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## INNOVATIVE SOLUTIONS FOR SUSTAINABLE REVERSE SUPPLY CHAIN MANAGEMENT

### ABSTRACT

With the growing technological advancements, the use of manufactured products is increasing day-by-day, be the use of mobile phones, artificial intelligence gadgets, daily usable products like cosmetics, medicines, food, clothes, and many more are an important part of our living. When the customers are done with the products, the question comes for disposal of used material, is major concern as it comes with increase in waste material. The purpose of this article is to come up with the effective solutions in sustainable reverse supply chain management which will help in to improve waste occurred by the used material in an environment friendly manner. The methodology used in this article is empirical research based on the survey of questions and the findings are through answers based on the questions surveyed. The research limitations are only up-to the sustainable reverse supply chain management of products which are packed in plastics such as cosmetics, medicines, food, and general items made of plastics. The practical implications of these used products can be done by recycling, reusing, and reducing methods such as collecting of plastic products separately, reusing, it or reducing its use with the use of bio-degradable plastics, empty medicinal bottles can be used to recycle, brown boxes used for packing can be recycle and reuse instead of throwing it in the garbage. With these practical implications we can help reduce the use of raw materials in making of these products which will eventually lead to a sustainable use among the people in the society and will have a greater impact towards the society's development in an environmentally friendly manner, sustainable and effective use of resources.

### KEYWORDS

Effective solutions, recycling, reducing, reusing, supply chain management, sustainable.

### INTRODUCTION

- SUPPLY CHAIN

A supply chain is a network of businesses, individuals, organisations, technologies, processes, activities, information, and resources used to move goods from a supplier to a customer. A supply chain is a system of suppliers, transporters, warehouses, retailers, and distributors who work together to produce, deliver, and sell goods to customers. These operations involve the movement and modification of items from the raw material stage to the final consumer, as well as the related information and financial flows. A supply chain, put simply, is the connection between a company or organisation and its suppliers and customers. Supply chain activities turn natural resources, raw materials, and component into a finished product that is supplied to the ultimate customer. The logistics network, also known as the supply chain, is made up of suppliers, factories, warehouses, distribution hubs, and retail stores. It also includes raw materials, inventories for work-in-progress, and finished goods that move between the facilities. Three major components make up a supply chain: supply, which focuses on how, when, and where raw materials are delivered for manufacturing. Production that aims to transform these basic ingredients into final goods. Distribution, which aims to make sure that the goods are delivered to customers through a coordinated network of wholesalers, storage facilities, and retailers. In complex supply chain systems, used goods may re-enter the supply chain at any point where residual value is recyclable. A supply chain comprises all operations in satisfying client demands and requests. How the supply chain should function in order to compete in the market is referred to as a supply chain strategy. The plan examines the operation's advantages and disadvantages. The supply chain strategy is centred on the organization's actual operations and the supply chain that will be employed to achieve a certain objective. The flow of goods, information, and cash is integrated, coordinated, and monitored by the supply chain.

- SUPPLY CHAIN MANAGEMENT

Supply chain management is the control of the distribution of goods, data, and money from supplier to consumer. All, of the required breaks between the supplier and the consumer are also included in the supply chain. The management of the supply chain involves organising the movement of materials both inside an organisation and to the final customer. In one of the books by Jaipur National University, Jaipur it mentions supply chain management is described as follows by the Council of Supply Chain Management Professionals "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities" (Supply Chain Management, 2013, p.4). It is significant since it also involves coordination and cooperation

with channel partners, which might include suppliers, middlemen, outside service providers, and clients. Supply chain management essentially unites supply and demand control within and among businesses. Supply chain management is an integrating function that is primarily in charge of connecting key business operations and procedures both within and between organisations to create a well-rounded and effective business model. It coordinates processes and activities with and across marketing, sales, product design, finance, and information technology. It incorporates all, of the logistics management functions mentioned above as well as manufacturing operations.

Supply chain management is also known as the art of management, which includes providing the consumer the ideal product at the ideal time, location, and cost. Three main flows can be identified in supply chain management: the product flow, the information flow, and the financial flow. The product flow involves moving products from supplier to consumer as well as handling customer service issues, the information flow involves order details and delivery status and the financial flow includes payment schedules, credit terms, and other agreements. Supply chain management is a collection of techniques used to effectively integrate vendors, producers, warehouses, and shops so that goods are produced and distributed in the right quantities, at the right times, and to the right locations in order to reduce system costs and meet service level requirements.

