

Sustainable Packaging on the Wishlist of Eco-Minded Consumers

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Abstract - In a country like India with abundant natural resources, the wastes from processing can be easily recycled. Previously, this was ignorant to most of the manufacturers, resulting in tonnes of organic waste reaching landfills every year. Statistically, in India 32 million tonnes of agro-waste is burnt creating smog and various other forms of pollution. On the other hand, plastics have an integral role in today's lifestyle. It comes with the alarming fact that the first plastic made in its inception during 1950, is still existing, unabsorbed by nature. The evidence that plastics take more than a hundred years to decompose, has created an alarming effect on all the segments that use plastic extensively. Food and Packaging industry is known to consume single-use plastics on a large level. The global packaging market is 500 billion euros serving mainly food and beverage packing. Today sustainability is the focal point of business today and consumers are interested in waste separation and inhouse composting. Increasing eco-conscious consumers have encouraged bags from recycled papers, compostable sheets, biofilms made from seaweed/corn starch, plates, and spoons from agrowastes (areca nut, bagasse, bamboo, wheat husk) are addressed to bring awareness and encourage more research in this genre.

Keywords: plastic, sustainability, eco-packaging, edible cutlery, biofilms

I. INTRODUCTION

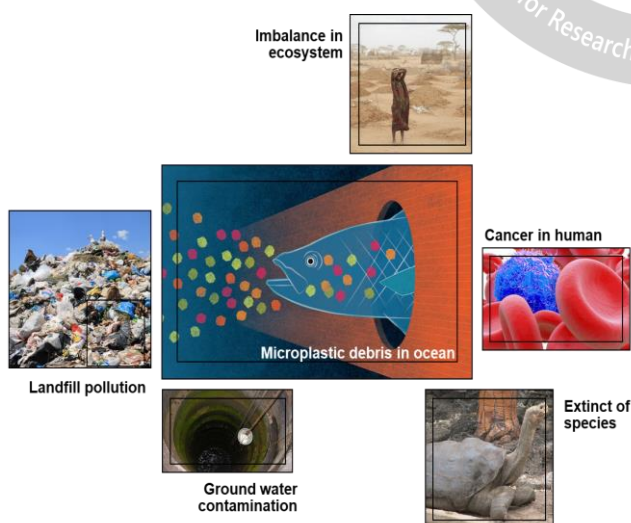


Figure 1. Problems with one time disposals made of plastics

Plastics have unknowingly become an integral part of living today. The extensive use can be listed from products like the toothbrush, toys, mobile phones, chairs, airplanes, flex, banners, multiple roles in occasions like weddings,

meetings, and conferences. The major reason for the popularity of plastics is its flexibility in production and cost-effectiveness. It is uncompromisable that decomposing of plastics initiate only after 100 years, within which innumerable hazards can occur to the wildlife and the environment that cannot be reversed. Such a non-degradable waste like plastic is a matter of concern across the globe today. Especially the one-time use and throw plastics have been the sole reason for the extinct of various species along with the imbalance in the ecosystem, microplastic debris in ocean, including the recent discussions on microplastics and depletion of ground water resource (Figure 1) [1-4].

Plastics and its Nondegradable facts

Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) and Polypropylene (PP) are the forms of plastic commonly used for everyday activities. In the past 70 years of plastic waste have resulted in pollution so ubiquitous scientists say it's a marker of a 'new geological epoch and a manmade Anthropocene'. The era of online business for shopping clothing or ordering

grocery, food has unknowingly contributed to a huge quantity of plastics in the landfill. Especially food and plastics are inversely integrated. Ironically, hot food absorbs plastic particles, which is not going to be visible in the naked eye but cannot be denied as well. Certainly, it can be one of the reasons for the increased number of cancer patients in India [4-6].

