

Clean India (Swacha Bharat) through Reuse and Recycling of Wastes

Jagadish Chandra Mahanti*

Professional Engineer (Fellow of Institution of Engineers, India) and Life Member of Indian Pulp and Paper Technical Association, Kolkata, India

Abstract

With changed life style in India, there has been increased consumption of items of daily use and consumer durables through retail outlets. These are packed in paper, plastics, glass, metal and other containers and the discarded packing materials often end up as garbage and cause land, water and air pollution. Whereas, most of them can be recycled back for reuse and are valuable raw material. The present garbage collection, handling and disposal system is primitive and inefficient. The deficiencies and consequences are highlighted in this article along with the socio-economic benefits of systematic segregation, reuse and recycling of discarded wastes mainly packaging material. Also, possible solution to the problem by participation of the individuals, communities and authorities has been elaborated. Details of waste handling in Germany have been given as an example of efficient and effective system.



Keywords: Solid wastes; Reuse and recycling; Land fill; Packaging material; Garbage; Litter

Introduction

The world (land, water and air) is being polluted through the years and environment protection agencies are fighting a losing battle. With the change in life style, pattern of human habitation and occupation, the quantum of pollution by each person is increasing every day and is naturally a matter of concern. One in two people in this planet is either Chinese or Indian. China has achieved better waste management as compared to India in spite of the higher economic growth. Improving waste management has numerous benefits leading to human wellbeing. Inappropriate waste management system is a significant threat to public health besides hampering growth and other developments. The present Indian Government has launched an ambitious initiative called the Clean India Campaign to combat and reverse the effects of pollution.

The main pollutants are the solid wastes, which in turn contaminate the water bodies and restrict the free flow and prevent their natural biological purification. Also accumulation of solid wastes often generates obnoxious poisonous gases like methane besides making the land unsuitable for cultivation. The major source of solid wastes, suitable systems for their collection and disposal without harming the environment mainly through reuse and recycling along with those practiced in some of the environmentally conscious countries (Annexure I) has been discussed here.

- Core to the vision of waste management in India is the use of waste as resources with increased value extraction through recovery, recycling and reuse.

Waste Generation and Disposal

India is the 2nd largest nation in the world with a population of 1.3 billion, accounting for nearly 18% of the world's human inhabitants. The urban population has grown at a rate of 31.8% during the last decade to over 377 million (Figure 1). The per capita waste generation rate in India has increased from 0.44 Kg/day in 2001 to 0.5 Kg/day in 2011, fueled by changing life style and increased purchasing power. There are 53 cities in India which together generate 31.5 million tons/year (86,000 TPD) municipal solid waste (MSW). The total solid waste generation in the country is estimated to be 68.8 million Tons/year (188,500 TPD). Only 43 million Tons of waste is collected, 11.9 million Tons is treated and the rest is dumped in landfill sites [1]. The collection and disposal system of garbage is mostly primitive. The recent collapse of Delhi's Ghazipur landfill killing 2 persons should be an eye opener. This and similar other landfills are subject to frequent fires and other hazards.

Growing use of packaging is a consequence of urbanisation with higher living standards of the people and changes in pattern of

*Corresponding author: Jagadish Chandra Mahanti, Professional Engineer (Fellow of Institution of Engineers, India) and Life Member of Indian Pulp and Paper Technical Association, Kolkata, India, Tel: 911322714081; E-mail: adyacon@gmail.com

Received October 16, 2017; Accepted November 14, 2017; Published November 20, 2017

Citation: Mahanti JC (2017) Clean India (Swacha Bharat) through Reuse and Recycling of Wastes. J Pollut Eff Cont 5: 202. doi: [10.4176/2375-4397.1000202](https://doi.org/10.4176/2375-4397.1000202)

Copyright: © 2017 Mahanti JC. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

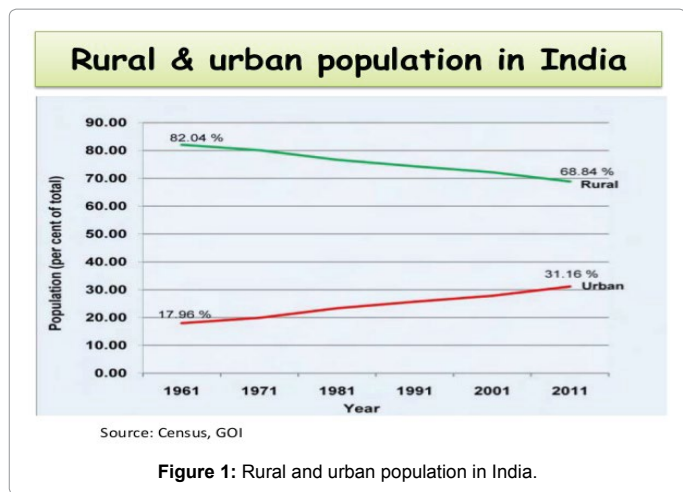


Figure 1: Rural and urban population in India.