- REVERSE SUPPLY CHAIN MANAGEMENT

Regulations and environmental issues have also changed supply chain operations. Institutions must now reorganise their supply chains to minimise their negative environmental effects. In order to promote environmental sustainability, manufacturers and consumers have a shared obligation to reduce waste through recycling, remanufacturing, reusing, and appropriately discarding unwanted products or commodities. Reverse supply chain maximises the value of used goods, which reduces the quantity of waste. Reverse supply chain management is the effective completion of a sequence of tasks necessary to collect a product from any point in the forward supply chain in order to either dispose of it or recover value. Due to growing environmental awareness among consumers and businesses in recent years as well as strong government environmental regulations, reverse supply chain management practices are applied in environmentally sensitive industries.

- REVERSE LOGISTICS

The American Reverse Logistics Executive Council defines reverse logistics as “The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for recapturing value or proper disposal.” (Rogers and Tibben-Lembke, 1999; Govindan et al., 2015).

- **REMANUFACTURING**

Remanufacturing can be defined as “It is the process of returning used, damaged or discarded products up to the quality standards of new products and with an equivalent warranty.” (Ijomah, 2009; Thierry et al., 1995). The product’s quality solely differs in terms of replacement and repair. (Seyda et al., 2022, p.11) mentions the following six steps which define the reproduction process:

1. “entrance diagnosis of the system
2. disassembly
3. cleaning
4. inspection
5. reconditioning
6. reassembly”

- **PRODUCT RECOVERY SYSTEMS**

When a product reaches the end of its useful life, product recovery refers to numerous re-operations such as repair, reuse, remanufacturing, recycling, and refurbishing. Product recovery promotes waste reduction and is a crucial step in the direction of sustainable development. In one of the reports by Ministry of Housing and Urban Affairs titled ‘Circular Economy in Municipal Solid and Liquid Waste’ mentions due to the high economic worth of its constituents, particularly recyclables, dry trash is the most valuable waste stream among municipal solid garbage. Currently, India produces over 1.45 lakh metric tonnes of solid trash each day, of which 35% is dry waste. It is made up of several parts, including plastic, paper, cardboard, glass, ceramic, metals, fabrics, rubbers, and tyres.

One of the biggest problems in this field right now is the lack of comprehensive ways for managing plastic waste. Other issues include the restricted collection and recycling of single-

use plastic and the informal sector's use of non-scientific recycling techniques. Along with this, governmental and regulatory shortcomings, including, among others, a lack of incentives to promote recycled goods and complicated EPR (Extended Producer's Responsibility) frameworks, have limited the potential of dry waste in the circular economy. "The sub-committee recommends (i) a comprehensive policy on mandatory use of certain percentage of recycled material in lieu of virgin material, (ii) expeditious implementation of EPR framework and (iii) rebate in tax/GST on recycled products to increase its competitiveness." (Circular Economy in Municipal Solid and Liquid Waste, 2021, p.7).

Chapter 2 of the report 'Report of Sub-Committee on Dry waste' describes dry waste is made up of explosive substances like other combustibles, non-recyclables, and recyclables like plastic, paper, cardboard, metals, glass, and rubber. Due to the great economic worth of its constituent parts, particularly recyclables, it is the most valuable waste stream among municipal solid garbage. Changes in consumption patterns have been brought about by rapid urbanisation and economic expansion. The potential value of recyclable fractions has increased as a result of economic growth, necessitating the implementation of circular economy principles for resource recovery. Most of the plastic garbage in India is recycled because of the country's unorganised industry. India may learn from nations with high rates of recycling: Germany (66.1%), South Korea (59.0%), Singapore (60.6%), and make it even more effective recycling and recovering. The report's main objective is to create a roadmap for putting circularity concepts into practise in dry management of garbage and assistance in finding the governing, guiding, physical, and citizen-centred waste interventions gathering, separating, sorting, and processing and material recovery for reuse, so minimising the use of new materials. The Hon'ble Prime Minister Shri Narendra Modi's Swachh Bharat Mission (U), which was introduced in October 2014, outlined a clear road map for the nation's scientific waste management. It is crucial to concentrate on the scientific management of all dry waste components as India's waste composition is changing due to the rise in dry waste over the past several years and the recovery potential that dry waste brings.

