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ARTICLE

MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA: A CASE STUDY OF POST CONSUMED TETRA PAK CARTONS IN DELHI NCR

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ABSTRACT

The per capita waste generation in Indian cities is increasing everyday with increase in their population size, change in their life style and standards of living. Therefore the problems of waste management are hitting our country and they are becoming the issues of national concerns. However, the management of municipal solid waste is still very much neglected in our country as compare to other issues of national concern. In current scenario of municipal waste, the quantity of organic waste is declining, whereas the quantity of inorganic waste (Tetra Pak, PET, paper, plastic, metaletc) is accelerating, which indicates the high preference of packed food amongst the modernsociety. However in lieu of disposing the urban waste in India, the present study aims to explore the possibilities and opportunities to make best use of tetrapak carton's waste as a resource to generate wealth and reduce the environmental damages which it may cause if disposed on landfills. To achieve the aim, an attempt has been made to analyze the entire value chain of Tetra Pak cartonscollection and recycling and identify the roles and responsibilities of each stakeholder involved for developing a sustainable business model for Tetra Pak cartons collection and recycling for the mega cities, which are actually facing the problem of post consumed cartons disposal. The results of the study indicates some positive environmental benefits, i.e. 1496.8 tons of GHG reduction and 4138 cubic meter of Landfill savings was achieved from collection and recycling of 1663.2MT of Tetra Pak cartons.

KEY WORDS
Waste generation; Tetra pak; Delhi-NCR;Domestic sector;Solid Waste management; Recycling

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INTRODUCTION

The increasing population and rapid urbanization in India has led to a significant increase in the waste quantity. In most of the urban cities with change in lifestyle and standards of living, per capita waste generation has increased tremendously and the nature of the waste being generated in the domestic sector has also changed. The literature reveals that almost 90% of the total generated waste is disposed of in a truly unscientific manner in open dumps, which are non engineered, unsanitary landfills in India [1]. It results into serious damages to public and environmental health as it attract birds, rodents and flies to the waste dumping site and create highly unhygienic conditions[2]. Further, the degradation of the solid waste results in the emission of carbon dioxide (CO_2), methane (CH_4) and other trace gases, which are the main green house gases [3]. The per capita/ per day waste generation rate in India varies from small town to large towns, for example, in small towns, per capita waste generations is nearly 100 grams/ day, whereas in large towns or cities like Delhi, per capita waste generation is almost 500 grams/ day[4].

In India Municipal Solid waste (MSW) is usually disposed of in low-lying areas without segregation and taking any precautionary measures before disposing. In places where there is no proper sanitation facilities, there streets serve as dumping grounds for both human and animal fecal matter and manure. The poor collection system and inappropriate facilities for transportation is making every nook and corner of cities occupied with waste. Furthermore, streets are widely been made useful for even dumping all kind of Construction &Demolition waste. Though the Solid Waste Management (SWM) includes activities, starting from generation, segregation, storage and collection, transfer and transport, treatment and disposal, most of the cities follow only four steps for managing their waste, i.e. generation, collection, transportation and disposal, which are also not in efficient manner[5]. Therefore, due to inefficient collection system (only 70% waste is collected), the uncollected waste often mixed with animal and human excreta dumped on streets, in drains and roads, leading to flooding, breeding grounds for insects, rodents and spread harmful diseases[6, 7, 8, 9, 10]. Thus waste management is becoming a crucial environmental problem in Indian metro cities. Further, in cities like Delhi, the land availability for waste disposal is very limited [11].

Although municipalities have the sole responsibility for managing MSW in their cities but they are failingto fulfill their duties and responsibilities. Their inefficiency is managing MSW is ultimately affecting human health, deteriorating environment and degrading our society. Now a days in the domestic sector the quantity of organic waste is declining whereas the quantity of that of inorganic waste (Tetra Pak, PET, paper, plastic, metal etc) is accelerating indicating that there is high preference of packed food amongst the modern society [12]. Thus with such waste generation scenario we require more and more land for its final disposal and land being a non-stretchable resource is shrinking with burgeoning population.