consumption and distribution. A number of key social and market trends are having a major impact on packaging in recent years. These include: smaller households with consequent demand for smaller pack size, increasing requirement of ready to process food and beverages and the growing use of cosmetics and packaged healthcare products. Also, increased disposable income and higher living standards and development of retail chains are fueling consumption of a broad range of goods with consequent growth in their packaging. Even though, the per capita packaging consumption in India is quite low at 3.4 Kg, compared to many other countries (like China 20 Kg, Germany 42 Kg and USA 71 Kg). Its disposal after use is causing environmental problems. A major component of solid waste is discarded packaging material. It mainly comprises of cartons and wrappers, pouches, bottles, cans etc. Litter is the waste that is discarded on public places for collection by the cleaning agencies (Table 1). Environmental awareness and statutory regulations has led to use of ecofriendly packaging materials and paper is the most favoured. Manufacturers are now under pressure to use materials for packaging and adopt methods that have less adverse impact on the environment as part of their Extended Producer's Responsibility (EPR). For example, in December 2010, the Supreme Court of India has imposed a ban on use of plastics packaging on some tobacco products like Gutka and Pan Masala. Eco-friendly packaging is usually made from recycled materials, reducing the waste of natural resources in production. Additionally, the manufacturing process itself tends to be more efficient. In addition to minimizing the environmental impact when creating the product, eco-friendly packaging also tends to be better for the environment after it has served its purpose as it will be recyclable or compostable. However, the collection and recycling of the packaging after use in India needs improvement to be effective.

The break-up of the different packaging materials consumed has been shown below (Figure 2 and Table 2) [2].

A typical solid waste management system displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control, the breeding of flies and vermin and the handling and control of informal waste picking or scavenging activities. These public health, environmental, and management problems are caused by various factors which constrain the development of effective solid waste management. Hence, waste composition, different waste management technologies available and the presence of recycling facilities are all aspects that should be considered while designing an appropriate waste management system.

Sources	Typical waste generators	Components of waste
Residential	Single and multi-family dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electricals and electronics, batteries, oil, tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government centers, hospitals, prisons, VIP residences	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas, paper, glass bottles, plastic pouches and bottles, discarded clothing

Table 1: Sources and types of municipal solid waste.

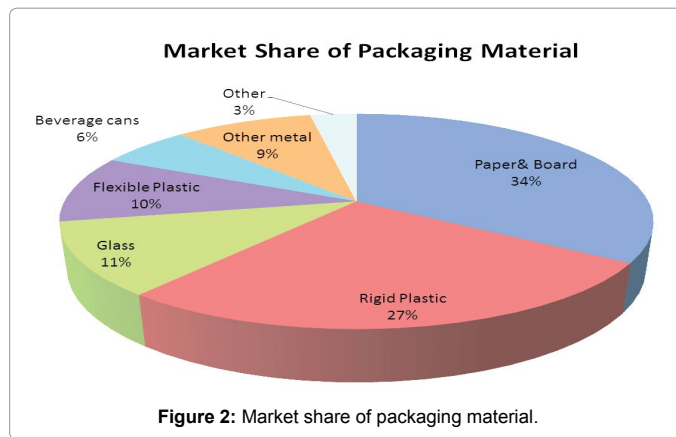


Figure 2: Market share of packaging material.

Material	Use	Reasons for preference	Consumption, million TPA
Paper and board	Cartons, boxes, bags and wrappers	Light weight, low cost, easy availability and disposal	6.50
Plastics	Pouches, bottles, caps, cartons, bags, wrappers, containers	Light weight, corrosion resistant, versatility of use, attractive display	8.50
Aluminium	Collapsible tubes, foils, cans and closures, containers	Tasteless and odourless with good barrier properties, greaseproof and shrink proof	3.0
Glass	Bottles, jars and jugs	Good strength with high rigidity, transparent, gas and water vapour barrier, chemically inert	4.50
Tin plate	Cans, containers and caps	High strength with good barrier properties, long self-life, reusable and recyclable	6.50
Laminates (plastics and paper)	Pouches, films, tubes and bags	High strength with good barrier properties, grease resistant, attractive design display, suitable for heat sealing	4.50
Others	-	-	5.0

Table 2: The estimated total annual consumption has been shown in the table below.

