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A Study to Provide an Insight to the Uses of Plastic Bags and Environmental Hazard, Keeping Kolkata (West Bengal) As the Sample Size

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Abstract: **The Government had notified the Plastic Waste Management Rules, 2016, in suppression of the earlier Plastic Waste (Management and Handling) Rules, 2011. The Minister of State for Environment, Forest and Climate Change, India, Shri Prakash Javadekar, amended that the minimum thickness of plastic carry bags has been increased from 40 microns to 50 microns. 15, 000 tonnes of plastic waste is generated every day, out of which 9, 000 tonnes is collected and processed, but 6, 000 tonnes of plastic waste is not being collected. An eco-friendly product, which is a complete substitute of the plastic in all uses, has not been found till date. In the absence of a suitable alternative, it is impractical and undesirable to impose a blanket ban on the use of plastic all over the country. The real challenge is to improve plastic waste management systems. The threat to environment and quality of life has been due to accumulation of plastic bags wastes. They are environmental unfriendly to its extreme level. The usage of plastic bags and further 'throw away culture' have resulted in finding their ways into the city drainage system, clogging the drains leading to sanitation problems, sewage problems which ultimately cause severe flash flood in the city. In this study an attempt will be made regarding the usage of plastic bags and environmental hazard with special reference to Kolkata. In this study descriptive method will be used and sample will be selected based on purposive sampling techniques.**

Keywords: **Plastic bags, environmental hazards, environmental awareness.**

1. BACKGROUND

In the 1960s, plastics were just becoming popular. Polyethylene, which today is one of the world's most ubiquitous plastics, had been created in 1898, and then again in 1933. But it wasn't until 1953 that anyone figured out how to make high-density polyethylene—the plastic that's identified in the recycling system as No. 2 and that's generally used to make the type of grocery store plastic bags that California just banned.In Sweden, a company called Celloplast—that had sold cellulose film—was working out ways to use and sell the stuff. In 1960, the company filed for a U.S. patent for "tubing for packaging purposes," designed by a team of three Celloplast employees. Their idea was that the tube of plastic, laid flat, could be sealed at regular intervals to create the bottom of a bag and left open at the top to insert whatever it was that needed to be packaged.

It was a good idea, but one of the team members, Gustaf Thulin Sten, apparently had a better one: Seal the bottom of the tube, but, on the other end, punch out part of plastic tube to create handles. In 1965 Celloplast obtained a U.S. patent for the idea that was later called "the T-shirt plastic bag," and it's the design, essentially, of every plastic bag you've ever been given in a grocery store check-out line.Mobil Chemical wanted in too. From the 1960s on, the company had pursued an aggressive policy on polyethylene packaging patents and by 1977 was producing its own bags. Plastic grocery bags were introduced in America in 1979; Kroger and Safeway had picked them up in 1982. But relatively few stores were using them.

In 1985, the Society of Plastic Engineers's Newark Section held its regional conference at the Holiday Inn in Somerset, New Jersey. The topic was "New materials and profits in grocery sacks and coextrusions." There, the author Vince Staten later wrote, a speaker pointed out to the assembled that plastic bags cost less than paper—one thousand plastic bags cost $24, while the same number of paper bags could set retailers back $30.By the end of 1985, 75 percent of supermarkets were offering plastic bags to their customers. Customers still preferred paper bags—plastic held just 25 percent of the market—but Mobil was working to change that.

Within the next decade, the plastic bag had captured 80 percent of the market.

2. INTRODUCTION

More than 15,000 tonnes of plastic waste are generated across India every day. An increasing fraction of this plastic waste is found in rural areas, as the reach of retail corporations and commercial organizations grows, and also as SMEs for plastic production increase in number. In spite of a paucity of reliable data on the volume and mix of plastic waste in rural areas, it is becoming increasingly clear that plastics are posing significant environmental and health challenges in rural communities. Plastics are disturbing local ecological balances and show up in water and land as micro-plastics. In their macro-form, they act as physical barriers, degrade soil quality, and get ingested by livestock and also other fauna, lead to blockages in drains and streams.

Plastic waste disposal methods in rural India are often basic and uninformed and further exacerbate the challenge. The open burning of plastics generates toxic emissions such as carbon monoxide, dioxins, and nitrides. Low-quality plastics, common in rural India, also leach out toxic additives. Plastics waste management has been looked at through the policy lens for at least two decades. Most policy measures have focused on segregation, collection, and in certain cases banning the use of certain categories of plastics altogether. However, most of this had traditionally been focused on urban India.