## RESULT ANALYSIS

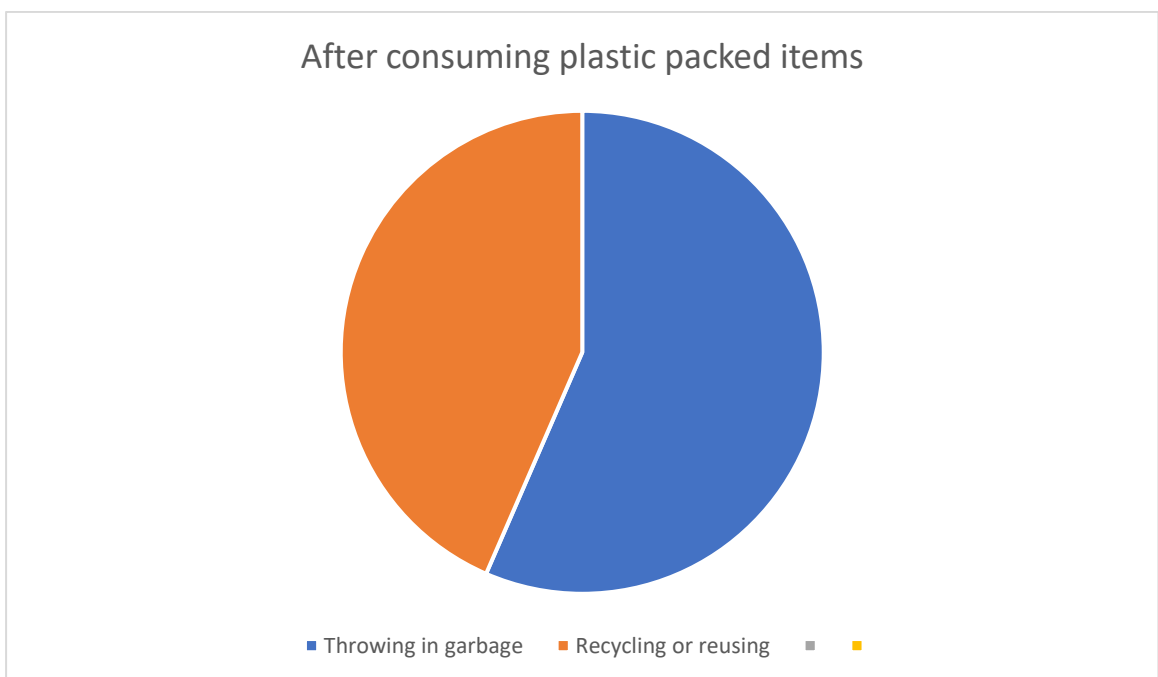
In my article I have examined opinion of students about recycling, reusing of products packed in plastics and made up of plastics. The responses I got are of 24 students and based upon these responses I have generalised results and made graphs. The questions which I asked are as below following with results of questions.

1. What you do after consuming plastic packed items such as food products etc.?

23 students have response to this question, among 23 students, 13 students throw the consumed plastic products in garbage while 10 students keep it for recycling or reusing. We can, generalized from this is that many of the people after consuming plastic packed products throw away in garbage while few, percentage of people keep it for recycling or reusing. This indicate there is an urgent need of method to collect plastics packed products to recycled and reuse instead of throwing away in garbage and increasing the burden of garbage in the environment. Most of these products are dry waste and can be recycled and reused, adding a sustainable way of reusing it.

Graph 1

*Frequency of students, actions after consuming plastic packed items.*



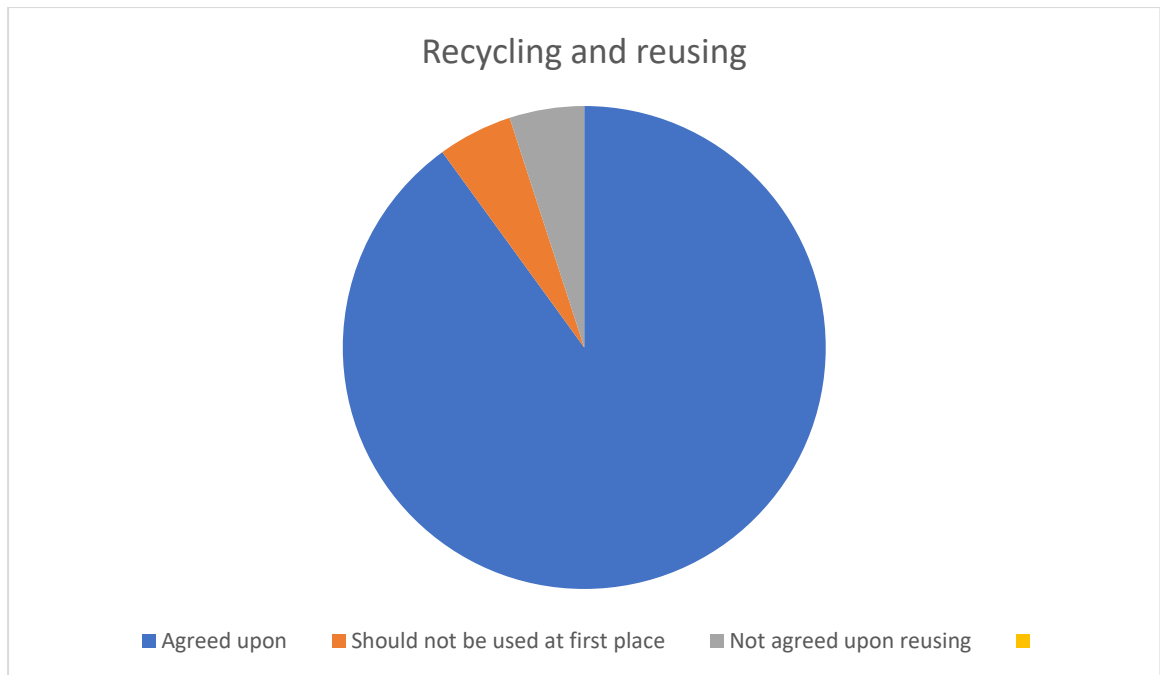
2. What is your opinion about recycling, reusing plastic packed products instead of throwing away?

