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Recycling of Used Paper Packaging, Socio-economic Perspective

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Review Article

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ABSTRACT

Recycling of any material after use is inevitable for sustainability. It prevents depletion of natural resources and protects the environment. Industries engaged in recycling produce articles of consumption from waste material with lower or no pollution of the environment and at the same time, provide employment opportunities. Hence both developed and developing countries are encouraging the same through incentives and legislations. This is more relevant for India as over half the population is engaged in agriculture, contributing less than 20% to the GDP. Over 65% are below the age of 35 and with growth rate at 1.58% p.a. the population should reach 1.53 billion by 2030. Gainful employment of this huge growing workforce is possible only by setting up manufacturing industries preferably suitable for rural locations. Paper is a common commodity of modern living and it's consumption is growing with improved and changing lifestyle. It is one of the most favoured medium for packaging of goods for wholesale delivery and retailing. The packaging is discarded after it has served the purpose and many times disposed off with domestic and other wastes causing land, water and air pollution. Manufacture of Packaging Paper and Board from reclaimed waste papers is an industry which is well suited for developing countries due to high growth potential and other aspects like lower investment, lower operating cost etc. While in some countries a lot of importance has been given to collection and recycling of used paper, the same is not true for many developing countries. Hence, the reasons for this lower rate of recycling and the Socio – economic benefits of producing paper from used packaging have been discussed in this article.

INTRODUCTION

Recycling, contributes to sustainable development by conserving resources and protecting the environment from pollution. Recovered paper is a valuable raw material that can be used to create new paper and board products. According to Mr.Pete Grogan, nationally recognised authority on resource recycling (Who recently received 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 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. Also, Collection and re-use of waste paper benefits the society economically. For example, "The Wealth Out of Waste" (WOW) campaign in Gujarat, India is dedicated to the education of girl children by earnings from sale of used papers donated by citizens. Considering the importance of Recyclables as a natural resource, Mr. Ranjit Singh Baxi, President of the Bureau of International Recycling (BIR, Headquarters in Brussels) has announced that the first Global Recycling Day to take place on March 18th, 2018. Mahatma Gandhi's observation "There is enough in this world to meet the need but not the greed" holds the key to sustainable development. Also, he was a great advocate of rural employment using rural resources by setting up cottage industries like spinning and weaving Khadi [1].

Packaging

Packaging, is defined as any material which is used to contain, protect, handle, deliver and present goods while at the same time, maintaining the brand image **(Figure 1)**. Growing urbanisation with higher living standards of the people, changes in pat-

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tern of consumption and distribution with development of retail chains, and the burgeoning healthcare and cosmetic sectors are driving packaging demand in India, China and other emerging economies. According to World Packaging Organisation, the global packaging industry has an annual turnover of US$ 500 billion, On the basis of application, the market has been segmented to food and beverage, personal care, consumer and luxury and industrial packaging. Medium term demand forecast indicate for food packaging a potential growth rate of 3.4% and drinks of 3.3% per annum reaching values of $ 284 billion and $102 billion in the next two years [2-4]. A study by Smithers-Pira has established that sales of packaging are concentrated in Asia, accounting for 36% of the total global demand in value terms. North America and Western Europe totally share 23% and 22% respectively. Eastern Europe is the fourth largest consumer of packaging with a share of 6%, closely followed by Central America with 5%. Africa and Australasia each have a 2% share. This segmentation of the market is expected to change significantly in the coming years with Asia predicted to represent over 40% of the global demand. In economically developed markets, a number of key social and market trends have been having a major impact on developments in packaging in recent years. These include: smaller households and accompanying demand for more number of smaller pack sizes, increasing requirement of convenience among consumers including ready to process food and beverages and growing use of packaged healthcare products, cosmetics etc. Growing urbanisation, increased disposable income with higher living standards, development of retail chains and the burgeoning healthcare and cosmetic sectors is fuelling consumption of a broad range of products in developing countries, with consequent growth in demand for packaging of these goods. Presence of a large number of professionals from developing countries in the Middle East and Western countries has resulted in import of provisions and FMCG etc. from the parent countries by the retail outlets there.

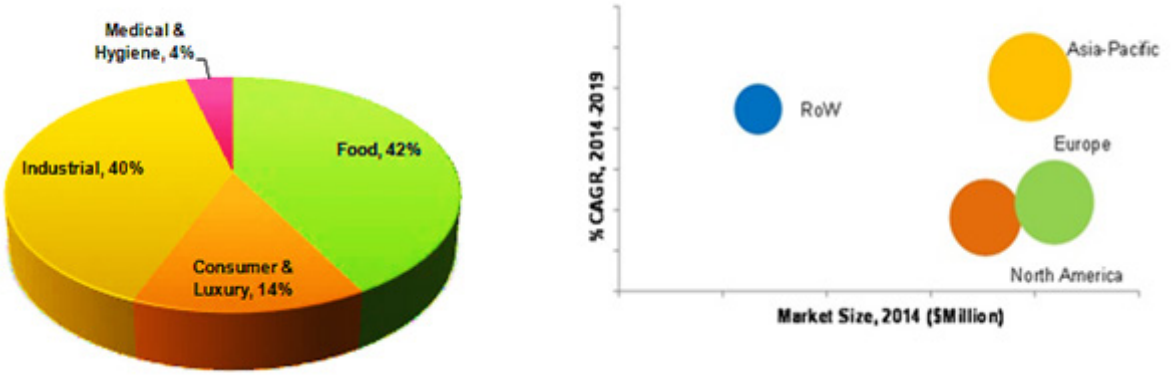

Figure 1. Global packaging market by market sector served all materials and regions.