While some States and local bodies have made guidelines compliant with these rules, there are challenges with their acceptance and implementation. The lack of segregation of plastics waste, the absence of organized systems of collection and efficient aggregation, poor economic value in low-grade (thin) plastics, and the livelihoods associated with plastics production have been the key categories of challenges. This Plastics Waste Management Implementation Framework for Rural India is meant to provide actionable guidance to States & Districts in implementing a well-considered approach to managing plastics waste in their regions. The document is structured into six parts focusing on the profile of plastic waste in rural areas, existing policy landscape, technologies that can be adopted, and implementation frameworks for state mission directors for SBM and district collectors across the country.

Plastic bags pose a grave danger to the environment. The use of harmful chemicals in the production of plastic gives rise to environmental problems such as obstruction of drains, groundwater contamination etc. However, if plastic is recycled according to approved procedures and guidelines, then this hazard may not become a threat to environment and health. The problem with the use of plastic bags aggravates due to the shortcomings in the waste management system in the country.

At present, the production of plastic in the world is about 100 million tonnes per annum and it is growing at 4 per cent per annum. In India too, the production and use of plastic is growing rapidly. On an average, every Indian generates around half a kilo of plastic wastes every year. Much of it is scattered on and around the litter stack, which, in turn, spreads environmental pollution.

Used worldwide for packaging, plastic is a substance made from large molecules containing repeat units (called monomers). It is a substance that cannot dissolve in the soil easily and is unaffected by nature; if left in the soil, it can stop the recharging of geothermal water. In case of plastic bags, the repetitive units are ethylene. When ethylene molecules are ‘polymerized’ to make polyethylene, they form a longer chain of carbon molecules in which each carbon is composed of two atoms of hydrogen.

Plastic bags are composed of any of the three types of basic poly ethylene polymers – high density polyethylene (HDPE), low density polyethylene (LDPE) or linear low density polyethylene (LLDPE). Grocery bags are usually made of HDPE while dry cleaner bags are made of LDPE. The main difference between these substances depends on the extent of the main movement of the polymer chain. HDPE and LLDPE are made up of a linear indefinite series, while the LDPE series disintegrates.

There is a special unit of carbon and hydrogen in thick polyethylene. It is a chemical additive, which cannot be broken. This is why the thick polyethylene does not rot.

With its inception in 1957, the Indian plastics industry has also shown a significant growth and currently employs about 4 million people. It operates more than 30,000 processing units, of which 85 to 90 per cent are small and medium enterprises (SMEs). The utilization of plastics ranges from toys to aircrafts, from dolls to hosepipes, from soft drink bottles to refrigerators, from gramophone records to television sets. Packaging represents the single-largest sector of plastics use and accounts for 35 per cent of plastic consumption. Recently, the government notified the Plastic Waste (Management and Handling) Rules, 2011, to replace the earlier Recycled Plastics Manufacture and Usage Rules, 2003, towards better management of plastic waste. According to the new rules, the minimum thickness of plastic bags has been raised to 40 microns and recycled carry bags made from compostable plastics need to conform to specific Bureau of Indian Standards (BIS) norms. The new rules require the municipal authority to constructively engage with waste pickers, and agencies or groups working in waste management. The district magistrate has been made responsible for the enforcement of the rules, and a committee is responsible for control at manufacturing level.

3. DESCRIPTION OF THE STUDY

Kolkata, also known as **Calcutta** is the capital of the Indian state of West Bengal. Located on the east bank of the Hooghly River, it is the principal commercial, cultural, and educational centre of East India, while the Port of Kolkata is India's oldest operating port and its sole major riverine port. The city is widely regarded as the "cultural capital" of India, and is also nicknamed the "City of Joy". In 2011, the city had a population of 4.5 million, while the population of the city and its suburbs was 14.1 million, making it the third-most populous metropolitan area in India. Recent estimates of Kolkata Metropolitan Area's economy have ranged from $60 to $150 billion (GDP adjusted for purchasing power parity) making it third most-productive metropolitan area in India, after Mumbai and Delhi.

