



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.935

Volume 15, Issue 10, October 2026

Beyond Green Appearances: Rethinking Plastic and Paper Bags in India

A Comparative Environmental Assessment from a Life-Cycle and Waste-Management Perspective

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ABSTRACT: The use of plastic shopping bags began in the late 1960s gradually becoming popular in 1970s and 1980s followed by their predominant usage in 1990s. Although very handy and easy to use, their burgeoning usage led to serious environmental concerns associated with littering, improper collection, disposal and recycling. In response to these concerns India has progressively introduced strict regulations for single use plastic bags. Paper and cloth bags are usually seen as the green alternatives of plastic carry bags. However, the assumption that paper bags are a superior and green alternative may not be valid when their complete life cycle assessment and waste management is studied particularly in the Indian context.

The present paper examines the environmental implications of plastic and paper bags after a detailed literature review, study of environmental reports, policy documents and life cycle assessment studies. The comparative study takes into account raw material consumption, energy and water requirements, greenhouse gas emissions, waste generation, collection, reuse, disposal and its recyclability in light of the Indian waste management scenario. The reviewed evidences indicate that paper bags although environmental friendly cannot be considered as environmentally superior just because they are biodegradable. The adverse environmental impact caused during the production of paper bag is far greater than that caused by plastic bags however the litter, collection and disposal related issues of plastic bags remain a serious concern.

The study concludes that the most sustainable approach is not a blanket ban on plastic bags but a hierarchy based on responsible collection, disposal, reuse and recycling of plastic bags. This will not only prevent the cutting of trees for the manufacture of paper bags but also prevent other environmental hazards caused during the manufacture and processing of these paper bags.

KEYWORDS: Plastic bags, paper bags, plastic waste management, single-use plastic, life-cycle assessment, recycling, reuse, sustainability, environmental impact, myth and fact.

I. INTRODUCTION

Rapid urbanization, population growth, changing lifestyles and the use of packaged items owing to its ease in handling and transport has increased the demand of plastic packing and carry materials leading to a substantial increase of plastic material in municipal solid waste particularly in India.

The Indian literature reviewed for this study identifies low public awareness leading to littering of plastic waste, inadequate collection, segregation, reuse and recycling facilities as the major contributors to environmental degradation by plastic carry bags and other packaging material. Moreover the complete replacement of plastics with alternatives like paper bags without considering life cycle assessment may increase carbon and water footprints.

To address plastic related pollution India has adopted a regulatory approach and has prohibited the use of single use plastic carry bags. But the question arises whether 'Is paper actually greener than plastic'. Environment sustainability cannot be measured in terms of biodegradability alone but the parameter of environment sustainability should consider the overall environmental impact based on the entire life cycle which includes extraction of raw materials, production, transportation, reuse and recycling.

Objectives of the Study and Methodology

The primary **objectives** of the study are to analyse the complete life cycle of paper bags and plastic bags and analyze the overall impact caused by either on the environment.

II. METHODOLOGY

The present study is based on secondary data collected from various government publications, research papers, industry reports, literature examining myths and misconceptions surrounding plastic bags, Indian literature on plastic pollution and waste management, and other credible sources.

After collecting data from these sources the two types of bags were compared with respect to raw material requirement, energy and water requirements during manufacturing process, greenhouse gas emissions, transportation, waste generation, reusability, recyclability, litter potential, decomposition rate, impact of land, soil, water bodies and wild life and end-of-life conditions.

Findings : Myth vs Facts**Myth 1: Paper Bags Are Always Better Than Plastic Bags**

Fact: Paper bags have environmental advantages, but they also have significant environmental costs. They are biodegradable but when the complete life cycle assessment of paper bags is done then research and literature suggests that paper bag production requires twice the energy and five times the water required for plastic bag production. A 2020 study in the Journal of Cleaner Production found that the energy gap could be even four times or more. Considering all these facts biodegradability alone cannot be the criteria to determine environmental superiority of paper bags.

Myth 2: Plastic Bags Are the Main Cause of India's Pollution

Fact: It is true that plastic waste is a major contributor to India's solid waste but plastic bags are only one minor component of the total plastic waste generated. Plastic waste although an important contributor to India waste problem cannot be considered solely responsible for the environmental hazards, other majors contributors being ewaste, industrial solid waste, biomedical waste, construction and demolition waste ,etc. Literature review suggests that poor collection, segregation and limited recycling facilities are the major reasons behind pollution caused by plastic bags.

Myth 3: Plastic Bags Cannot Be Recycled

Fact: Plastic bags are technically recyclable, but recycling thin plastic film is challenging. Plastic bags can be recycled and can be reused for making plastic roads or can be used to make plastic pellets that can be burnt as fuel .However the major problem is the lack of public awareness leading to the littering of plastic carry bags. Since these carry bags are very thin film bags hence the ragpickers generally do not collect them and hence they find their way into the water bodies and soil instead of being recycled.

Myth 4: Paper Bags Have No Environmental Impact Because They Biodegrade

Fact: It is very true that paper bags are biodegradable but the total climatic impact of paper bag if used once is greater than plastic bag. Other adverse impact of paper bag arises from the fact that they are almost seven times heavier than plastic bags which means that more energy is required for their transportation. Researches show that the global warming potential of paper bags competes with plastic bags only if it is used three to four times which is generally not the case. Generally paper bags are also thrown away after single use causing greater environmental damage as compared to plastic bag. A paper bag is also manufactured, transported and distributed before reaching its disposal stage. As discussed earlier the water and energy required for making causes greater environmental damage, moreover manufacture of paper bags requires felling of trees. Moreover current research shows that in modern landfills, paper does not degrade or break down at a substantially faster rate than plastic does. Due to the lack of water, light, oxygen, and other important elements necessary for the degradation process to occur, nothing completely degrades in modern landfills.