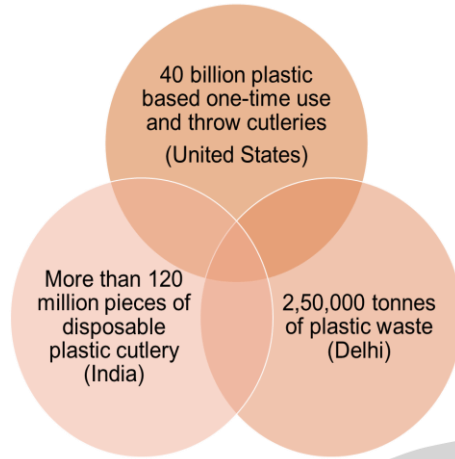


Figure 2. Reports on plastic pollution

Asia, China, Indonesia, and the Philippines are listed among the top ten plastic polluting nations in the world. It is estimated that every year in the United States, 40 billion plastic-based one-time use and throw cutleries, end in a landfill. Pathetically, in India, more than 120 million pieces of disposable plastic cutlery are discarded on the landfill every year (Figure 2). This motivates the need to bring some awareness of sustainable packing and also edible cutlery. Experiments point out that by reducing the production of plastic by 1 kg, approximately 3.5 kg of CO₂ emission can be prevented. It is in this context, now, every industry is shifting towards avoiding plastics and replacing with renewable materials to achieve the sustainability goals of the institution [7-10].

As per the reports of 2012, global plastic production was 288 million tons, which increased to 448 million tons which has more than 40% to be single-use plastics for food packing. Malnutrition and starvation of aquatic animals, microplastic debris, ingestion of plastic by humans through seafood consumption are commonly discussed topics in this scenario.

A report published in 2016 by European Food Safety Authority (EFSA) indicated depriving human health due to plastic deposition in commercial fish varieties across the globe, followed by the ban from European Union on single-use and throw plastics. Onetime use and throw materials (plastics) are symbolized as luxury, modernization, and sophistication which conceals the ill effects of them on nature.

Predictions by NGO, the 'Toxic links', point that, every year plastic consumption, is increasing at a speed of 10% in our country. Reports also quote that India generates around 56 lakh tones of plastic waste annually, in which

headquarters Delhi alone accounts for generating around 2,50,000 tonnes of plastic waste annually (Figure 2). It is an absolute need now, that, Kathmandu (Nepal), Uttar Pradesh (India), and Malacca (Malaysia) along with many states in India has an effective ban on plastic bags. In 2015, a neighbouring country, Singapore published a report that saved 10 million plastic bags through the concept of "bring your own bag" initiative [11-14].

FAQ by consumers - 'Product and Packing sustainable?'

It is certain, that a good product should have an efficient and sustainable package that does not pollute nature. Ironically, today the entire supply chain is evaluated for its ecological impact and sustainability quotient. For example, toothpaste which is an essential commodity is always questioned for its package which is plastic. The amount of paste bought in a year multiplied by the total human population will give a mere understanding of the number of plastics thrown in the name of toothpaste. As an eco-friendly initiative, Lindsay McCormick invents toothpaste pill which does not have any preservatives come in sustainable packaging (glass). In contrast to plastic, biodegradable products use alternate organic materials that are derived from nature. Life Cycle Assessment is done to the product for the certification process which is mandatory for accepting an export order [15-18].

Various inventories are launched by companies and researchers across the world. As an alternative to plastic plates, bagasse waste is experimented to be made into tableware. These have the merit of being able to be decomposed within three months. The collected sugarcane waste (bagasse), grounded and mixed with starch is made into tableware. After hydraulic pressing, the biomass gets a shape, over which gaw-gaw resin is applied. In Mexico, a team of scientists has made cutlery from Chaff (corn husk), which is organic waste and biomass, rich in fiber, iron, and vitamins. This act has prevented landfill pollution and kindled upcycling of organic waste. Another example, corn plastic which is a bio-based plastic is used which will be easily decomposed after its usage.

The fermented plant starch can yield polylactic acid (PLA) which is used as a bag and thin film to protect vegetables and fruits. Wheat straw tableware has good heat resistance, water-resistant, oil resistance, and load-bearing capacity as per the studies. These are made by adding 800kg of water to 1000 kg of straw. Straw washing and separation are done and after disinfectant using Ozone/ UV the material is packed. The fact that these degrade quickly is an added advantage. Another invention, Potato plastic designed by Pontus Tornqvist, is used to make edible, compostable bags from the potato mixed and processed with glycerol. Knife, fork, spoon, cups are made from these that are easily degraded on disposal. Cupffee by Genome Labs, make edible cups from millets and grains, which is claimed to be diabetic-friendly in addition to being

nutritious [3, 19]. In this manner, various types of agro and farm wastes are used in the packaging industry.