The Kolkata metropolitan area is spread over 1,886.67 km^2 (728.45 sq mi) and comprises 3 municipal corporations (including Kolkata Municipal Corporation), 39 local municipalities and 24 panchayat samitis, as of 2011.The urban agglomeration encompassed 72 cities and 527 towns and villages, as of 2006. Suburban areas in the Kolkata metropolitan area incorporate parts of the following districts:

North 24 Parganas,

South 24 Parganas,

Howrah,

Hooghly,

And Nadia.

Kolkata, which is under the jurisdiction of the Kolkata Municipal Corporation (KMC), has an area of 185 km^2 (71 sq mi).The east–west dimension of the city is comparatively narrow, stretching from the Hooghly River in the west to roughly the Eastern Metropolitan Bypass in the east—a span of 9–10 km (5.6–6.2 mi).The north–south distance is greater, and its axis is used to section the city into North, Central, and South Kolkata. East Kolkata is also a section.

In this study it has been delimited to Kolkata city and the four major axial coordinates' of Kolkata have been taken into consideration.

4. NEED AND SIGNIFICANCE OF STUDY

Plastic is an organic material manufactured from petroleum derivatives. It is composed of one organic substance or more. It can be shaped into any form or shape as desired. Manufacturing or burning of plastics cause emissions of toxic gases and release a toxic carcinogen called dioxin. The dioxin affects the function of the reproductive and immune system. It also causes hormonal disruption and growth problems. It has the ability to accumulate in the food chain and stay for long periods of time in the environment. It poses serious danger even when it is in small quantities. Plastic bags when dumped into rivers, streams and sea contaminate the water, soil, marine life as well as the air we breathe. When plastic bags are burned, they release a host of poisonous chemicals including dioxin into the air. Moreover, recycling of plastic is uneconomical, and polluting. It is associated with skin and respiratory problems resulting from exposure to and inhalation

of toxic fumes, especially hydrocarbons and residues released during the process. Also, recycling plastic bags merely puts them back into circulation in the market place and eventually the environment, thereby making no reduction. Plastic bags are known to clog drains and thus hit urban sewage systems. Choked and blocked drains provide excellent breeding grounds for mosquitoes, besides causing floods during the monsoon season. Due to indiscriminate dumping of plastic bags on land, toxic metals such as lead and cadmium pigments percolate into underground water. Garbage mixed with plastic bags interferes in waste processing facilities and causes problems in landfill operations. Since plastic bags do not undergo bacterial decomposition, land filling using plastic bags would mean preserving the poison forever. Buried in landfill sites, plastic takes hundreds of years to degrade.

Kolkata has been reeling under numerous environmental problems caused by various factors. Plastic/polythene bags have been consumed by the people in purchasing or selling things as well as in various other day to day activities. These has lead to disposal of such plastic bags in an unplanned way which result in problems like sewage problems, flash flood, pollutions, and various diseases. Keeping in view with these harmful effects of plastics bags, the present study has been conducted.

5. STATEMENT OF THE PROBLEM

A study to provide an insight to the Uses of plastic bags and environmental hazard, keeping Kolkata (West Bengal) as the sample size

6. OBJECTIVES

The present study has formulated the following objectives-

- To find out whether the people use plastic bags or polythene bags
- To study if the people are aware of harmful effects of plastic bags on environment
- To study if the people use any alternative to plastic bags

7. METHODOLOGY

A) Methodology

The present study is based on descriptive study method. Descriptive research deals with the relationship between variables, the testing of hypotheses and the development of generalizations, principles, or theories that have universal validity. They make an attempt to find out generalized attributes. The method of descriptive research is particularly appropriate in behavioral sciences because many of the types of behavior that interested the researcher cannot be arranged in a realistic setting. They are non-experimental because they deal with the relationships among non- manipulated variables.

B) Sample

Purposive sampling is a non probability sampling where the elements/units selected for the sample are chosen by the judgment of the researcher or investigator. Purposive sampling technique is used to select the sample for this study. However, due to limited time frame, the sample has been restricted to 300 household 50 from each coordinative division of Kolkata city which is purposely selected.

C) Tools

A self-structured interview schedule has been used to collect the necessary information regarding usages of plastic bags and environmental hazard associated with it.