22 students have response to this question and among them 18 students opts for recycling and reusing which is generalize as it would be healthier and environmental

friendly, it is better way instead of throwing away as we can use it and recycle it, conserving natural resource, there must be implementation of 3 R principles, it is helpful for environment, reusing in industries, is good to resume it, it helps the nature, it should be recycled and reused if possible, it is good help to protect the environment, throwing of plastic is very harmful, that it is a sustainable way of usage, that recycling and reusing plastic is good initiative but it is hard to implement, that it is better for future, 1 student's opinion is that it should not be used at first place or other alternatives should be used instead of that. According to 1 student, it could be harmful to recycle and reuse because every plastic has its own expiration dates, if we reuse the plastics packed products after their expiry dates, plastic will start dissolving in water or food products in the form of microplastics therefore it could be very harmful to humans, raising to this concern my, opinion is that plastics packed products when not used within a period, and had been kept for longer hours results in dissolving of microplastics into plastics packed products and thus we should avoid keeping plastic packed food products or water bottles for a longer time. By using of techniques to sanitize the used plastics, to defect micro-organisms can be a method to ensure it is safely recycled and reused. This indicate that though recycling and reusing should be encouraged there are the problems of recycling and reusing plastics safely and cleanly in order to minimize its disadvantages of plastics dissolving in water or food products.

Graph 2

*Frequency of students, opinion about recycling, reusing plastic packed products instead of throwing away.*



3. Would you like you contribute your plastics packed products for recycling, reusing? If any concerns please mention.

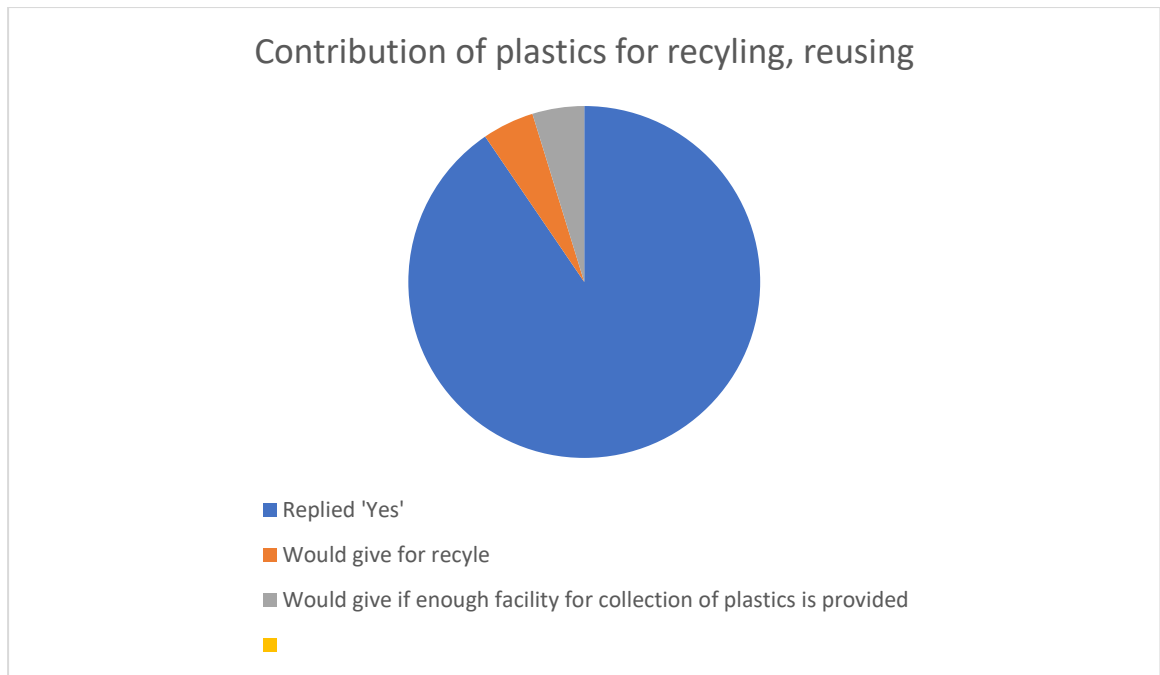
21 students have response to this question and among them 19 students replied ‘yes’ to contribute their plastics packed products for recycling, reusing. 1 student’s opinion is that he could give plastic products for recycle but not for reuse, while 1 student’s opinion is that he would like to contribute plastic packed products for recycling and reusing provided, that there is enough facility given by the Authorities or Municipal Corporations to recycle the plastic products.