Figure 3. Sustainable packaging examples

Cassava starch is used in making biodegradable, water-soluble bags that are a replacement to plastic carry bags are some of the examples. There are edible water blobs to quench the thirst and avoiding plastic bottles to carry them, they have a biodegradable capsule holding the water (Figure 3). It is very interesting to see sauce and cocktails in this edible packaging, that is either consumed after the purpose or decomposed naturally. Plastic consumed by marine animals is a burning issue when Edible ring packaging by Saltwater Brewery launched grids made from barley and wheat to hold the beverage cans, which when disposed of, are consumed by the marine animals without harm. Shampoo as small pods was designed by Benjamin Stern, which helps in eliminating plastic in the packing of shampoo bottles. [5, 20-23].



Figure 3. Eco-friendly packaging

II. EMERGENCE OF SUSTAINABLE PACKAGING

Packing is an important attribute in selling an item/ commodity. The presentation of a product is always an important criterion designed with great thought, simplicity, and uniqueness. Reduce, reuse, redesign, recycle are commonly chanted words by any industry across the globe. We can see various eco-friendly materials (Figure 3) alluring the market as recycled paper, brown bags, recycled old containers, steel/ copper/ glass jars, cardboard, self-printed bottles (avoiding label-plastic), cloth bags, recycled textiles, refill can, compostable sheets, biofilms as wraps, areca nut plate, wooden spoon, coconut shell utensils, jute bags, earthen pots, steel and copper utensils getting back into the limelight. The companies have understood that raising the bar of sustainability is the need of the hour. In a study on consumer choices, the findings quote that the raw materials, harmless nature of the product, eco-friendliness of the commodity on whole to be the major attributes used by the consumer on judging the eco-friendly nature of the product [24].

WHO report says that by 2050, the world's population will be 9.6 billion that needs three planets additionally to suit our current lifestyle. It is not surprising, that there are more plastics than fishes in the ocean. The current rate of e-commerce is 18%, which is more than the forecasting reports of the last decade [25-26]. Consumers are found to get excited about seeing a package arriving at their doorstep. The sense of joy, accomplishment, curiosity, convenience has outnumbered the sustainability ratio of the package [27]. Amazon is one of the popular sites for online shopping, decided to start the FFP (Frustration free packaging) which is made with objectives as below;

- packaging right for the product size and easy to open,
- packaging made from renewable materials and recyclable
- reduce damage to the product in shipping,
- save shipping cost by being less in weight [28],

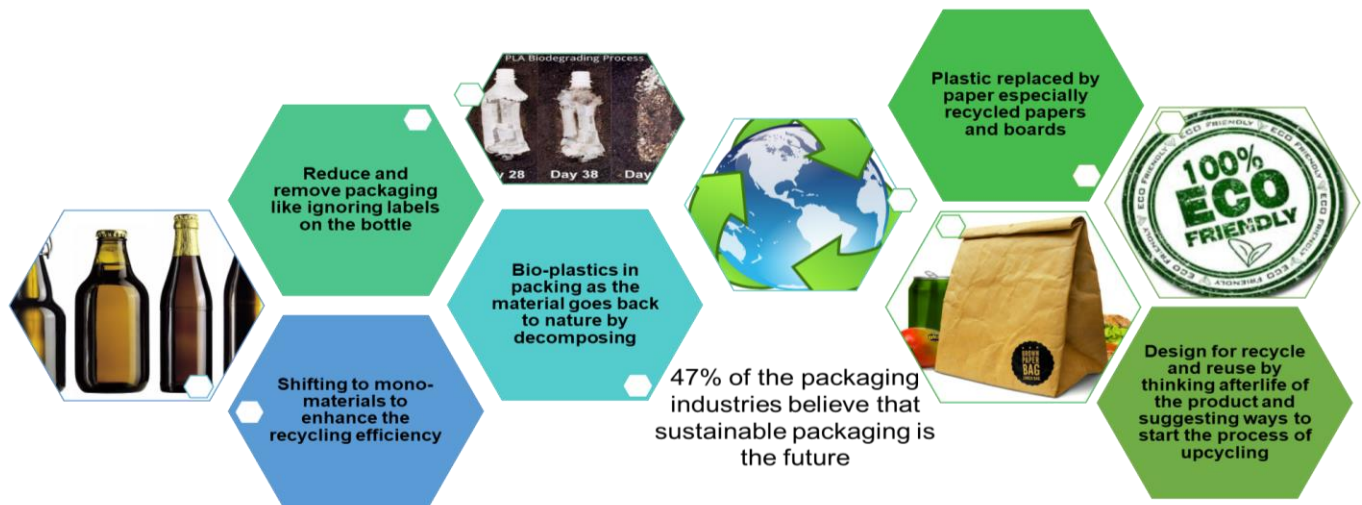


Figure 4. Thrust areas of research in sustainable packaging

Some of the traditional companies have redesigned and launched their new brand image with sustainability packaging that has helped them get more attention. One of the finest examples was by H&M (Figure 3), which designed a bag that can be used as a cloth hanger, so the consumer does not have to throw the bag after purchase. The reception of such ideas among the consumers gives an audacity of hope, which is very encouraging to the manufacturers.