8. ANALYSIS AND INTERPRETATION

The data collected for the study has analyzed statistically using simple percentage and graphical diagrams has been used for better presentation of the scenario. The present study has the following findings regarding uses of plastic bags by the people of Kolkata. The investigator also tried to highlight environmental hazards faced by the people in Kolkata city:

a) It has been found that 258 persons out of 300 have responded that they use plastic bag in their day to day life. This shows that 86% of people use it while only 14% have responded that they don't use it or try to avoid using it

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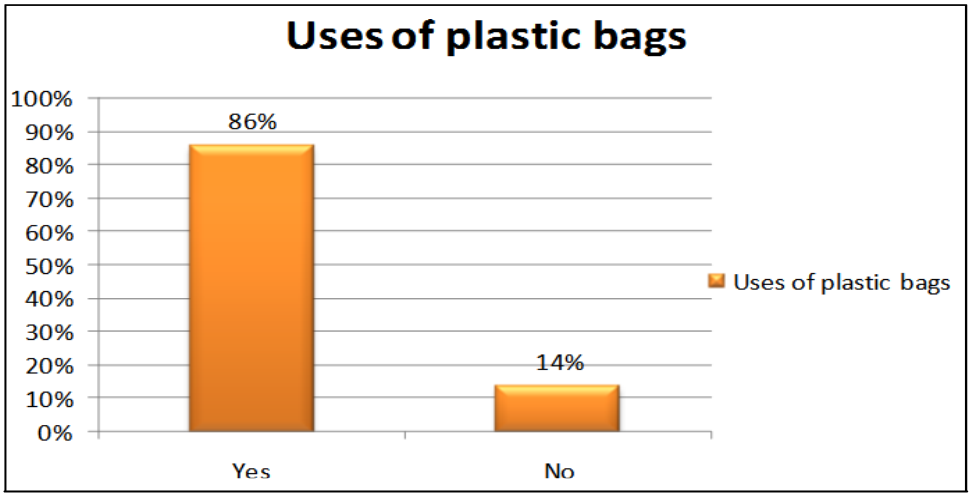
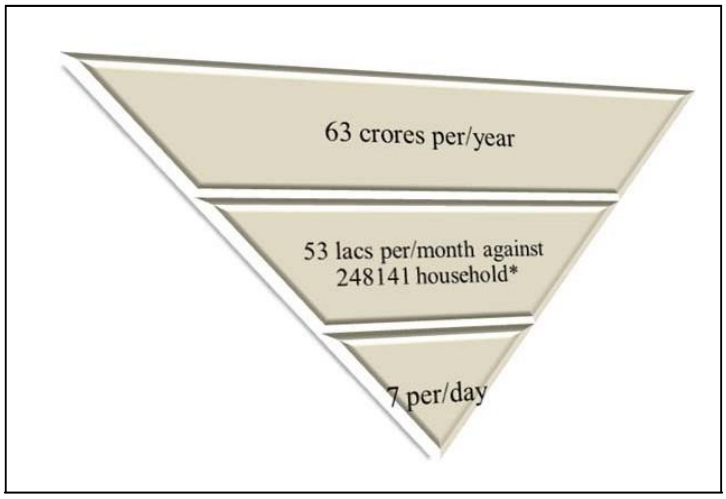
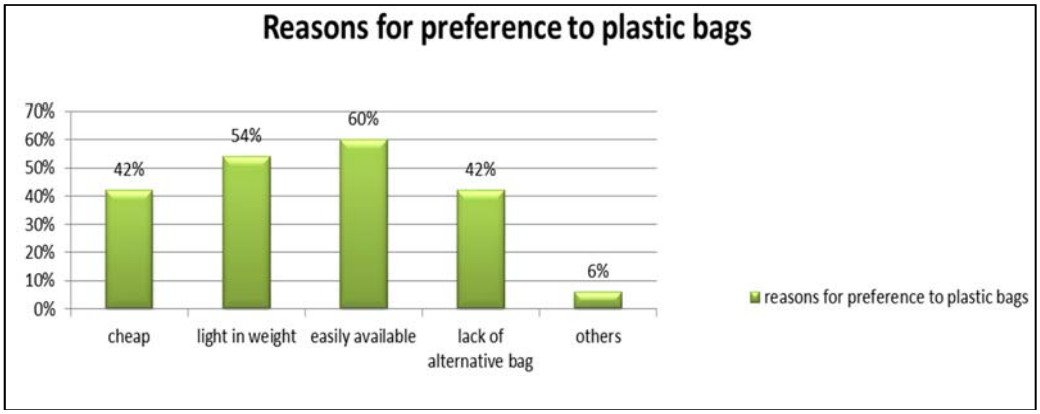


b) In spite of it the average no of plastic bags uses in every household is 7, which sum up to 1,736,987 per/day number of bags against 248141 household (including both residential and non residential purposes) according to census report of 2011.