This indicate that many are ready to contribute but with the lacking of proper system of collection of plastics products makes it difficult for its implementation. Thus, there is the need of some facility for collection of such products in every region of India, whether it be Municipal Corporations in urban areas or Gram Panchayat in rural areas for successful recycling and reusing of such products.

#### Graph 3

*Frequency of students, opinion about contributing their plastics packed products for recycling, reusing.*





4. Should there be any method for collecting plastics packed products from consumers, if yes then how it should be done?

14 students have response to this question and among them 11 students agreed for a method to be used for collecting plastics that after the use of plastic it should be collected in a specific bin and recycled, plastic packed products can be collected from all home and send it for recycling process, provide garbage truck 2 times a day in every area of the city, plastic pickers, running drives or keeping workers for areas to collect from, routine collection vehicles, plastic garbage collector whoever is appointed can come on weekends or any other specified day to collect it, encouraging people to collect all their plastic products and the Municipal Corporation workers could pick these products from people's doorstep.

According to me the solution which we can brought up is to introduced a separate vehicle for collecting plastics packed products and it should be collected into two different ways, in one where only, plastics made products should be collected and second for wet waste. Government must introduce certain systems and laws which will help in its regulation, a separate team for plastic and waste management must be created in every region of the country, ranging from small rural to big urban areas, each of them should be given, particular areas for collection, biodegradable bags must be distributed to people for separate plastics collection and they should be encouraged to follow it, once in a week a collecting vehicle should come and collect all the bags and bring it to

an industry which should be well equipped with machines recycling plastics where all these plastics should be recycled and later reused according to it needs. A machine should be installed as such that it collects plastics and divides plastics into different groups of products for recycling. Plastics needed to be collected by diving them into different scan code depending upon their uses such as medicines packed in plastics should have a common code for medicinal products only, companies manufacturing medicines must marked that code in their every, products similarly for cosmetics, food products, water bottles etc. Plastics are made for many uses and depending upon for which purpose they are being used whether it be used for packaging products, such as medicines, cosmetics, food products, water bottles, etc different scan code should be introduced by government and companies should be made to marked those scan codes in their products so that they can be easily divided by the machine on the basis of their scan code and that particular code products should use for recycling and reused accordingly.

Graph 4

*Frequency of students, opinion about any method for collecting plastics packed products from consumers.*



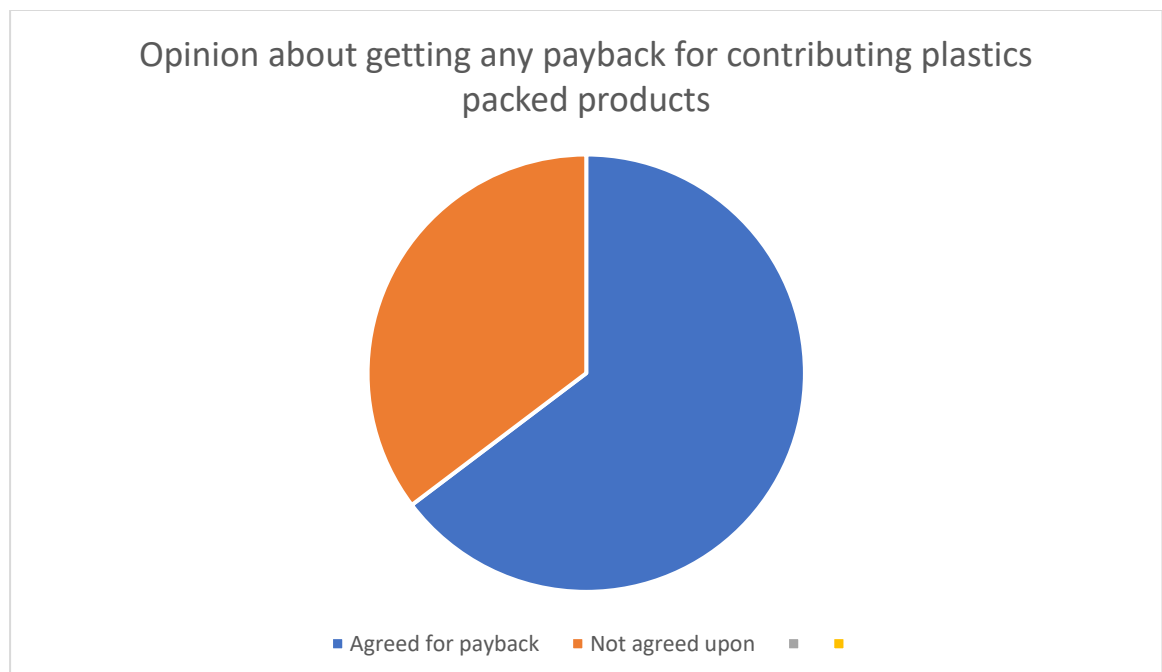
5. Would you like to get any payback after contributing your plastics packed products to some organization collecting plastics for recycling, reusing, if yes, any reasons?