The use of "Paper" was mainly associated with cultural activities i.e., transmission, dissemination and storage of knowledge. This is not so any more as with advent and wide use of the electronic media, change in lifestyle and other socio-economic factors, the consumption of paper for cultural use is declining in most: countries, whereas, a major part of the paper produced now is being used for packaging of goods. Environmental awareness and statuary regulations has led to increasing use of eco-friendly packaging materials. Manufacturers are now under pressure to use material for packaging and adopt methods that have less adverse impact on the environment as part of their Extended Producer's Responsibility (EPR). Changes in consumer preferences, rising petrochemical costs and increasing government regulations have also caused food and consumer products companies to look for alternatives to plastics packaging. For example, The Supreme Court of India has ordered a ban on use of plastic packaging in tobacco products like Gutka and pan masala. Different types of paper have been and are being developed to meet specific packaging requirements. While, glass, plastics and metals are recycled, paper is both recyclable as well as, biodegradable. Today, paper is the most favoured packaging material due to environmental, social, economic and many other advantages. Also, manufacturers using paper packaging are having an edge over their competitors as customers are favouring environmentally friendly packaging. Hence, manufacture of packaging paper and products are industries with high growth potential **(Figure 2)**.

Benefits of manufacturing packaging paper and board by recycling

a. Preventing denudation of forests.

b. Lower cost and wide spread availability of raw material.

c. Non-polluting operation.

d. Lower consumption of Utilities (Water, Fuel and Electricity).

e. Environmental protection by reducing land and air pollution.

f. Lower investment in setting up the plant.

The consumption of different packaging materials in India at present is shown below:

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Flexible packaging materials for food, pharmaceuticals, cosmetics, toiletries, textiles etc. account for 22%, rigid and semi-rigid plastic container 22%, paper and board 31%, glass containers 7%. Metal and tin containers account for 14%.

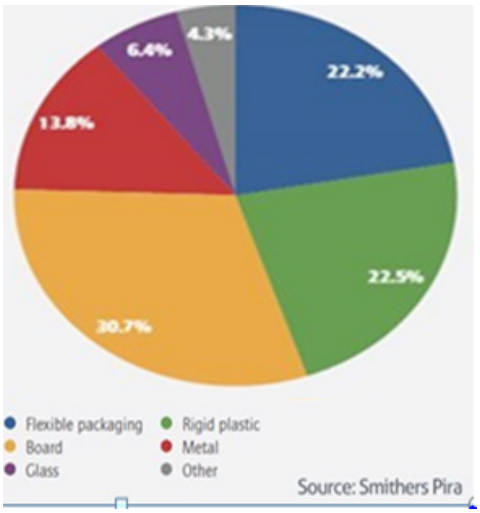

Figure 2. The consumption of different packaging materials in India.

Packaging Papers

Mainly, Kraft papers and Paper boards are used in packaging Corrugated boxes made from Kraft paper has dominated the packaging industry. Also termed as convenience packaging, it serves more than the main purpose of preserving and protecting the contents. Use of good quality corrugated box is preferred highly in every sector, whether it is pharmaceuticals, electronics or anything else. It is believed that if corrugated boxes cannot withstand the transportation risks, no other packaging can. Even, corrugated containers are used for transport of other packaging like pouches, cans, bottles, folding cartons etc. to manufacturers of different products and to the whole sellers and retailers after being filled in. Kraft paper is being used for making carry bags and packets in most retail outlets and it is also used for wrapping of goods before packing and delivery. Kraft papers of very high strength properties are being used for making sacks for packing cement, tea and several other items **(Figure 3)**.

Duplex (multi-ply) boards also termed as Carton board are used for making folding cartons for packaging almost all consumer and many industrial goods like food and provisions, pharmaceuticals and cosmetics, tobacco products, garments, electrical items and other consumer durables. Grey and Box board is used for rigid boxes for many consumer goods like foot wear, partitions, book and note book covers, displays etc. Also it is used as industrial raw material for textile cones, core tubes etc.

Figure 3. Different packaging papers: (a) kraft paper; (b) duplex board and (c) grey and box board.

Kraft papers

There are basically two categories of Kraft paper made from reclaimed fibers used in corrugated packaging, each with different characteristics: Waste-based fluting (WBF) and Test-liners. Due to their different functions, separate properties are required from papers used as liner and fluting. Originally paper made only from virgin fibers, Kraft pulp for liner due to strength and semi-chemical pulp with residual lignin for fluting due to stiffness, were used for producing corrugated board. With progress in paper manufacture including introduction of chemical additives, development in waste paper re-pulping process and paper making machines design including multiply sheet forming, most of the corrugated board produced in the world now is from fiber that has been used before (i.e., reclaimed paper).