The thrust areas of research in packing (Figure 4) are focused on, plastic replaced by paper especially recycled papers and boards, reduce and remove packaging like ignoring labels on the bottle, design for recycling and reuse by thinking afterlife of the product, suggesting ways to start the process of upcycling, bio-plastics in packing as the material goes back to nature by decomposing and shifting to mono-materials to enhance the recycling efficiency [29].

Mindful choices by brands

The Environmental Protection Agency quotes that 80 million tons of packaging waste is thrown in United States every year most of which belong to the one-time use and throw plastics from the food and packaging industry. The popular brand like iPhone 6s to 7 is marketed to have less plastic usage by 85% and Imac pro with packaging having 78% less plastic and 85% recycled material into it. Marketing and

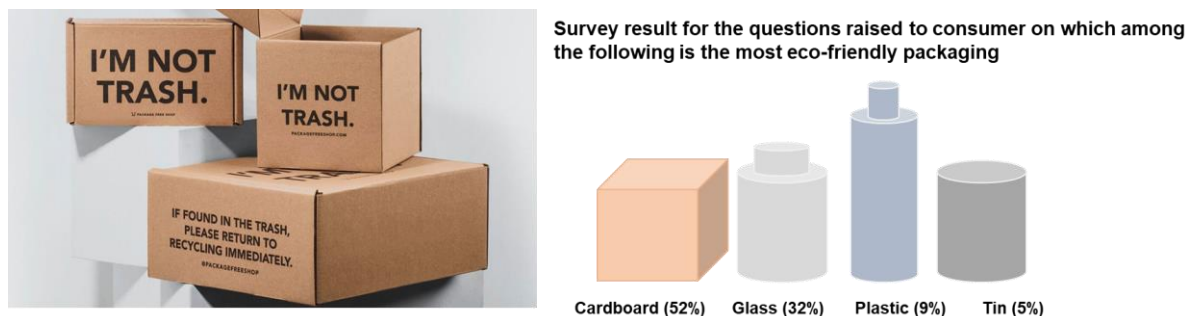


Figure 5. Sustainable packaging

Image courtesy: <https://theecobahn.com/packaging/sustainable-packaging-insights-eco-revenue/>

promotion of a product is certainly examining and using the sustainability perspective (Figure 5). In 2009, Coco cola redesigned its bottle, using 30% of plastic derived from nature. Today plant-based, mushroom-based, starch (potato) based packaging materials, edible cups from seaweed, compostable bags (and inks), water-resistant, and compostable paper bottles (L'oreal), tabs for closure avoiding the use of resins are popular in the market. Every year, nine billion pounds of ink is made from renewable sources. Water and soy-based inks are available as an alternative, but still, it uses carbon, making it non-eco-friendly. A sustainable brand, Eno-enclose makes ink using algae cells, compostable wraps, papers that are recycled, eco-friendly carton tape, bag, and labels (Figure 6).

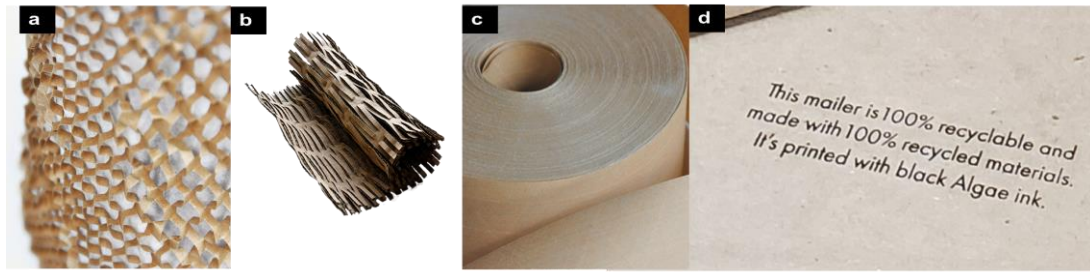


Figure 6. Sustainable product of the brand “Eco-enclose” (a & b) green wraps (c) carton tape (d) print using algae ink