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Tetra pak which is a six layered packaging box made up of internal polyethylene layer that seals in the liquid, polyethylene layer for lamination process, aluminum foil that creates a barrier for oxygen, light and flavors, polyethylene adhesion layer needed for lamination, followed by paperboard that gives stability and strength and finally the polyethylene layer that protects food from external moisture. Every Tetra Pak carton is primarily made up of paper with 75% made up of paperboard remaining 20% of polyethylene and 5% of aluminum. These three materials are compressed together and layered by means of heat and pressure to form a six layered armor which protects the contents from light, oxygen, dirt, air and moisture. The design of cartons is not just to protect the contents but to also prevent the content from being wasted while distribution [12]. But the only issue with Tetra Pak cartons is the outermost polyethylene layer, that makes it non-biodegradable and make them stay in the ambient environment for thousands of years till they eventually degrade. The mixed paper mills only recycle the paper content of the tetra pak carton, therefore there is a complete loss of aluminum and polyethylene content due to lack of technology at mixed paper recycling units. Though in countries like UK initiatives have been taken for segregation and recycling of the waste Tetrapak but in India the main problem is lack of awareness amongst the waste collectors and scrap dealers to segregate tetra pak's carton from the mixed paper waste so that it can 100% recycled and they can also be benefitted by generating more revenue. The waste should be segregated into three separate streams namely bio-degradable or wet waste, non bio-degradable or dry waste and domestic hazardous wastesby the waste generators as per MSW rules, 2015-16 [13]. However, these rules are rarely practiced in the metro cities, which further aggravate the problem. The Tetra Pak cartons being non-biodegradable in nature, when reach landfill sites continues to stay for 1000 of years and cause continuous GHG emissions[14]. Moreover most of the landfill sites of Delhi has exhausted and do not have any alternative left for the waste disposal. The problem related to solid waste management in Delhi may become even worse in the near future if we don't take correct actions. A trained and motivated group of stakeholders are needed to collectively help in managing solid waste. To combat this problem of non-biodegradable nature of Tetra Pak cartons the present paper showcases the attempt made by Indian Pollution Control Association (IPCA) to create a sustainable model for post consumed TetraPak carton collection and recycling in Delhi NCR region. A regularized system of source segregation followed by collection, sorting, bailing and finally recycling Tetra Pak cartons helped to enhance the social and economic status of the waste collectors involved in managing Tetra Pak cartons.

SITE DESCRIPTION

The project was implemented in Delhi NCR region which is located in northern India between the latitudes of 28°-24'-17" and 28°-53'-00" North and longitudes of 76°-50'-24" and 77°-20'-37" East. It has an area of 1,483 sq. km, with a maximum length of 51.90 km and greatest width of 48.48 km. The site is between the borders of two states i.e. Uttar Pradesh and Haryana. The specific site locations of project area are clearly shown in [Fig. 1].

METHODS

The case study of post consumed Tetra Pak cartons in Delhi NCR has been undertaken by the Indian Pollution Control Association (IPCA), a not -for-profit, non-government organization working on Solid waste Management, Rain Water Harvesting and several other environmental issues, to understand the opportunities for improving the status of municipal solid waste in Indian cities, which was evaluated by Indian Institute of Public Administration (IIPA), New Delhi. IPCA in collaboration with Tetra Pak had initiated collection and recycling of Tetra Pak cartons across Delhi NCR. In this process a total of 500 waste collectors were involved who worked with IPCA is collecting Tetra Pak cartons from different locations all across Delhi. After collection and further segregation these cartons were sent to bailing site located at Dallu Pura village, Mayur Vihar. At this site, daily 1-1.5 tons of tetra pak cartons were bailed into blocks. After converting the cartons into bails they were send for recycling to different recycling units. There these bails were separated and fed into a large tank with water, where it was swirled around. The fibers absorb water and convert into slurry form (watery fiber). Any non- paper element such as plastic, aluminum etc. usually sink or separate out of the slurry. The slurry was then poured on thin flat surface to make recycled paper which can be used to produce other useful products. The plastic (polymer) and aluminum foil was further processed to produce the poly-al sheets. This process of recycling Tetra Pak cartons and recovering maximum of the paper, plastic and aluminum contents is a good practice and has many scope of improvement. The overall steps of recycling has been detailed in the subsequent section

Value chain analysis of Tetrapak collection and Recycling

Collection System

The trained waste collectors collect the Tetra Pak cartons generated from houses, institutions, commercial complexes and others. Cluster wise collection was done which helped in connecting different waste collectors in one location enabling maximum collection maximum. These small clusters work together and collect cartons from different locations within their range.