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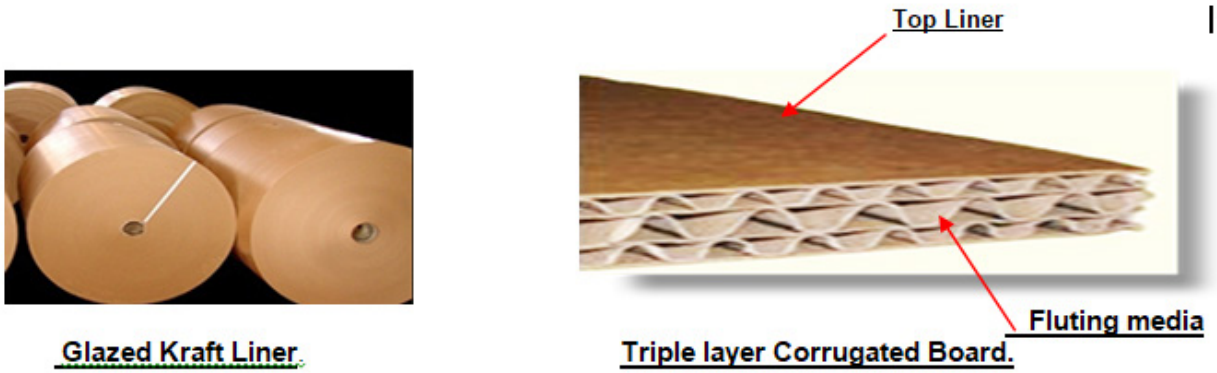

Figure 4. Categories of kraft paper.

• Waste based fluting: Starch is added to improve the stiffness. Starch performs the same function as lignin in fluting made from semi-chemical pulp.

• Test liner from waste paper: Chemical additives like gum are added to improve strength and starch is applied on the surface to reduce absorbency and improve printing quality. (When required, white or coloured pulp is used in the top layer of the liner and coating is applied to provide attractive printing surface) With the use of high strength papers for corrugating containers and paper bags etc. today most of the Kraft paper is being produced in paper machines with 2 to 3 layer sheet forming **(Figure 4)**.

Paper boards

Paper boards are usually made with 2 or more layers of paper sheets bonded together with aggregate substance over 225 grams per square meter (GSM). According to the Recycled Paperboard Alliance, 100% recycled paperboard has the ability to be completely customised. It can be coated where needed or be made to be fully recyclable. White top board is produced by using white recovered paper in the top layer. Additives and treatment within the production process meet requirements for moisture, vapour transfer, moisture resistance, anti-tarnish, oil/ grease resistance, opacity, customised colours and coefficient of friction **(Figure 5)**.

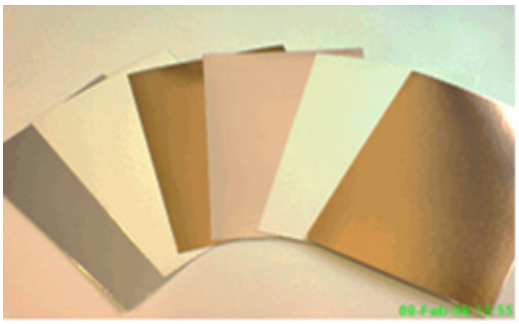

Figure 5. Sheets of paper board.

Grades include: “white back” or white inside surface achieved by using a high percentage of white recovered paper for the inside layer of the board.

Special purpose papers: like grease proof, bread wrapping etc.

Coated and laminated papers: used for liquid packing (tetra-pak) labels, stickers etc.

Paper Recycling

Ecologically, recycling is the most preferred option of what to do with paper at the end of its life - instead of using it as fuel or putting it on landfills. By recycling, the paper is put into a loop as raw material having a new life instead of rotting in a landfill emitting methane polluting both land and air. This in turn, has social benefits by creating new jobs adding value to the economy. Almost any paper after use can be recycled, including newspapers, cardboard boxes, folding cartons, corrugated containers, stationary, direct mail, magazines and catalogues, greeting cards and wrapping paper. It is important that these are kept separate from other wastes as contaminated paper is not suitable for recycling. Since the paper fiber loses its strength after each recycling (normally it can be recycled 4 to 6 times) the system requires blending of virgin fibers. Fortunately, most packaging wastes are a mix of papers from recycled and virgin fibers [5]. Today, 52% of the paper produced is from reclaimed wastepaper. Europe is the global champion on paper recycling with a rate of 72%. About 60 million tons are collected each year, out of which the European paper industry uses close to 48 million tons and the rest is exported to other countries like India and China for conversion in paper

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mills there. In most European countries e.g. Germany, separate collection bins are provided for different types of waste materials like paper, plastics, glass etc. in residences and public places. Super markets, offices and other commercial setups have their own collection and disposal system.

Indian Context

Production of packaging paper and board from reclaimed waste paper is particularly relevant in developing countries like India both to meet the growing demand as well as to provide employment to the growing workforce. Preferred location is in rural areas to utilise the substantial quantity packaging being wasted and provide alternate employment to members of rural families thereby contributing to the three pillars of sustainable development i.e.,

- Economic pillar Growth for reducing poverty and creating employment.
- Social pillar Social and geographic inclusion with gender equality.
- Environment pillar Minimal environmental damage while pursuing development.