Changes in consumer preferences, rising petrochemical costs have led to food and consumer products companies to look for alternatives to plastics based packaging. While glass, plastics and metals are recycled,

paper is both recyclable and biodegradable hence more manufacturers are opting for paper based packaging. With growth in demand key special grades paper have evolved to meet different packaging options. Presently, about 7 million tons of paper is being consumed in India for packaging, of which only 33% is being collected and recycled. Typical paper packages are shown below (Figures 3a and 3b).

In spite of the reservations, “Plastics” are the material of choice in packaging for the sectors such as FMCG, food and beverages, pharmaceuticals etc., due to innovative visual appeal for customer attraction and convenience. Additionally, they improve the hygiene quotient and shelf-life of the products. As they are light weight, the high product to package ratio results in lighter weighed end product. (For example, only 1 Kg of flexible plastics can deliver approximately 40 Kg of beverage; compared to two Kg of aluminium or 35 Kg of glass). Besides, plastics can be reused and recycled with low energy requirements during production, (consume about 25% less energy in production compared to other alternatives resulting in lower emission of CO₂ gas and in lighter environmental foot print).



Figure 3a: Corrugated shipping container.



Figure 3b: Folding cartons.

According to a report prepared by FICCI and Tata Strategic Management Group (TSMG) on plastic industry titled “Plastic packaging: The sustainable choice” [3]. India is a growing market for plastics and consumes about 12.8 million metric tonnes (MMT) of plastics annually against global consumption of 285 MMT per year and the consumption is growing at an average rate of 10 percent (Figure 4).

As estimated by the Central Pollution Control Board (CPCB), 15,342 Tons of plastic waste is produced every day, of which about 60% is recycled. While the recycling rate is quite high (Global average 14%), over 6,100 tons end up as landfill or polluting ground water resources (Figure 5).

The stench and ugly sight of garbage dumped on the road side, sometimes overflowing from drains or floating on the surface of the rivers is not at all uncommon in India. Also, with clogging of the drains with garbage, there is water logging and flooding of residential areas, roads and even railway tracks in the rainy season disrupting normal life. Usually in cities and towns, the garbage collectors come to the house every morning, empty the bins into their cart or truck and dump all the garbage from the neighbourhood on an abandoned piece of land called “landfill”. People also litter the streets and public places excessively. The street sweeper collects and throws this garbage in to a local dump from where it also goes to a landfill. The Energy Research Institute (TERI) estimates that by 2047, 1400 Sq km land would be required for municipal wastes [4].

The Present Situation

The present landfill method creates land pollution (and in most cases, ground water contamination). The waste is not sorted for recycling, composting or any other form of environmental treatment. Hazardous toxic wastes lie side by side with organic wastes in the landfill. Quite often, the garbage is dumped in the bank of the neighbouring river. The state of the Yamuna River in Delhi is a testimony to this fact. The river practically doesn't flow at all and expansive white deposits can be seen on the surface which prevents the flow, these are toxic wastes that have reacted with the water. Practically, there is no living creature in this section of the river. The seriousness of the contamination has been highlighted in a study undertaken by TERI [5]. It shows how



Figure 4: Pet bottles for soft drinks and aerated/mineral water.



Figure 5: Typical plastic waste, mainly pet bottles.

industrial effluents and untreated sewage continue to choke the river. In fact, by polluting the ground water and soil, the toxins have entered the food chain through vegetables grown in the banks of the river. In most rural areas there is no organised garbage collection and it is dumped on the nearest vacant public land earmarked for cattle grazing and other public purposes. Also, the land by the sides of the passing railway lines is littered with paper, plastics, bottles etc. thrown by passengers from the passing trains. The average railway passenger generates 64 grams of garbage and with 1.4 million passengers in a day, this comes to 3980 Tons per day [6].

The importance and effectiveness of recycling is evident in a 2009 study by Chintan Environmental and Action Group [7], where it has been computed that Delhi's recycling efforts saved around 3.6 times more greenhouse gas than any project receiving "Carbon credit" at that time. A clean environment is also critical for cultural and commercial development of the country as it is imperative to make a favourable impression on potential foreign investors and tourists. Naturally, nobody would like to come back to walk through stinking roads or relax on littered beaches or resorts.