18 students have response to this question and among them 11 students agreed for payback as it is important to encourage people for collecting plastics products instead of misusing it, that some companies give money after giving some amount of plastic so it is beneficial, that this will motivate people to recycle plastics, that as incentivizing collection of plastic would motivate people to collect more and more plastic products. While 6 students do not agree upon getting any payback as it is our work to clean our mother Earth, that much we should do for environment.

According to me, solution can be through making of laws to regulate the collection of plastics, encouraging people to take part in it, laws can help by implementing it, it should be made compulsory for every people to collect plastics in biodegradable bags and as every day garbage collector comes for taking garbage, every day or once in a week a separate plastics collector should come and collect the bags. Swachh Bharat Abhiyan is a greater step taken by the government to make country clean and divine and this small step when added will also contribute to our mission of gaining a beautiful clean India.

#### Graph 5

*Frequency of students, opinion about getting any payback after contributing plastics packed products to some organization collecting plastics for recycling, reusing.*



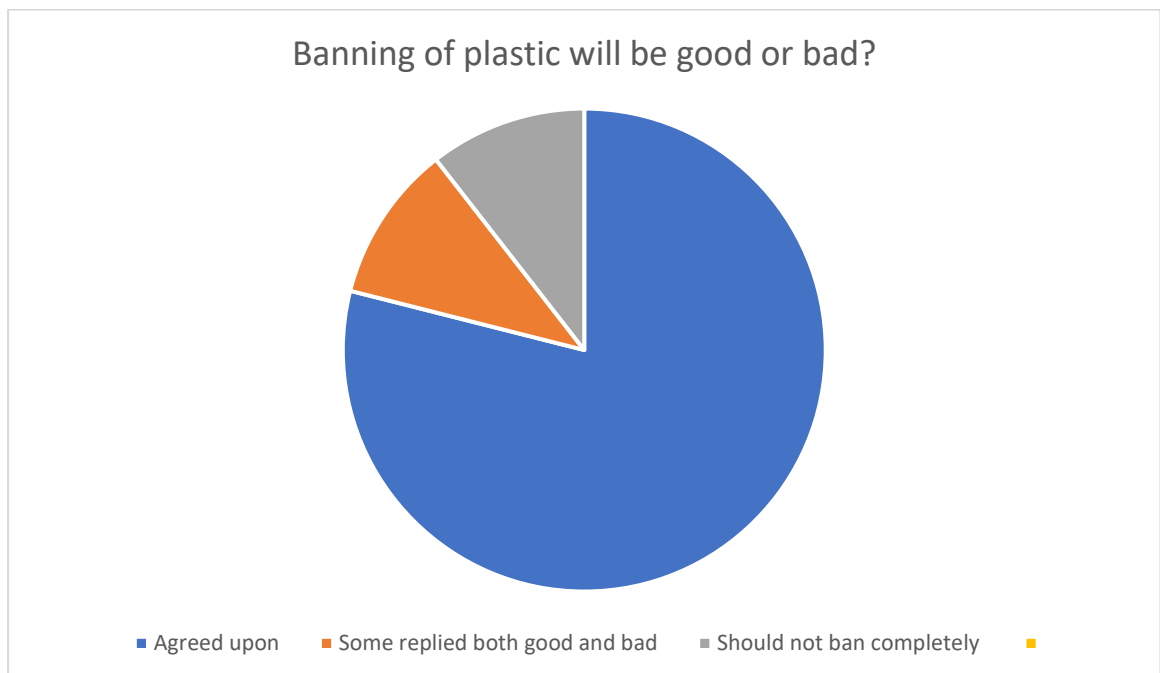
6. Ban of plastics will be good or bad? Give reasons.

22 students have response to this question and among them 15 students agreed upon banning of plastics as it is good to ban because plastic harm our environment, use plastic but like recycling and reusing type, can save many life's and protect our environment, to protect the nature before banning plastics we should find alternative to replace plastics, environment will be free, because it is polluting our environment, banning can help but other degradable alternatives should be produced in cheaper way, it would decrease the level of pollution in the environment also plastics are eaten by animals such as cows and goats which results in death of these animals. While 2 students replied that it will be good and bad both as in good sense it will contribute to environment and bad because most of local vendors and shopkeepers use it so they will have its disadvantage, that it creates environmental problems and good side used in medical equipment, according to 3 R principles dangerous side of plastics can be managed and control use of plastics, also 2 students replied that it should not be ban completely its use should be regulated, laws should be implemented on using plastic, it will be good but not complete ban.