Besides employment opportunities, the manufacturing units will provide "on the job" training to the local population and contribute to skill development. This will be of help in operating and maintaining modern farm machinery and equipment. Also, as part of their social responsibility, the units will contribute to development of the locality by promoting hygiene, education, sports and cultural activities, providing clean drinking water etc. Modern living conditions in rural areas, with better housings having running water, flush toilets, electricity (solar), cooking gas (bio), garbage disposal etc., are the consequences of increased industrial employment and not the other way around [6,7]. The relevant aspects of setting up packaging paper production units in rural areas have been detailed below [8-10].

Products

Kraft papers (Liner and Fluting), Duplex and Grey boards depending on the availability of raw materials and market demand.

Rate of production: At least, 50 Tons per day (16,500 Tons per year) based on the following considerations.

a. Minimum for technical and economic viability.

b. Availability of raw material and fuel from local collection.

c. No undue stress on water sources.

d. Disposal of waste water and solid rejects without harming the environment..

e. Utilisation of local surplus man power.

f. Marketability of the products within close proximity.

Land Requirement

3 to 5 Acres (12 to 20,000 Sq. meters) preferably unsuitable for cultivation.

Raw Material

- For Kraft and Fluting media: Old corrugated cartons, used brown paper bags/ envelops and corrugating trimmings.
- For Duplex board (bottom layer) and Grey board: Used cardboard boxes and folding cartons, street pickings, discarded books, copy book covers, newspapers and magazines, egg trays, office waste etc.
- For Duplex board (Top Layer): Used copy books, white press trimmings, sorted office waste etc. (Bleached pulp for very high grades).

Figure 6. Mixed waste paper.

When using recovered fibers it is desirable to select the recovered paper depending on the end product requirements and

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which also allows the most efficient recycling process. In India, the share of waste paper as raw material for paper has risen from 7% in 1970 to over 50%. This has reduced consumption of bamboo and wood from 84% to 30% in spite of the substantial increase in paper production. Because of the low collection, bulk of the waste paper consumed is being imported, costing billion dollars every year. One of the main reasons for low waste paper recovery (below 30% as opposed for example, 75% in Germany) is that due to small quantities available in rural areas, their collection is not economical and they are disposed off with other wastes as garbage. Since, there is no organised garbage collection system, the waste paper along with other garbage is dumped on any available open land usually meant for recreation and cattle grazing **(Figure 6)**. This is causing hazards to the health of humans and animals besides environmental pollution which will be reduced by collection of waste paper for recycling.

Availability of Raw Material

Even in rural areas, most of the items of daily use like groceries, snacks and sweets, pharmaceuticals, cosmetics, garments etc. are packed in folding cartons or cardboard boxes. Also, with restrictions on use of polythene, paper carry bags and wrappings are being used at most retail outlets. Corrugated containers are used for bulk transport of almost all items. A major part of these packaging are discarded after use and will be recycled to produce fresh paper. As mentioned earlier, most of the household paper waste can be recycled however, it is important that these are kept separate from other household waste as contaminated paper is not suitable for recycling. It is expected that at least 1000 Tons of waste paper for the plant would be available through household collection within 50 kms from the plant location (about 1 kgs/month per household with 125 households per square km). The balance quantity would be collected from public places, as well as, shops, offices and other establishments.

Consumption of utilities

- Water: 8 to CuM/ Hr. (abt. 0.05 MGD).
- Fuel: (Green, Annexure VI), Locally available paddy husk, bagasse, ground nut and cashew nut shells, wood waste etc. abt. 25 Tons/ day. (Maximum possible solar heat generation).
- Electricity: about 750 to 850 KW (including 250 KW by-product and 50 KW solar generation).

Use of solar energy

To overcome the global warming through carbon dioxide generation, the trend now is to harness energy from natural sources and due to it's several advantages, solar is the most favoured [11,12]. Harnessing solar energy is particularly relevant in India, with the radiation level in different regions between 5 to 7 Kwh/sq.mtrs./day for about 300 days in a year. Paper manufacture requires heat and electricity in substantial quantity and part of the requirement can be met through harnessing solar energy by utilising available open land used for storage of raw material, fuel etc. water reservoir, effluent lagoons and also roof tops.

Environmental Impact

Waste water

More than half the water intake will be evaporated in the manufacturing process or through solid rejects. The balance quantity shall be used for horticulture/ floriculture in the plant premises. Chemicals used, will mainly comprise alum, rosin, gum and starch, all of which are harmless. The present trend is for complete recycling of waste water (i.e., Zero effluent) and if required, the same will be implemented **(Table 1)**.

Solid wastes

Solid wastes Will mostly comprise polythene, metals and ash from burning the fuel. Polythene and metals shall be disposed off through scrap dealers for recycling. The ash shall be used for filling up low lying areas or road construction and If possible, be sold for making bricks and cement.

Exhaust gas

Exhaust gas from burning the fuel in the boiler will meet the stipulated limits (no objectionable gases and particulate matter below 800 mg/Nm^3) and shall be discharged at 20 mtrs. above ground level. There will not be any noise pollution.

Table 1. Mass balance manufacture of 50 tons/day kraft paper and grey board.