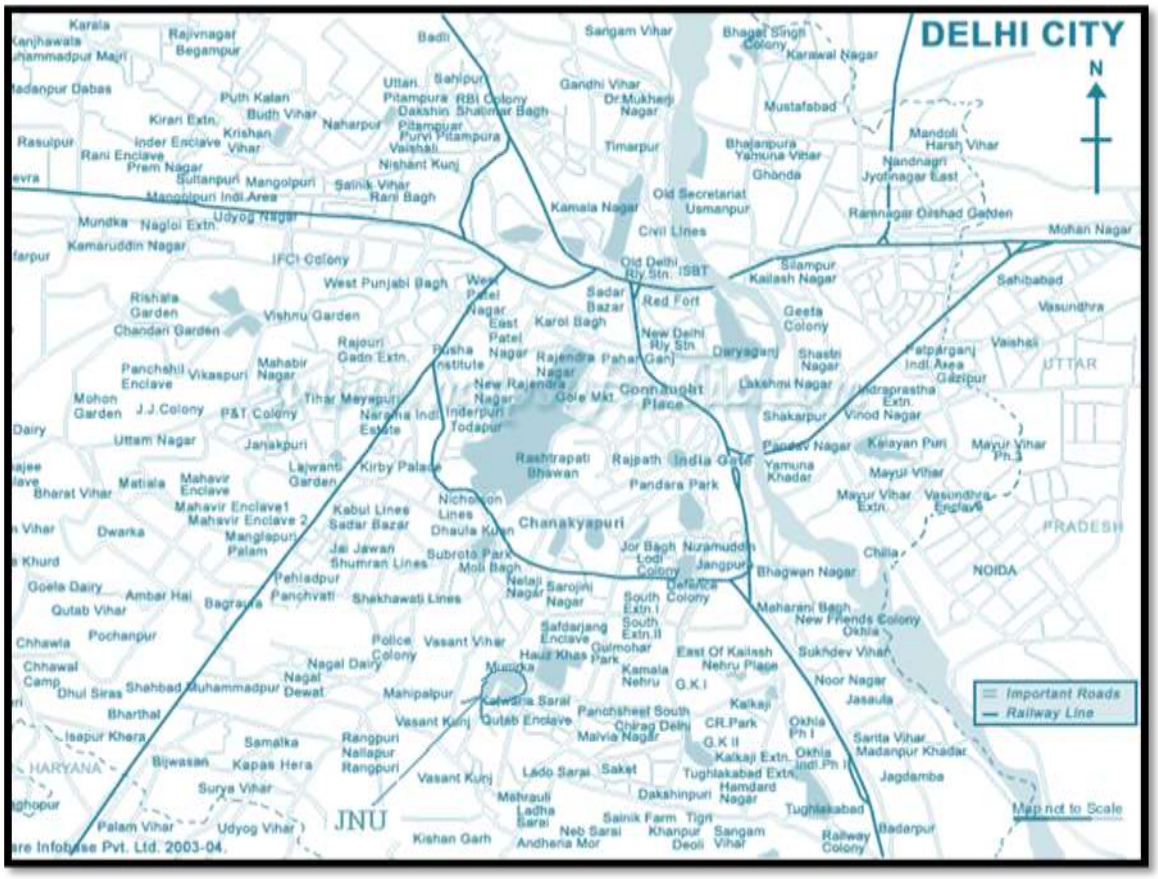

Fig. 1: Geographical location of the study area

Sorting system

After collection they do further sorting in order to remove any scrap paper, cardboard, metal, pet bottle, tissue, glass, aluminum foil, milk pouch, plastic, tin can, poly bag or any other type of dry waste.