How to Overcome the Problems?

We can blame the authorities for not providing enough resources to collect and process all the garbage or we, ourselves take steps to reduce generation of such huge amount of garbage.

"Dirt is the right thing in the wrong place" For example, grease is not dirt in the chain of the bicycle but becomes so, on the sleeve of the shirt. Similarly paper, plastic and metal wastes etc. are valuable material for recycling if handled properly. As a first step, packaging material (like bottles, cans, cartons etc.) should be reused as far as practicable. Glass bottles can be reused 50 times and pet bottles up to 15 times (Annexure II). The material discarded as garbage should be segregated and stored in separate containers for recycling or suitable disposal. This is a very important step as contaminated material is often not suitable for recycling. Organic material like kitchen and garden waste should be converted to compost and enrich the soil. Of course, reuse is preferable to recycling as the later involves loss of material, consumption of energy and causes pollution. In some ways, the waste can serve as a resource.

Recycling

Recycling means that natural resources are used in an efficient way and it contributes to sustainable development. For example recovered paper, plastics, glass etc. are valuable raw materials that can be reused to create new products. According to Mr. Pete Grogan, nationally recognized authority on resource recycling, who recently earned the lifetime achievement award from the National Recycling Coalition, USA. "Tossing paper into a landfill is not a sustainable practice. It depletes resources, wastes energy, and represents a missed opportunity to participate in the multi-million dollar recycling economic sector". Reclamation and recycling of material after use is of utmost concern in both developed and developing countries for sustainable development. Recycling one Ton of corrugated containers saves 390 KWh of energy and 5 cum of land fill. Considering the importance of recyclables as a natural resource, Mr. Ranjit Singh Baxi, President of the Bureau of International Recycling (BIR, Head quarter at Brussels) has announced that the first Global Recycling Day will take place on 18th March 2018. The Wealth Out of Waste (WOW) campaign in Gujarat is dedicated to the education of girl children by earnings from sale of old papers donated by citizens.

Used newspapers, copy books, text books, magazines etc. are either

used for making paper bags or recycled to produce newsprint and writing printing papers. Similarly, discarded corrugated cartons are recycled to produce Kraft paper which is again converted to corrugated cartons. These are usually sold to scrap dealers mainly through door to door collection. The paper waste in the garbage mainly comprises of mixture of all varieties crumpled or in small sizes which cannot be sold normally. However, these are suitable for producing paper boards used for making cartons, boxes and other products. Also due to the low quantity available, it is usually not economical for scrap dealers to collect from villages and remote habitations and the entire waste paper from these places goes to the garbage (Figure 6).

The recovery and recycling rate of waste paper in India is presently below 30% whereas, it is 73% in Western Europe (Global 57%) and much needs to be done.

15,342 Tons of plastics waste is produced in India every day of which 60% is recycled. According to Federation of Indian Chamber of Commerce and Industry (FIICCI), the plastics recycling industry in India employs over 1.6 million people and has more than 7500 recycling units. In HDPE bottle-to-bottle recycling the process of used-material sorting and separation must meet highest demands. For example, food-quality packaging is being generated from HDPE milk bottles. It must be guaranteed that different types of plastics and contaminant materials are reliably separated. Since, the garbage collectors are paid by weight; there is no incentive for them to sort out the waste. Mechanised sorting units should be installed in all the Metros to handle the huge volume of garbage produced. This will boost recycling and reduce the amount of garbage to be disposed off (Figure 7).

Setting up of recycling units in rural localities close to metros and cities will create employment and prevent migration of rural population to cities in search of livelihood. For example, 50 Tons per day mill producing packaging paper and board by recycling reclaimed waste paper will provide employment to about 125 to 150 persons. This addition of earning members will cause a big boost to the economy of the locality. Also, downstream units for producing cartons, boxes, cups, plates, pouches etc. will come up creating further employment



Figure 6: Mixed waste papers and paper board sheets.



Figure 7: Mechanised sorting and bailing of municipal waste.

opportunities. Setting up of these manufacturing units in rural and semi-rural areas will provide “on the job” training to the persons of the locality and contribute to skill development. Also, as part of their social responsibility, the units will promote hygiene, education, sports and cultural activities, provide clean drinking water etc. Modern living in rural areas with better housing, electricity (solar), running water and flush toilets, cooking gas (Bio), scientific garbage disposal etc. are consequences of development through increased employment and not the other way around [8].