	Solid T/D	Water Cum/D		Solid T/D	Water Cum/D
IN			OUT		
Waste paper	51.00	4.50	Paper	46.00	4.00
Chemicals	0.80	____	Rejects	5.80	65.00
Fr. Water	____	225.00	Effluent	___	98.00
			Vapour	___	62.50
Total	51.80	229.50	Total	51.80	229.50

Employment

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125 persons (115 direct plus 10 for casual or contractual jobs). Besides at least another 25 persons will be engaged in sourcing raw materials and fuels as well as, supporting services like canteen, transport etc. Addition of 150 earning members in the community will increase the demand for facilities like health care, retail outlets, restaurants, tailoring, repair shops etc. and create further employment.

Market potential

Production of packaging paper and board has a very good demand prospect as:

a. Packaging is among the high growth industries in India. Due to lower manufacturing costs, the country is fast becoming a preferred hub for sourcing packaging products by multi – national companies. The over 10,000 corrugated sheet and box making plants, are employing over half a million people both directly and indirectly. The industry is converting over 3.5 million tons paper per year in to corrugated boxes. Factories are spread out in all parts of the country, even in the remotest areas. Folding carton (made from multi- ply board) market size is estimated at 2.2 million Tons.

b. Consumption of packaging papers is closely linked with economic development of the country and is increasing at a very fast rate. India is witnessing rapid growth compiled with increasing production activities. This economic growth accompanied by surging affluence of the Indian population, increase in tourism and increasing exports has triggered the increase in production of consumer goods. The requirement of packaging of these goods subsequently has created demand for packaging materials in the country. The present consumption of different types of paper in India and the projected increase by 2018 –19 is tabulated below in **Table 2.**

Table 2. Production of different papers (Source FAO, RISI**, J.K.Paper).

Product		Global		India 2014-15			India 2018-19	
category	% Mn	Tons	CARG % 4 years	% Mn	Tons	CARG % 5 years	Tons	CARG % 4 years
Coated	13.2	41	-2.3	4.8	0.7	6.7	0.9	7
Uncoated	14.2	64	0	25.9	3.8	5.6	4.8	5.7
Packaging board	13.7	58	1.6	22.2	3.3	9.4	4.6	9.1
Tissue	7.7	33	4.2	0.6	0.1	12	0.2	15.5
Industrial Incl. Kraft	35.7	152	2.8	26.5	3.9	8	5.5	9
News Print	8	27	-5	17.6	2.6	4.2	2.7	1
Others	7.5	33	1.6	2.4	0.3	7.5	0.5	8
Total	100	408	0.9	100	14.7	7	19.1	6.8

According to the above, the CAGR between 2014 -15 and 2018 -19 for boards and Kraft papers is about 9% whereas, that for writing printing papers is 5.7%. Out of the total projected increase in production by 4.4 million Tons, the share of packaging grades will be 66% (Board: 1.3 and Kraft: 1.6 million Tons). Mr. Ranjit Singh Baxi estimates that by 2025, Kraft paper production in India will be 7 million Tons requiring about 9.5 million Tons recovered fiber. For Duplex board the figure is 5 million Tons requiring about 6.6 million Tons recovered fiber. Assuming that half the increase in consumption will be met through expansion of the existing mills there is very good scope for setting up new units.

c. Green packaging Environmental awareness has led to increasing use of eco-friendly materials.

d. Feasibility of setting up downstream units like corrugating, box making, manufacture of paper plates, cones, tubes and other products.

The packaging industry in India is currently valued at Rs.165,000 Crores ($24.6 billion) and is expected to grow to Rs. 210,000 Crores ($32 billion) by 2025 (Source: Smithers –pira). Starting from packaging of fruits and vegetables, medicinal products, home and personal care products to highly dangerous and heavy industrial products, the packaging industry has led to greater specialization over a period of time. It is one of the largest markets for packaged food in the world, just behind the US, China, Brazil and Mexico, and the second-largest in Asia. With more than 50 percent of the population younger than 25 years, increasing disposable incomes, a growing middle class, ongoing urbanisation and changing lifestyles, India enjoys highly favourable demographic patterns. As young people are one of the key drivers in the demand for processed and hygienic packaged foods, manufacturers are introducing products that increase convenience and reduce the time required to prepare meals. Products with additional ingredients - in easy to handle packaging and convenient package sizes will continue to gain popularity. E- tailers are also enjoying increasing online revenue sales. According to research, sellers in India have a positive sentiment towards e-commerce with maximum traction seen in food businesses. Major factors likely to influence the Packaging industry are:

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a. Electronic business processing.

b. Convenience packaging.

c. Supply chain management.

d. Marketability.

e. Benefits like labelling, tamper evidence, freshness.

f. Environment friendly.

Investment and Financial Viability

The total capital outlay for setting up the paper mills as proposed will largely depend on the location with site conditions and several other factors like degree of automation and sophistication. However as an indication only, it is expected that it will be within Rs. 25 to 30 Crores. The operation of the mills should be financially viable as there are several favourable conditions as compared to larger units. These are mainly:

- Cheaper raw materials and fuel from local collection.

- Lower man power cost by utilising local inhabitants.

- Savings in energy cost due to harnessing solar power to meet part of the requirement.

- Lower working capital requirement (reduced inventory of raw materials, fuel and finished products.)