c) The amount of plastic bags for a year has increase to 63 crores i.e., 34 lacs kg (5 gram per one plastic bag). It has increased from 1.8 crores kg per year in 2004 to 5.4 crores kg per year in 2014. But in 2016 only 57lacs kg/year are used by the people of Kolkata which comprises only plastic grocery bags. Even the numbers of respondent using 40 micron plastic bags are only 19% in comparison to 88% not using it.



d) It has been found that 60% uses it for being easily available while 54% as it is light in weight and durability. This is diagrammatically shown as follows:



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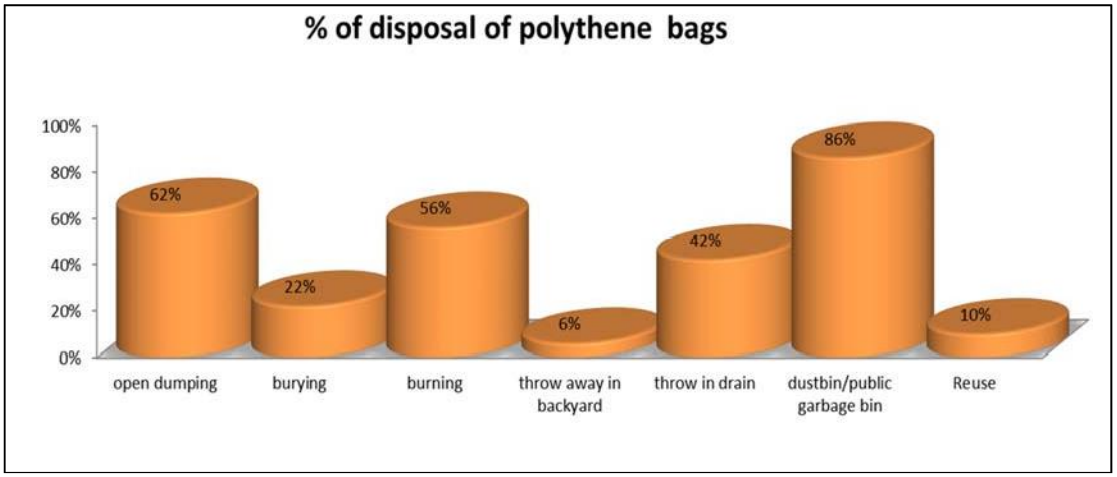
e) The purpose behind the use of plastic bags is shown below:

f) The survey has shown that though people claim to be educated still their techniques of disposing polythene bags are not satisfactory. The table below shows that

Techniques of disposal of polythene bags	%
Open dumping	62%
Burying	22%
Burning	56%
Throw away in the backyard	6%
Throw in drain	42%
Dustbin/public garbage bin	86%
Reuse	10%



g) People in Kolkata city though they are using plastic bags in their daily life they still confronted that they are harmful for the environment.100% responses shows that the people are aware of the fact that they cause problems to both man and environment The table showing the problems as specified by the respondents:

Problems	Percentage
Land/soil pollution	40%
Air pollution	34%
Sewage problems	37%
Artificial flood	92%
Water pollution	46%
Others	10%