Recommendations for Improving the Solid Waste Management

Besides creating public awareness, the following measures are recommended to be taken immediately to reduce the pollution through solid wastes.

Reduction of waste generation at source by enforcing:

- Reuse of packaging like glass and pet bottles by manufacturers through refund on their return at the retail outlets.
- Use of bio-degradable packaging like paper pulp mouldings for food products and other items.
- Tax on plastic and paper carry bags to increase the cost and restrict their use.
- Segregation of waste material at source by providing separate garbage bins for different wastes (recycling/compost/others) in housing complexes, offices, public places like railway stations etc.
- Garbage from individual dwellings to be kept segregated for collection.
- Provision of separate garbage bins for different wastes in places of recreation like parks, beaches, stadiums etc. and strict enforcement of rules against creating litter.
- Use of separate vans/trucks with compartments for different wastes for collection.
- Plants for sorting and baling wastes should be set up by municipalities and other public bodies near urban centers. Wastes collected in semi-urban and rural areas should be transported to these plants.
- Organic wastes should be converted to Manures and Bio-fuels.
- Setting up of recycling plants should be encouraged by the Government through subsidies and tax incentives on capital investments and on the products.

The activities required by a community while planning waste management should include:

- Consultation with interested stake holders (Sanitation, transport, environment, public health, business)
- Identify potential waste streams (Quantity of waste generated by each stream, the possibility of reduction at source)
- Evaluate the reuse and recycling programme (Availability of recycling facilities and market for reused and recycled products)
- Consider waste collection strategies (How to separate the wastes and reduce the volume before collection)
- Determine waste processing sites (Suitable for sorting, staging, processing and storage without contamination)

- waste management options. (Reuse, recycling, composting, treatment before disposal and transport to remote site)
- Create a community outreach plan (Inform the community about the waste management related activities and the involvement required by them)
- Address the health and safety issues of waste management operators (Appropriate training with knowledge of the hazards and risks involved as well as, use of protective equipment)
- The importance of this cannot be over emphasized in view of the continued death of sanitation workers in Delhi and other Metros due to suffocation and inhalation of poisonous gases in underground drains [9].

Annexure I: Waste Disposal in Germany

Germany produces 30 million tons of garbage annually and the country has been very successful in its fight against growing garbage heaps. The manufacturers and retailers have to pay a “Green Dot” fee on products, the more the packaging the higher the fee. This has reduced the garbage by about a million tons per year. However major success of the programme is the proper sorting and processing of the garbage [10].

It has implemented the EU policy on packaging through its ordinance on the avoidance and recovery of packaging waste. The ordinance makes industry responsible for packaging at the end of its life cycle, including the costs of collecting, sorting, and recycling packaging after consumers discard it, and calls for retailers to install bins so that customers may leave primary and secondary packaging in stores. It also imposes mandatory deposits on non-refillable containers for beverages, washing and cleansing agents, and water-based paints. Furthermore the ordinance also rules out incineration for energy recovery as an option.

Return of bottles and cans

Throwing bottles and other beverage packaging in the garbage bin is a waste of money. These would be refilled many times before they are sent to be recycled into new containers. When you purchase something like coke or beer in a bottle or can, you pay the advertised price plus a deposit (*Pfand*). When you return the empty bottles and cans through a machine it issues a voucher for the refund amount to be adjusted against purchases. This results in zero litter, minimum environmental impact and saving in cost by the municipalities [11].

Garbage bins of different colours

Bins of different colours are provided in residential buildings and public places for different wastes like glass, paper, plastics which are collected on designated days in the week (Figure 8). Any kind of bottle or glass jar that is non-returnable and on which a deposit or “Pfand”, has not been paid belongs in the designated glass bins. This includes wine bottles, jam/preserve jars, oil bottles, juice bottles and even bath-