However, these projects should not be treated as pure commercial ventures but should form a part of the government's schemes for social and rural development and poverty alleviation. Consequently the following incentives and facilities should be provided.

- Land on lease free of cost.

- Site development and connecting road from Highway. (through NAREGA)

- Dedicated electricity supply line from the substation.

- Subsidised electricity tariff.

- 100% reimbursement of cost for harnessing solar energy.

- Subsidy on investment.

- Tax exemption and lower rate of interest on loans.

While, the actual figures will depend on individual cases and circumstances, even with an operating margin of Rs. 2000 per Ton paper, the investment will be paid back within 10 years and much earlier, if the incentives mentioned above are taken in to consideration. It is advisable that units for conversion of part of the production like corrugating, carton and box manufacture etc. This is set up in the mill premises or nearby for generating further employment and save on transportation costs and overheads.

Comments and Observations

About 70% of India's population (presently 1.35 billion) live in 638,000 rural villages and over 50% of the country's work force are engaged in agriculture contributing only 17.9% to the GDP. Due to low remuneration and seasonal employment in the agriculture sector, there is large scale migration of adult population from rural areas to the cities often for low paid menial jobs with unhealthy living conditions. The growth in urban population and decline in rural population has been indicated in the 2011 Census of Govt. of India as shown in the Chart below. According to the same:

The rural population declined from 72.19% in 2001 to 68.84% in 2011.

Level of urbanization increased from 27.81% to 31.16% in this period.

- Out of the urban population 48.36 Crores (37.8%) are migrants.

This migration of the rural population has to be reversed as in the metros and urban areas, the basic needs like air and water have become highly polluted. Also, facilities like housing, sanitation, education and health care etc. are inadequate and highly stressed **(Figure 7)**. This can only be achieved by improving the employment opportunities and living conditions in rural areas by setting up manufacturing units utilising local wealth, human and material particularly, agro based units. China is an example, where the rural enterprises known as Township and Village enterprises (TVEs) have contributed remarkably to rural development and economic growth with empowerment of women and reversing the migration to cities. Agriculture provided more than 50% of the GDP In 1952 but it fell to 14% in 2004, during which period the rural enterprises known as Township and Village enterprises (TVEs) have contributed remarkably to rural development and economic growth. Their share has grown from none to one third

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of the GDP. According to the statistics from World bank, the urban population growth rate has come down from 4.9% in 1960 to 2.6% in 2016 [13,14].

Figure 7. Rural and urban population in India.

- Smithers-Pira Worldwide authority on packaging, paper and printing industry with facilities in the US and UK.
- RISI Authoritative global source of information on forest products including pulp, paper and timber.
- Bureau of International Recycling. (BIR) the only global recycling industry association representing 800 companies and 35 affiliated national associations.

Innovations and Packaging Trends

Reducing food waste

Food waste is a huge issue that the world is facing. It's a long and complicated journey from farm to table, and 54% of food is lost between harvest and consumption. Proper packaging plays a large role in keeping food fresh during its journey.

Retail ready packaging

Easy to handle packaging and convenience continues to gain popularity. The key drivers of the trend are efficiency, protection and brand management.

Sustainable packaging

Most producers of consumer goods are seeking ways to enhance their sustainability.

Smarter packaging

Maintains brand image while protecting the products.

Advanced packaging technologies

it reduce package failure by reinforcing critical stress points and adding functionality that retailer's value **(Figure 8)**.

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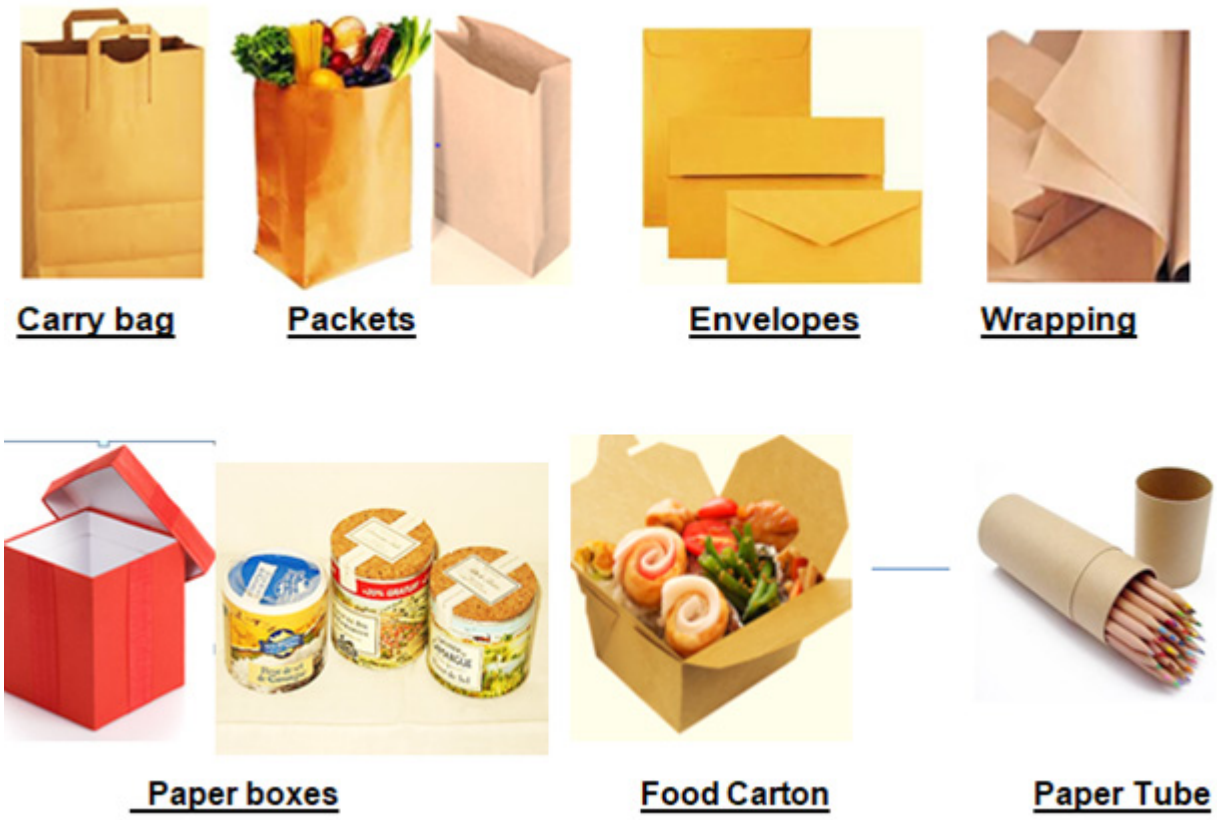