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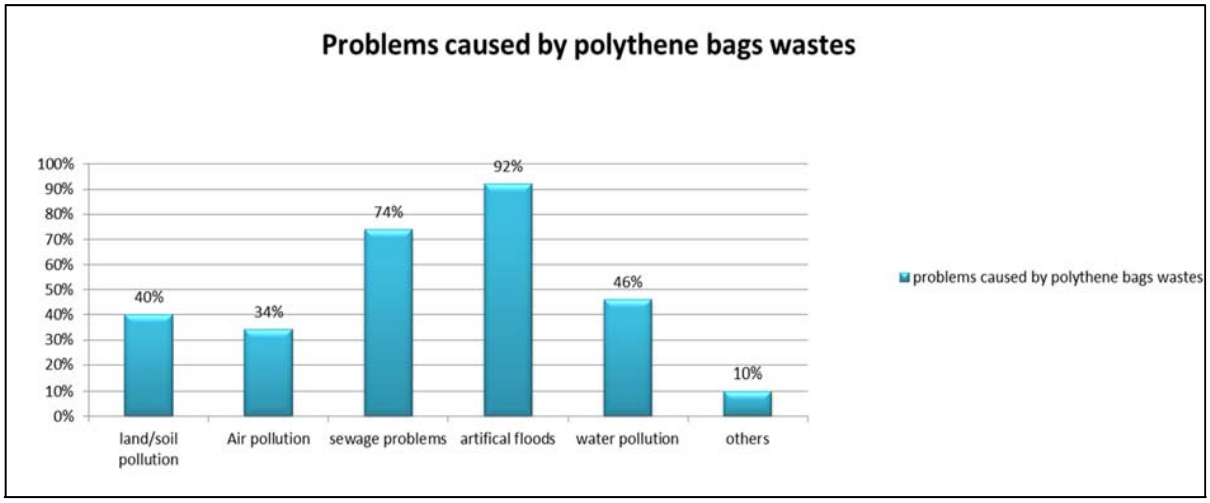

h) The survey also shows that some of the conscious citizen of Kolkata uses other alternative to plastic bags. But the percentage that supports this fact is not satisfactory with only 38% uses such alternative while 62% are least bother. In this survey people have also highlighted another aspect of using plastic bags as the alternatives to plastic bags or other bio-degradable are quite expensive in comparison to polythene bags.

Responses	% of responses
Uses alternative to plastic bags	38%
Does not uses any alternative to plastic bags	62%

9. CASE STUDIES

Case 1

A joint family of 10 members resides in Kolkata. The family usually does monthly shopping of grocery and weekly for their fruits and vegetables. They carry jute and other alternative bags for shopping in the market. However they do use plastic bag (often less than 40 microns) while buying bread, milk and sometimes fruits from the market. On weekly basis 35 plastic bags (on average) are used by the family. In fact they throw their garbage both organic and inorganic in plastic bag which is again less than 40 mircons. On the average the family uses 4 plastic bags daily to throw their garbage in a day that make 28 bags/ week and 1,460 bags/year. This is the case of one family residing in the city Kolkata.

Case 2

Another nuclear family residing in Kolkata with only 4 members has minimized the used of plastic bag by regular use of jute and other bio-degradable bags. In fact they throw their garbage separately (organic and inorganic) in garbage bag which is eco-friendly in nature. In spite of this they have to use plastic bag while purchasing certain fruits and vegetables which make 4/week i.e., around 200/year.

Case 3

In another case, a family of one mother and two children in spite of the knowledge regarding harmful effect of plastic still continues to use plastic bag in their daily life. From shopping in daily basis to grocery and disposing of garbage the family use plastic bag for all purpose. In daily basis, the family uses 7 plastic bags/ day which make up to 49 bags / week. In fact the family disposes the garbage in the cheap quality polythene bags which is not bio degradable in nature.

10. FINDINGS

- It has been found that people in Kolkata city use plastic bag in their day to day life. In fact it is regularly used with an average of 15 polythene bags a day. The study conducted by an NGO in the year 2014 had found that the amount of plastic waste generated in the state had increased from 1.8 crores kg per year in 2004 to 7.4 crores kg per year in 2014.but only plastic grocery bags used and disposed in 2016 found to be 34 lac kg(excluding plastic bottle, plastic

sheets etc)