Bailing system

It is a technique of compressing the Tetra Pak cartons into thin flat sheets (bails). This method reduces the unavoidable losses that creep in due to air bubbles, dust particles, liquid juice content etc since all this can lead to cutting losses at the recyclers end and to avoid such problems and recycle maximum Tetra Pak cartons bailing is done. Bailing reduces the size of the cartons which converts its shape from a three dimensional rectangular box into a two dimensional thin sheet. These thin sheets occupy minimum space and can be transported in greater volume to larger distance with less transportation cost. The bailing unit is set up in village Dallu Pura, Mayur Vihar Phase III, near Dharmashala hospital, Delhi and here the cartons collected from different locations were converted into bails. On an average every day 1.5 tons was bailed at this bailing unit.

Recycling system

Once the bails reach the recycling unit, it is further sent for quality check. Usually at the section some percentage losses occur. After quality check all the Tetra Pak cartons bails are separated and put into a large tank with water, where it is swirled around. The fibers absorb water and convert into slurry form (watery fiber). Any non- paper element such as plastic, aluminum etc. either sinks or separates out of the slurry. The slurry is then poured on thin flat surface to make virgin paper which can be used to produce other useful products. The plastic (polymer) and aluminum foil are further processed to produce the poly-al sheets.

New Products

The 75% of paperboard is usually recycled into recycled paper and remaining 20% plastic and 5% metal in recycled to produce poly-al sheets, which has further applications like poly-al sheets can be used to make rooftop sheets, furniture etc

RESULTS AND DISCUSSION

IPCA initiated systematic cluster wise collection of Tetra Packs from 2011 since then there has been a marked increase in collection which is reflected in Table , which indicate that Tetra Pak collection has increased every year with a rise of 35%[14]. This increase in collection is possible through combined efforts of IPCA team and waste collectors. Training and workshop sessions has helped them in understanding the need for collection and recycling, which is depicted in increasing collection rate.

Environmental analysis of Tetra Pak collection and recycling

Green House Gas emission savings/ Carbon savings

The Tetra Pak collection and its 100% recycling, is resulting into carbon savings. The waste which was otherwise ending into landfills, drains and water streams and accelerating the rate of carbon emissions into the environment is now reduced through proper channel of collection and recycling these cartons. Through collection and recycling process carbon savings of 1496.8 tons have been achieved till date and with increasing collection rate every year it is expected to increase the GHG emission savings here forth.
Formula used for calculating carbon footprint is as follows-
*Carbon footprint (tons of CO_2 eq) = Activity * Emission factor (CO^2 e per unit)*
[1]

*= 1663.20MT * 0.9 = 1496.8 tons of CO^2 equivalent*

Table 1: Tetra Pak Collection (Metric Tons)