Figure 8. Some packaging products made from paper.

Laminated (Asceptic) Packing for Liquids

Laminated aseptic packages are made by laminating paper and board with polyethylene and aluminum foil. This multilayered construction enables the carton to protect the contents from various factors responsible for spoilage, thereby preserving the freshness and value. Laminated cartons are used to store liquids such as milk and pure orange juice, for up to a year. The most famous laminated cartons are manufactured by Tetra Pak. In Sweden, over 130 billion Tetra Paks are manufactured each year.

Figure 9. Laminated (asceptic) packing for liquids.

Aseptic Packaging market in India is generally classified into three segments Juices, Dairy products (flavoured milk, other dairy items) and liquor. Presently the Indian Aseptic Liquid Packaging Market is growing at 17 to 18% per annum, and the market is expected to double up in the next five years to approximately 20 billion packs per annum. Drawing parallels, China boasts of a tremendous growth story which has already reached approximately 80 billion packs. In India, with similar population, there is a huge growth potential **(Figure 9)**. The company Lucart of France has received the 6th European Paper Recycling Award for 2017 due to developing and implementing an innovative technology for paper recycling along with Tetra–Pak **(Table 3)**. The process involves separation of cellulose fibers in beverage cartons from polyethylene and aluminium parts without use of substances that are harmful to humans and the environment. The polyethylene and aluminium are converted to a material called AL.PE.

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Table 3. Consumption and recovery of paper in different countries.

Country/ Region	Consumtions (millions tonnes)	usage	Recovery (millions tonnes)	Recovery rate
China	76.4	72%	48.9	46%
Wetern Europe	45.9	52%	54.3	73%
North America	32.0	36%	50.8	65%
Japan	17.4	64%	21.6	78%
Indonesia	6.3	61%	3.8	56%
India	5.7	55%	3.3	27%
Mexico	4.9	99%	3.9	51%
Brazil	4.4	41%	4.4	43%
Thailand	3.8	77%	2.8	60%
Africa	2.7	57%	2.8	32%
Turkey	2.6	85%	2.5	45%
Middle East	2.5	75%	2.9	36%
Worldwide	237.5	57%	237.3	57%

Garbage Collection in Germany

Germany produces 30 million tons of garbage annually and the country has been very successful in it's fight against growing garbage heaps. The manufacturers and retailer s 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.

Return of Bottles and Cans

When you purchase something like Coke or beer in a bottle or can, you pay the advertised price plus a deposit (Pfand) which is refunded when you return the empty bottles and cans **(Figure 10)**. This results in zero litter, minimum environmental impact and saving in cost by the municipalities. Bins of different colours are provided in residential buildings and public places for different wastes like glass, paper, plastics which are collected for recycling on designated days in the week. 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 **(Table 4)**.

Figure 10. Garbage bins and trash bins at railway station.

Table 4. Availability of bio-fuels (million tons/year).

Main crop	Total annual production	Bio-fuel	Ratio
Rice	104.4	Husk 31.3	0.30
Coarse serials*	40.0	Husk, 72.0	1.80
Sugar cane	339.0	Tops, 41.0	0.12
Note: *crops like maize, soybean, tapioca, bajra, groundnut, jowar, maize, groundnut, arhar, castor seed, gram and til contribute the major shares of residues.			