- Plastic bags are prefer to and used in every household in Kolkata basically for being easily available and convenience. Even the light in weight is also the cause behind its uses. Another interesting fact is that the elite sections of Kolkata are aware of its harmful effects and have reduced its uses and replace it with eco- friendly bags.
- From the study it has been observed that it is highly used for throwing garbage and shopping purpose. Some of the respondents have confessed that though they are aware of harmful effect of polythene bags still they used it. Some of them also claim that the vegetables or fruit vendors often give the things in plastic bags. The people have said that they don't use it for storing food materials
- From this study it can be concluded that people are still under the grip of using plastic bags. Even they can correlate the cause behind the throwing garbage in plastic bags and pollution (land and water) and sewage problems**.** It has been seen that people have specify artificial flood as the main effect of polythene wastes followed by sewage problems, water pollution, land and air pollution. Lightweight plastic grocery bags are additionally harmful due to their tendency to be carried away on a breeze and become attached to tree branches, fill roadside ditches or end up in public drains, rivulet and river
- The case study of three families reveals an interesting fact that in spite of awareness regarding harmful effect of plastic people do use it. Case study 1 reveals that the family uses 35 plastic bags per week for various purposes and for disposing garbage the family uses 28 plastic bag /week. Although the family also use of jute and bio-degradable bags.
- In another case it shows that the small nuclear family uses 4 plastic bags /week. They stress on the use on bio-degradable bags like jute bag or cloth bags. In fact the family disposes the organic and inorganic garbage separately. However another nuclear family with only 3 members use 7 polythene bags per day on average (i.e.,49 bags per week) and use the polythene bags to dispose the garbage. They in fact do not dispose the garbage separately.
- This shows that where joint family use a maximum number 63 plastic bags (shopping and garbage disposal purpose) per week, a small family uses 49 plastic bags per week. This reveals usage of 4-5 bags on average by the 10 family member of joint family while the small family uses 15-16 bags by only 3 family members. Thus from this we can justify that the size of the family do not matter regarding use of plastic bags.
- Plastic especially that used in plastic bags is one of the major toxic pollutants of our times. Being composed of toxic chemicals and most importantly, being a non- biodegradable substance, plastic pollutes the air, water and soil. The noxious substances emitted from plastic bags seriously impairing the fragile ecosystem, these chemicals can cause an array of maladies ranging from birth defects, cancer, and nerve and immune disorders, to blood and kidney ailments.
- City officials blamed the destructive floods on plastic bags which clogged gutters and drains, preventing the rainwater from leaving the city through underground systems. By clogging sewer pipes, plastic grocery bags also create stagnant water; stagnant water produces the ideal habitat for mosquitoes and other parasites which have the potential to spread a large number of diseases, such as encephalitis and dengue fever, but most notably malaria.
- It has also been found that old and unwanted plastic bags are not always easy to dispose of. Plastic bags defy any kind of attempt at disposal, be it through recycling, burning or land filling. Plastic bags decompose very slowly, if at all. In fact, a bag can last up to 1000 years, inhibiting the breakdown of biodegradable materials around or in it
- A slow but encouraging trend has been seen that the people are opting for the eco-friendly and reusable bags like cloth bags, fiber or jute bags etc. The following are some of the feasible alternatives like Reusable bags and Biodegradable plastics**.** This is an alternative which can be reused many times for shopping. These come in canvas, woven plastic fiber, hemp, cotton and even leather.

11. SUGGESTIONS

- The first and the best option for reducing plastic waste is to minimize single use plastics in your daily life.
- It is essential to reuse old plastic bags for multiple shopping trips. Even people should make habit to refuse a bag for

things that you can easily carry.

- People should try to reduce the use of plastic bags by using reusable bags or eco-friendly bags. Use cotton, canvas and jute shopping bags as substitutes for shopping or any other purpose. In fact brown paper bags can be use to buy things such as rice, pulses, bread etc.
- Administration must make strict rules to get rid of these plastic bags. Government should make shops charge heavily for every plastic bag given out and collect it from them as addition tax on plastic. Furthermore the tax collected from these can be used to make bio- degradable bags.
- Educating the people regarding harmful effect of plastic in its any form is the best way to overcome the menace. Further creating awareness as how these harmful bags are deteriorating the environment and reducing the life shelf of the planet.

12. CONCLUSIONS

Plastic grocery bags have been a part of daily life. Unfortunately, the most common final resting place for garbage bags is the garbage bin, resulting in countless numbers of bags filling land and spilling over every other surface of the planet. In Kolkata the people are aware of its harmful effect to both health and environment but are still using it. The reason behind it is multi furious-the authority concerned has not been successful in imposing the ban, availability of lower grade plastic bags, and also in availability of eco-friendly bags. It is high time to think about our planet Earth for our survival. Plastic bags are creating various problems like sewage problems, flash flood, air and land pollution in Kolkata and in times to come these problems will become unmanageable if necessary measure are not taken. Thus the question of plastic bags ultimately comes down to the issue of use. If people are willing and able to use environmentally-friendly alternatives, such as reusable cloth or plastic bags, the use of plastic bags will reduce which will be way to safe and green environment.