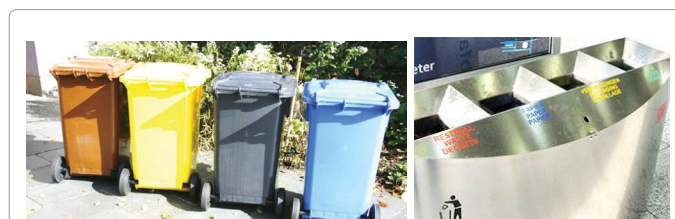


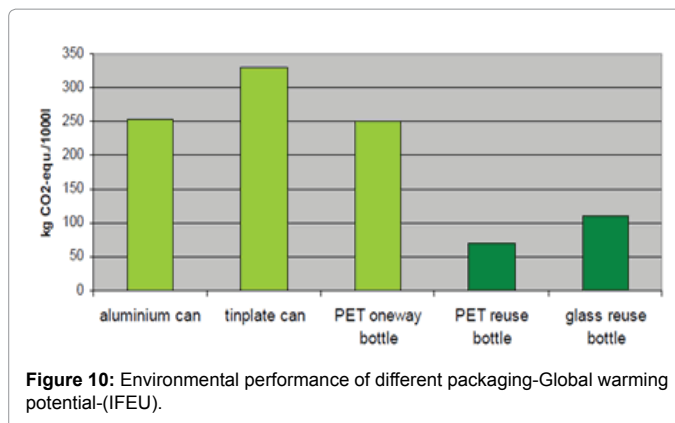
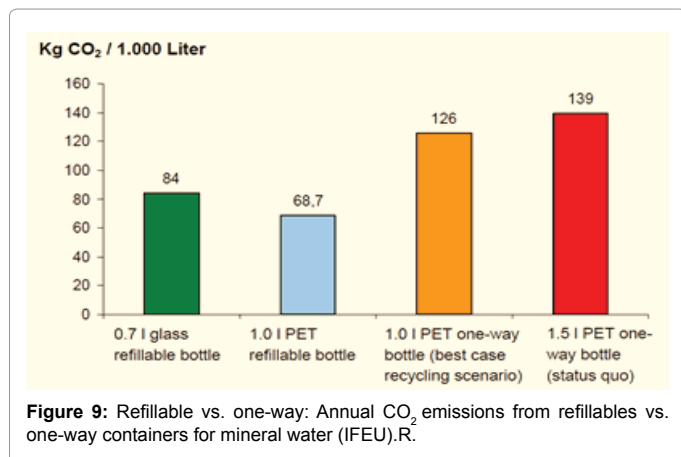
Figure 8: Garbage bins and trash bins at railway stations.

salt bottles. (Ceramics, china, mirrors and wine corks do not belong in the glass bins). Glass is sorted by color. There are different slots for depositing green, brown and clear glass. The other bins are color coded; green, blue, yellow, brown and gray for paper, plastics, organics and non-recyclables. For the hazardous waste, which includes fluorescent tubes, batteries and acids, cans of paint still containing paint, thinners, adhesives, corrosives, disinfectants, insecticides and so forth, a notice is issued by the local town council on when and where the truck collecting this kind of waste will be available. Batteries can be disposed of separately in a bin provided in the local shopping area. Another useful feature of the waste disposal system in most cities is the Recycling of, an outlying area with containers to which one can transport and deposit heavy garbage like old furniture, electrical appliances etc. [12].

Annexure II

Life Cycle Analysis (LCA) carried out by the German Environmental Protection Agency to prove the significant negative environmental impacts of one-way systems regarding material (resource) consumption, energy consumption, global warming potential, acidification, ground level ozone and eutrophication compared to environmentally friendly refillable systems (Figure 9).

A recent LCA from the IFEU Institute shows that refillable bottles have 50 to 60% lower global warming potential than one-way beverage containers. For instance, using only refillable bottles for all



non-alcoholic beverages in Germany compared to the use of one-way packaging could annually reduce the global warming emissions with 1.26 million tonnes CO₂ equivalents (Figure 10).

References

- Lahiry H (2017) Down to earth. India's challenges in waste management.
- Kumar P (2016) Packaging Industry in India.
- Panchal M, Karthikeyan KS, Singh PS (2016) Plastic packaging-the sustainable choice, A report on plastic industry.
- Singhal S, Pandey S (2001) Solid waste management in India: status and future directions. TERI Information monitor on environmental science 6: 1-4.
- TERI (2012) Yamuna, the poisoned river, Study sponsored by UNICEF and posted by TERI.
- Jayaraman G (2013) On track for a clean sweep, India today.
- Chintan publications-Research and Reports.
- Mahanti JC (2017) Recycling of used paper packaging, socio-economic perspective. Indian agro & recycled paper mills association. Paperiindia.
- Joshi R, Ahmed S (2016) Status and challenges of municipal solid waste management in India: A review. Environ Chem Pollut Waste Manage.
- Kumar S, Smith SR, Fowler G, Velis C, Kumar J, et al. (2017) Challenges and opportunities associated with waste management in India.
- Green Machine (2017) Municipal solid waste recycling processing systems.
- Buchner M (2012) 3 Alternative ideas for waste management in developing countries.