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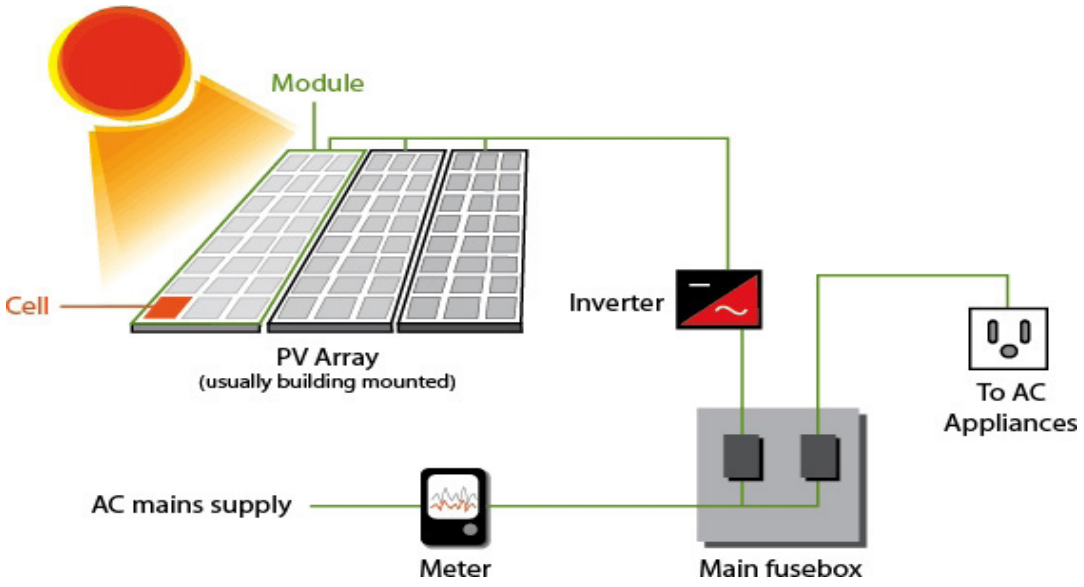

Figure 11. Solar PV electricity generation.

1 KW of PV solar panels require 10 sq.M of shade-free space and will generate about 4.5 Kwh electricity per day on average @ 1 kg of CO_2 reduction/ kWh **(Figure 11)**.

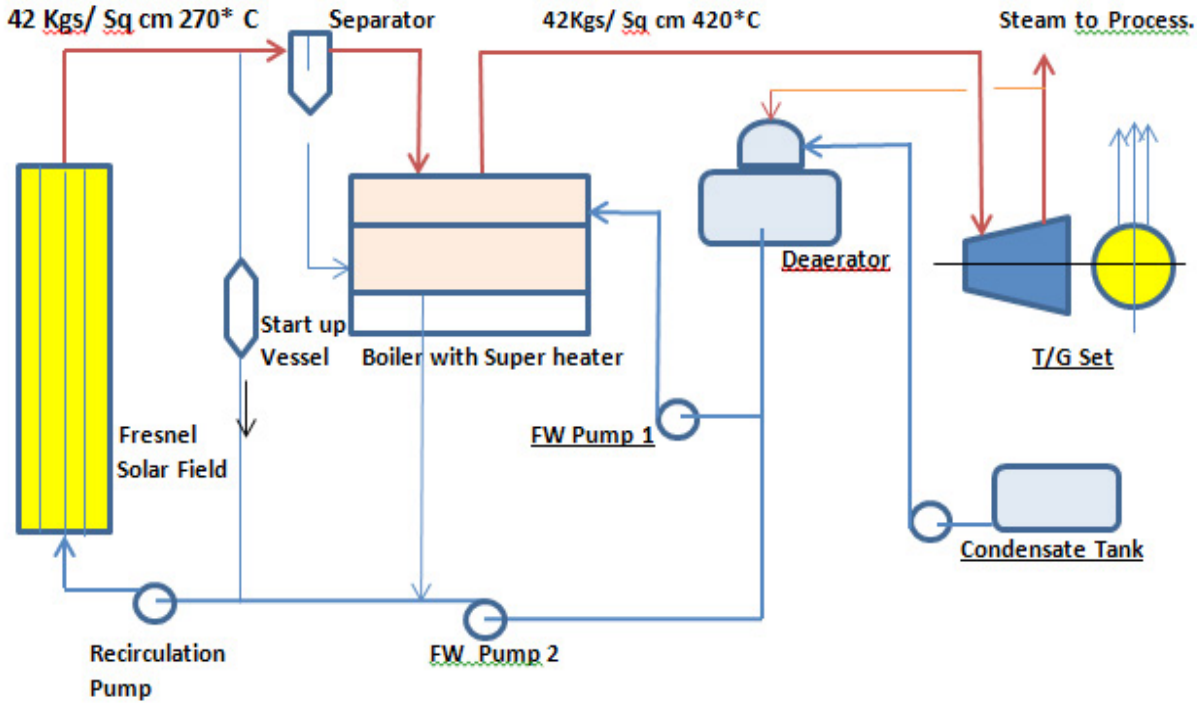

Figure 12. Hybrid solar- bio/fossil fuel steam and electricity generation.

100 Sq Mtr. CSP steam generation system will save 30 Tons bio-fuel (Paddy husk) or 20 Tons coal/year for at least 20 years with corresponding reduction of CO_2 **(Figure 12)**.

CONCLUSION

Manufacture of Packaging Paper and Board from reclaimed waste papers is an industry which is well suited for developing countries due to high growth potential and other aspects like lower investment, lower operating cost etc. While in some countries a lot of importance has been given to collection and recycling of used paper, the same is not true for many developing countries. Hence, the reasons for this lower rate of recycling and the Socio-economic benefits of producing paper from used packaging have been discussed in this article.

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