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REFERENCES

[1] Goldberg, E.D. (1997) Plasticizing the seafloor: an overview. Environmental Technology 18:195-202.

[2] Gregory, M.R. (1996) Plastic ‘scrubbers’ in hand cleansers: a further (and minor) source for marine pollution identified. Marine Pollution Bulletin 32:867-871

[3] Gregory, M.R. (2009) Environmental implications of plastic debris in marine settings – entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. Philosophical Transactions of the Royal Society B. 364:2013-2025

[4] Henderson, J.R. (2001) A pre and post-MARPOL Annex V summary of Hawaiian Monk Seal entanglements and marine debris accumulation in the northwestern Hawaiian Islands, 1982-1998. Marine Pollution Bulletin. 42:584-589.

[5] Sayan Basak. “Plastics- a kind request to you “Do not throw me out. Please.”.” IOSR Journal Of Humanities And Social Science (IOSR-JHSS) , vol. 22, no. 9, 2017, pp. 35–37

[6] MacFadyen, G., Huntingdon, T. & Cappell, R. (2009) Abandoned, lost or otherwise discarded fishing gear. UNEP Rome. Maggs, J, Hougee, M & Balk, V. (2010)

[7] No place for waste. Let’s end ship waste dumping at sea. Brochure by Seas at Risk and the North Sea Foundation. Mattlin, R.H. and Cawthorn, M.W. (1986)

[8] Marine debris – an international problem. New Zealand Environment 51:3-6. Melzer, D, Rice, N.E., Lewis, C. et al. (2010)

[9] Association of urinary bisphenol a concentration with heart disease: evidence from NHANES 2003/06. PLoS One 13: 5(1).

[10] Rios, L.M., Jones, P.R., Moore, C. & Narayan, U.V. (2010) Quantification of persistent organic pollutants adsorbed on plastic debris from the Northern Pacific Gyre's "eastern garbage patch" Journal of Environmental Monitoring 12:2226-2236.

[11] Ryan, P.G. (1988) Intraspecific variation in plastic ingestion by seabirds and the flux of plastic through seabird populations. Condor 90: 446-452.

[12] Ryan, P.G. (2008) Seabirds indicate changes in the composition of plastic litter in the Atlantic and south-western Indian Oceans Marine Pollution Bulletin 56:1406-1409.

[13] Ryan, P.G., Moore, C.J., van Franeker, J.A. & Moloney, C.L. (2009) Monitoring the abundance of plastic debris in the marine environment. Philosophical Transactions of the Royal Society B. 364:1999-2012

[14] Sancho G., Puente E., Bilbao A. et al. (2003) Catch rates of monkfish (Lophius spp.) by lost tangle nets in the Cantabrian Sea (northern Spain) Fisheries Research 64:129-139.

[15] Talness, C.E., Andrade, A.J., Kuriyama, S.N. et al. (2009) Components of plastic: experimental studies in animals and relevance for human health. Philosophical Transactions of the Royal Society B 364:2079-2096.

[16] Teuten, E.L., Rowland, S.J., Galloway, T.S. & Thompson, R.C. (2007) Potential for Plastics to Transport Hydrophobic Contaminants. Environmental Science & Technology 41:7759-7764.

[17] Teuten, E.L., Saquing, J.M., Knappe, D.R.U et al. (2009) Transport and release of chemicals from plastics to the environment and to wildlife Philosophical Transactions of the Royal Society B 364:2027-2045.

[18] Ten Brink, P., Lutchman, I., Bassi. S. et al. (2009) Guidelines on the Use of Market-based instruments to Address the Problem of Marine Litter. Institute for European Environmental Policy (IEEP), Brussels, Belgium & Sheavly Consultants, Virginia Beach, Virginia, USA. Thompson, R.C., Olsen, Y., Mitchell, R.P. et al. (2004)

[19] Lost at Sea: Where is all the plastic? Science 7: 838. Thompson, R.C., Swan, S.H., Moore, C.J. & vom Saal, F.S. (2009) Our plastic age. Philosophical Transactions of the Royal Society B 364:1973-1976. Tomás, J., Guitart, R., Mateo, R., & Raga, J.A., (2002)

[20] Marine debris ingestion in loggerhead sea turtles, Caretta caretta, from the Western Mediterranean. Marine Pollution Bulletin 44, 211–216.