Puma designed a bag with a box, for its packaging, which after use, can be coupled to be a plant holder. The brand Box latch products design latches that are used in the closure of the boxes, which avoids resins and plastic tapes during the package. This is a typical example of minimalism. Pangea Organics packaging contains seeds (sprouts) that give life (plant) on disposal. Greenkraft clamshells from recycled cardboard, wheat straw and make a series of items like boxes for diaper, bath kit, essential oil, USB driver, soap, garden kit, spices, air plants (Figure 7).



Figure 7. Brands working towards sustainable packaging

Nike's shoe 100 percent recycled post-consumer waste like lid, cartons, container were used to make the product. Bio-lutions, a Germany based company in Bengaluru, makes tray, a box from agrowastes preventing the burning of the crop, that will cause havoc through smog, that is a matter of concern in north India. Chuk, another company in Faizabad, Uttar Pradesh, makes brown tableware from sugarcane waste. Consequently, majority of the renowned brands like Unilever, Walmart, Target, Nestle have set 2025 to have 100 percent reusable, recyclable, and compostable plastic packaging. Especially when the material is declared compostable and be compliant to the ASTM D 6400-04 and ASTM D 6868 standards [32].

Many companies across the globe are looking for lightweight, recyclable materials that cause no harm to the environment. Some of them are CEFLEX (Europe), the New Zealand Soft Plastics Initiative, and the REDcycle recycling program (Australia). However, the companies strongly believe this is the time to close the recycling loop, by creating market value for recovered materials. One of the challenges is having the right recycling infrastructure, which is lacking, even though consumers have an interest in buying recycled items. Various brands are involved in making such sustainable packaging to hold a position in the future, some as discussed in Table 1, which can be a source of inspiration for researchers and entrepreneurs in the future.



Figure 8. Popular brands promoting Sustainable packaging

Table 1
Sustainable packaging initiatives by various brands across the globe [7 & 11]

Brand name	Raw material/ design idea	End product
Replenish (reusable)	They make spray bottles with cleaning liquids, which is designed to be used multiple times	When the liquid is done, the adding of pods and water makes the sprayers ready for work, unlike the conventional one-time use and throw model (Figure 8)
Drake's Supermarkets	This bio-plastic can be used to cover fruits and vegetables to keep them clean and fresh.	Compostable wrapping sheets made from a plant-based resin called Matter B (Figure 8)
Pizza round	Product is made from tree-free, plant-based compostable material with 80% sugarcane waste and 20% bamboo.	Designed pizza boxes with a cutting knife (Figure 8)
IKEA	Ecovative is a design to replace Polystyrene packing which takes more than 1000 years to decompose	100% biodegradable material from mushroom which decomposes in a few weeks (Figure 8)
Nuatan	Corn starch, potato starch, and used cooking oil is designed to make a Bioplastic stronger than plastic	It was designed to combat marine plastic and labeled as material safe for consumption by ocean animals.
Ooho	This idea has removed the need for plastic bottles. Recently they have launched sauce pots, for sports, sachets, cocktails, take away that has replaced the plastic sachets.	It makes an edible drinking capsule from seaweed used first for the marathon runners in September 2018. Water, cocktail, or any drink could be filled in, which the consumer can drink, eat the seaweed, or throw them away to dispose of in a few days. (Figure 3)
Tide Eco-box (by P&G) in collaboration with Amazon	Reported that they saved 4,58,000 tons of packaging material, 60% less plastic, and used 30% less water than the conventional type.	By shifting from bottle to boxes (Figure 8)
Threeagl	Agricultural biomass waste	Deo-stick container that can degrade in two years (Figure 8)
Monday's Child	Packaging cover can be turned into a doll-house	Cover of young girls clothing (Figure 8)
UAU	3D printed art that enhances the packaging, which later can be used as a display of the art in the house.	Packaging (Figure 8)
The Tshirt Mill	Makes customized apparel and accessories	The packaging is 100% compostable
Ocean Bound Plastic's Envision	Closed-loop recycling – using plastics from the ocean, minimizing carbon footprint, uses the help of local manufacturing and warehousing facilities	Plastics collected from 50kms of high-risk coastal areas, recycled to make bottles for skin and hair care products. This technique had, no water, no solvent along with proper effluent treatment.
O-I:Expressions	No metal-based inks, no label, no printing, a customizable option is also available	Glass containers
Biotika.pl	Recycled cardboard, with minimalist design	Packaging
The Paper Bottle Project	The virgin pulp from Scandinavian forests	100% recyclable and biodegradable paper bottle for carbonated beverages
Red algae	Red algae	Packaging for dry foods and grain
Henkel & The Plastic Bank	100% recycled bottles	Packing of their home, beauty and laundry products
Frosch-brand detergent products	Easy recycling possibility	By using mono-materials, zero printing, no glue or adhesive in their packaging
Sharepack (Netherlands)	-	Containers to hold salad, pizza or other hamburger, which after use, will be collected that will washed and reused.
Hasbro	-	Simply, reduced 50% of plastic in its packaging
Slopes (Dutch based company)	Bamboo (renewable resource)	Packaging
Sheyn	Uses 80% recycled material	Packaging
Origin X performance	Natural and biodegradable polymers	Bags
Ritual	Vitamin supplements	Recycled newspaper and printing using plant-based ink
Maison Tess	Home textile	Reuseable cotton drawstring bags
Foodcraft	Supplier of organic, dairy-free, and vegan food	Compostable plant-based PLA
Mrs. Meyer's Clean Day	Soap and cleaners	Recycled bottles
P&G	Shampoo bottle	Plastic collected from ocean is sent to teracycle for sorting, then cleaning, grinding and made into pellet for making recycled bottle
H&M	10% discount	When consumer return their empty cosmetic box or any textiles