Myth 5: Replacing Plastic Bags with Paper Bags Will Solve India's Plastic Problem

Fact: It is a big myth that replacing plastic bags with paperbags will solve India's environmental problem. The challenge associated with plastic bags has more to do with the poor collection and recycling of paper bags rather than

with the material used for the manufacture of these bags. If plastic bags are replaced by paper bag without considering the complete life cycle assessment of the two, it will only shift the burden from one end to the other.

Myth 6: Biodegradable Plastic Bags Are Automatically the Best Solution

Fact: It is true that biodegradable plastic bags solve a part of the problem but the biodegradable plastics require specific processing conditions. If these conditions are not available then the purpose for which these bags are made may not be met.

Table given below shows the environmental impact of plastic bags vs paper bags

Indicator of Environmental Impact	Light weight plastic bag	Paper bag
Consumption of renewable primary energy	1.0	1.1
Consumption of water	1.0	4.0
Climate Change (Emission of greenhouse gases)	1.0	3.3
Acid rain(atmospheric acidification)	1.0	1.9
Air Quality(ground level ozone formation)	1.0	1.3
Eutrophication of Water bodies	1.0	14.0
Solid Waste Production	1.0	2.7
Risk of Litter	1.0	0.2

Source: Research and library science , Northern Ireland Assembly ,Kirsty Bell and Suzie Cave , pg 36/11,February 23,2011

Indian Regulatory Perspective

India has progressively strengthened its regulatory framework for plastic waste. The Plastic Waste Management (Amendment) Rules, 2021 increased the minimum thickness requirement for plastic carry bags, and identified single-use plastic items were prohibited from 1 July 2022. The policy direction therefore combines restrictions on selected products with measures intended to improve plastic-waste management and promote responsible consumption.

Paper Bags and the Indian Resource Question

Paper bags are generally perceived as an environmental friendly substitute of plastic bags. But the overall study proves that if plastic bags can be collected and recycled then comparing the complete life cycle of plastic and paper bags the former appears to be a better option.

III. RESULTS AND DISCUSSION

Although there is a wide acceptability of the fact that paper bags are environmentally greener as compared to plastic bags but the evidence does not support conventional wisdom that paper bags are a more environmentally sustainable alternative than plastic bags . The relevant facts reveal that

1. The greenhouse gas emissions of plastic bags is 39% less compared to that of uncomposted paper bags and 68% less as compared to composted paper bags.
2. The CO₂ equivalents generated per 100 million plastic bags is 3,096 tons whereas CO₂ equivalents generated per 100 million paper uncomposted and composted paper bags is 7,621 tons and 14,558 tons respectively.
3. Water consumption for manufacture of plastic bags is nearly 6% less compared to paper bags. Production of 1000 plastic and paper bags requires 39 gallons and 1004 gallons of water respectively.
4. Energy required for manufacture of plastic grocery bags is 71% as compared to that of paper bags.
5. Paper bags generate five times more solid waste as compared to plastic bags
6. Although paper bags contribute less to littering but compared to single use plastic bags they have a much higher impact on climate, eutrophication and acidification. paper bags can be good for the environment only if they are used multiple times and the waste bags are incinerated rather than being disposed off into the landfills.

7. Biodegradable plastic bags although contribute less to littering but have adverse environmental impacts due to eutrophication, acidification and toxic emissions. These bags degrade into small fragments and the problem of microplastics aggravates in the environment.

Considering the above facts

1. Paper bags cannot be considered environmentally superior only on the basis of their biodegradability.
2. Considering the complete life cycle, paper bags have low environmental impact only when they are used three to four times.
3. Papers have adverse environmental impact because their production requires more water and energy. Their production also requires felling of trees.
4. Light plastic bags have lower impact because of low material requirement.
5. Plastic bags have serious environmental disadvantage owing to littering, poor collection, recycling and reuse.

IV. CONCLUSION

The review of literature and other available sources clearly points to the fact that labeling 'plastic' as harmful and paper as 'environmental friendly' is an oversimplification.

Plastic bags undoubtedly cause serious environmental challenge owing to the fact that light weight plastic bags escape the waste collection hierarchy and end in streets, water bodies, drains and even in the food pipe of animals. At the same time a blanket ban on plastic bags will shift the load to paper bags and the detailed life cycle assessment of paper bags concludes that although biodegradable their overall adverse impact owing to the energy, water requirements during production, raw material requirement, emission of greenhouse gases during degradation outweighs the advantages of paper bags over plastic bags.

The reviewed studies demonstrate that lightweight plastic bags may perform better in several conventional LCA indicators. The Indian solution therefore should not be a simple 'plastic versus paper' choice. A more appropriate hierarchy is:

AVOID → REDUCE → REUSE → RECYCLE/RECOVER → RESPONSIBLY DISPOSE

Awareness creation among consumers can help in the reuse and collection of plastic waste enabling it to make its way to the recycling channels. It can be concluded that reducing environmental impacts of bags is not just about choosing, banning, recommending or prescribing specific materials or bags, but also about changing consumer behaviour to increase the reuse rate and to avoid littering. The shopping bag that has the least impact on the environment is the bag the consumer already has at home.

Banning single-use plastic bags while favouring other single-use alternatives results in environmental trade-offs. For example, single-use paper bags have less impact of littering, compared to single use plastic bags, but often have higher impact on most other environmental categories (Climate Change, Acidification, Eutrophication, Ozone Depletion, Land use change). When defining policies on bags, these trade-offs should be evaluated in the specific geographical context.

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