S. No.	Year	Collection of Tetrapak (MT)
1	2011	80
2	2012	165
3	2013	419.715
4	2014	450.089
5	2015	548.402

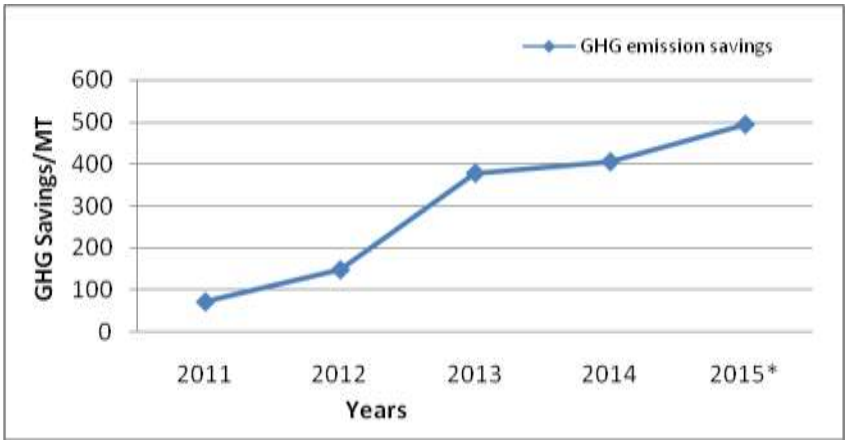

Fig: 2. GHG emission savings

Landfill savings

The usual practice in most of the countries is that whatever is of no use is ultimately dumped into landfills. In Delhi we have three landfill sites which are floating beyond its capacity. With such a situation there will be no space left at landfills to assimilate the waste generated by the city. Thus looking into the present scenario and future concerns something can be done. Only through Tetra Pak collection, sorting, bailing and recycling approximately 4138 m^3 of landfill site have been saved since 2011 and it is expected to increase in the coming years with increasing collection rate every year. Relationship used in calculating landfill savings is taken from a study done by Tetra Pak, Europe of beverage cartons. The study depicts that by recycling one ton of beverage cartons we can save 2-3cubic meters of landfill(Source: Recycling of used beverage cartons in Europe, Tetra Pak)

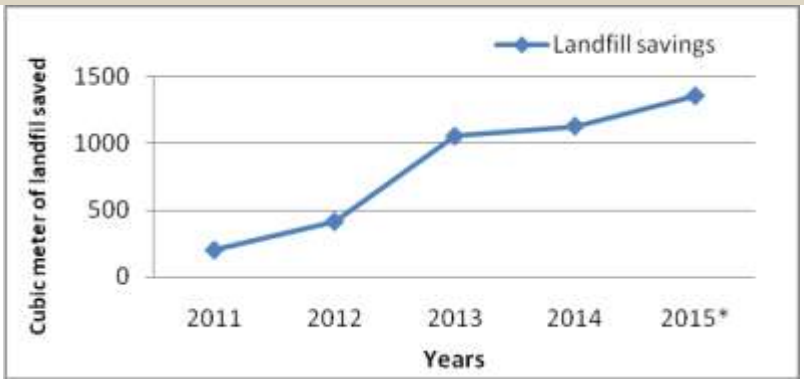

Fig.3: Landfill savings

CONCLUSION

Tetra Pak collection and recycling as practiced by IPCA is a very sustainable business model which can be adopted in mega cities where the Tetra Pak generation rates are high and its disposal is a major problem. Being non-biodegradable in nature untreated Tetra Pak cartons can stay for 1000 years landfill sites and cause continuous GHG emissions. If practiced systematically and regularly the sustainable model developed by IPCA can mitigate problems like Tetra Pak cartons littering, dumping in drains which eventually block the drains and cause other health problems. However, lack of waste segregation by the waste generator is the biggest challenge in the model developed since Tetra Pak cartons come under the category of dry waste and if waste segregation is not practiced at the point of generation, the waste collector team have to put a lot of effort in its segregation. Thus if source segregation is done at point of generation, a lot of waste recovery can be done along with lesser health exposures to waste collectors. Moreover, the study also reflects that till date IPCA had been able to achieve collection of 1663.2MT of Tetra Pak cartons, which is turn has benefited the members involved in its value chain. Also, the increasing collection rate is also reflecting some positive environmental benefits like 1496.8 tons of GHG reduction and 4138 cubic meter of Landfill savings was achieved from 1663.2MT of Tetra Pak collection and recycling. Thus if this process continues we can save the carbon footprints and in turn reduce environmental load from Tetra Pak cartons.

Besides there is an urgent need to create more clusters of waste collectors and spread awareness about Tetra Pak cartons amongst more waste collectors, so as to increase the collection all across Delhi NCR. More R&D needs to be promoted to identify potential technological options to recover maximum paper content out of the post consumed Tetra Pak cartons, which currently is only 40-50% out of total 75% paper. If this recovery is increased to 60% it can create huge revenue opportunities for the recyclers and the waste collectors. Waste segregation campaigns should be initiated first at household level and then replicated to commercial areas. This practice can help recover higher Tetra Pak cartons from the dry waste stream without much wastage. Technological options for recycling poly-al part of Tetra Pak cartons should also be explored. Some economically viable technologies should be identified to attract more and more recyclers to indulge in its recycling.

CONFLICT OF INTEREST

There is to certify that there is no conflict of interests.

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None

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