III. FUELLING SUSTAINABLE PACKAGING



Figure 8a. Sustainable logo design - Coca Cola

(Inventive measure adopted by Coca Cola, 30% of the bottles plastic is from plants and the product is 100% recyclable)

Urbanization and busy life patterns have resulted in adopting things that are packed and ready to use including dresses, food, cosmetics, etc. United Nation report in 1987, has the formal definition of sustainability and sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. In addition to fabric care, quality, safety, logistics, the packaging is also gaining momentum to be projected sustainably. The litter and water pollution caused by the polymer-based food packaging is unapologetic. Sustainable Packaging Coalition published facts that motivated various companies like Coca - cola (Figure 8a), Mc Donald’s, PepsiCo, Unilever, Kraft-Heinz, and Nestle to have action plans to have sustainable packaging by 2025. They have plans on design for better recovery of materials in recycling, reduction in the weight of the package, using recycled or sustainable materials for production to get better market value and consumer satisfaction. But the challenging part is real-time success showing increased sales that are unpredictable. Hence renewable and sustainable materials like bio-fibers, bio-films, bio-polymers, and bio-composites are explored for sustainable packaging [33].

Life cycle assessment involves packaging, transport, and disposal of the product, in which the packaging has an integral role. It serves as a means of communication between manufacturer and consumer, which can drive an emotional response and trigger to buy the product. There are pieces of evidence that consumers like eco-friendly packaging, whereas their idea of what they understand as ‘eco-friendly’, and the results vary in each geographical region. Sustainable packaging has three major benefits name environmental, improved brand image, versatility (Figure 8b). Moreover, environmental concern in a

consumer’s mind can be handled by eco-friendly packaging. Sustainable packaging helps in protecting, communicating, promoting recycling, aiding waste reduction, analyzing production, consumption, disposal, and recovery protocols. This is done by using wind energy for production, efficient packaging design and recycle, sensible shipping, save money, reduce carbon footprint, minimizes energy waste, reuse of packaging material, print with vegetable ink, and so on.



Figure 8.b. Advantages of Sustainable packaging

IV. CONCLUSION

In a nutshell, sustainable packing reduces the carbon footprint and initiates a circular economy. A study quotes that 47% of the packaging industries believe that sustainable packaging is the future. This paper derives a conglomeration of ideas and market value for the theme sustainability in packaging. One has to remember that plastic is very dangerous and it is quintessential to keep the world free from one-time use and throw plastics. The education system should introduce more awareness, research, and projects on avoiding measures for plastic pollution and largely promoting awareness in the communities. The article is entitled to serve the same objective, by giving an idea of the existing works going around the world, a graduate student or a start-up can work to take the idea forward.

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