

$= 1385.71$litres $\times 2.6763 = 3708.57$ kg
CO2 exhaust by Petrol vehicle for reusable napkins $= 1/7 \times 8500 = 1214.28$ litres $\times 2.2715 = 2758.237$kg

Round trip is taken as each time the loaded vehicles are supposed to move it will again come to the original place.

4.0 Result and Discussion

Every day the vehicle will take the reusable napkins to go to laundry for washing and come back to the hotel. According to the assumption in one day a hotel produces only 300 paper napkins waste i.e. 1.2kg of waste which is not enough for disposing. But on 5th day the waste will be 6kg, still not much quantity but quite economical to dump as compared to the one day dumping strategy. Vehicle travel 5km per liter of diesel and travel 7 km per liter of petrol.

4.1 Cost analysis

One disposable napkin cost= Rs0.147 (approx.) Total assumed number of disposable napkins cost= Rs15847.334/ year

One reusable napkin cost = Rs25.5 (approx.)

Total assumed number of reusable napkins cost= Rs11475/ year

Around 4372.334 can be saved by using reusable napkins over disposable ones.

4.2. Research gap

1. Recycled paper data could be used to have a better perspective (Although for this study even if we add that, the amount of GHG and the cost associated with that will only increase.)

2. Genuine data collection for the respective motive could be done in India.

3. A hotel survey could be done to enhance the actual customer arrival rate and the proper usage and disposing of the napkins.

4. For reusable napkins, drying them after the laundry is a major issue.

5. Decomposing duration of both the napkins after send to landfill could be taken into account.

5. Conclusions

Hence considering assumptions from the above table, an estimated conclusion is made that within a year disposable napkin generates 432 kg of landfill but on the other hand reusable napkins make only 14.4 kg, neglecting the fact that disposable napkin takes around 1month and reusable napkin around 5months to decompose. From the data that we collected to our assumption we can get that linen displays the smallest carbon footprint of all the

napkins. On comparison, the following CO2e emission sequence was found.

Paper > PET > Cotton> Linen

Hence using Linen napkins in your hotel with a transportation system of petrol vehicle is a better choice and is more ecofriendly.

Acknowledgment

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