This indicate that plastics cannot be banned completely as it serves its uses in many important fields, but due to regulation of its use, it can be managed and control in order to not let its disadvantages happen in the surrounding and plus an alternative way of packaging of products should be introduced.

Graph 6

*Frequency of students, opinion on banning of plastics would it be good or bad.*



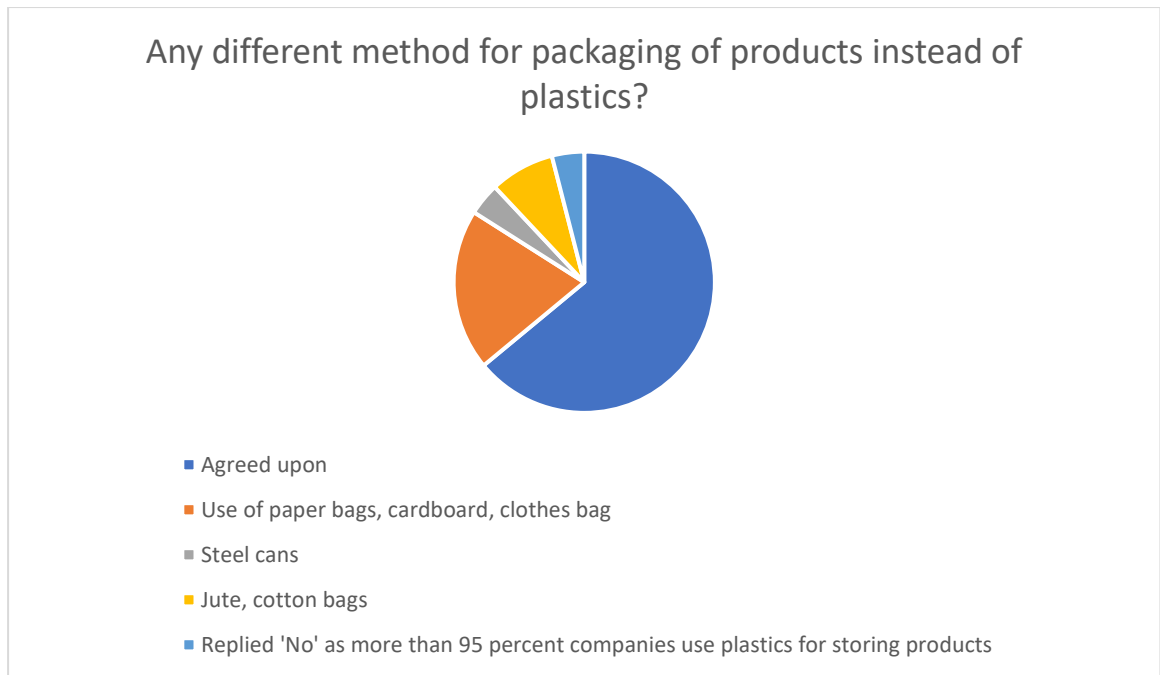
7. Should industries use any different method for packaging of products instead of plastics if yes then which method to be use?

20 students have response to this question and among them 16 students have agreed upon to have a different method for packaging of products as they can use paper bags, steel cans, that there are many products where plastics are used to store products but to minimize the use of plastics outer packing should be done with cardboard or paper or clothes bag, use of paper and clothes packets for storing anything, jute bags, cotton bags, foils, boxes, industries should use different packaging for plastic products they should print instructions on the packaging guiding consumers to recycle the products in a particular way. While 1 student replied 'no' as more than 95 percent companies use plastics for storing products.

With the growing use of plastics use, it will be difficult to introduced an alternative way of packaging of products but with recycling and reusing it can minimize the new production of plastics, industries should be encouraged to use recycled plastics for manufacturing instead of producing new ones. The solution can be brought up by collecting papers instead of throwing away and can be used for packaging such as in medicinal products, use of tin in storing of products such as food products, cosmetics, clothes which are not in used instead of throwing away can be reused by reshaping it in making clothes bag to carry things around instead of plastics bags, these implementation also requires collection of these things which again should be encouraged and made compulsory for people to follow. These initiatives taken can help solve major problems of the nature.

Graph 7

*Frequency of students, opinion whether industries should use any different method for packaging of products instead of plastics.*

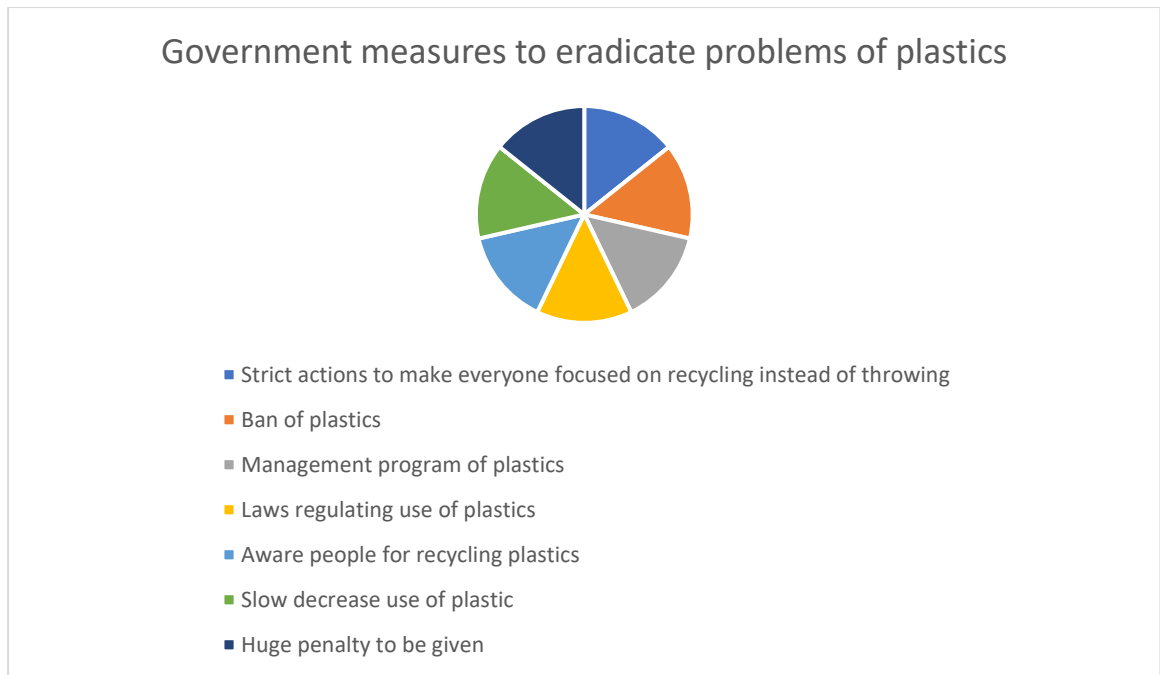


8. What government measures should be taken to eradicate the problems of plastics?

19 students have response to this question and all of them suggested some measures to be taken such as to take some strict actions to make everyone focused on recycling instead of throwing, to make it ban, management program of plastics must implicate to reduce risk of plastics and make environment clean and healthy, use of paper instead of plastic, reduce the plastics, use jute bags, government should implement some laws regulating the use of plastic, aware people for recycling plastics, reuse recycle, slow decrease the use of plastic, huge penalty should be given, legislation, local rules, check and balances system, banning plastic spontaneously will not help but decreasing its production and replacing it with other material things will help, firstly the government should ban the use of plastic, secondly, if we cannot ban the use of plastic the government make run initiatives to create awareness for recycling of plastics.

Graph 8

*Frequency of students, opinion about what government measures should be taken to eradicate the problems of plastics.*



### REVERSE SUPPLY CHAIN MANAGEMENT OF BROWN BOXES

With the growing of online platforms through which we can buy products online makes our work easy just by sitting in home and receiving necessary goods delivered in brown boxes but the problem which I noticed is that these brown boxes after we take our products gets thrown in garbage, most of us do this, and in my opinion these brown boxes instead of throwing away can be recycled and reused for packaging other products, for this government must make it compulsory for online shopping apps such as Flipkart, Amazon to introduced such policy to collect back these brown boxes from consumers and recycled and reuse it, as these boxes are not getting spoiled, instead of producing new boxes for packaging or either a collective boxes can be collected by the government authorities and brought up for recycling and reusing. These methods can help in using sustainable way of boxes and thus saving our nature from greater problems. These reverse supply chain management from consumers to back to industries can help reduce the exploitation of natural resources in the environment. With government actions and laws these can be made possible in every way.

### CONCLUSION

From the empirical survey of questions and answers it gets clear about the uses of plastic products, its disadvantages to the nature also about its management and control use of plastic can help reduce the problems of plastic waste around the country and later around the world. These innovative solutions for sustainable reverse supply chain management with the introduction of laws, regulations, government policies, schemes,

actions can play an important role in minimizing the exploitation of natural resources for production and with the recycling and reusing method there will be around a balance system surrounding the use of plastics and its ways of controlling it. The use of plastics cannot be banned suddenly but with less use of it in a managing way can help reduce its negative implementation. The act of collecting plastics products from people to recycling and giving them back to industries for reusing according to its needs creates a sustainable way of reusing used plastics packed products in a healthy and clean way. Reusing the use of brown boxes adds to the beauty of using things in a sustainable manner. Apart from these, collection of old clothes, papers and reusing it for packaging also introduces sustainably using of such things. In this way the art of collecting used materials from consumers can result in a very innovative roadmap for establishing sustainable reverse supply chain management and creating a sustainable cycle of used materials between consumers and industries.