



Combating Plastic Pollution Through Eco-Friendly Agricultural Packaging

A.R. Shravanthi¹, Jyotsnarani Pradhan^{2*}

¹Assistant Professor, School of Agribusiness and Rural Management, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125, India

²Assistant Professor, Department of Botany, Plant Physiology and Biochemistry, College of Basic Sciences and Humanities, Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125, India

*Corresponding author email ID: jyotsna.pradhan@rpcau.ac.in

ABSTRACT

Extensive application of plastics in the packaging, storage, handling, and transport of agricultural products has become a serious environmental problem. The negative impact of conventional plastics on the quality of the soil, sources of water, growth of plants, and ecological well-being of the environment occurs because of their long lifespan and gradual fragmentation into micro-plastics. In such conditions, the use of eco-sustainable packaging materials for agricultural products is a viable way to replace conventional plastic packaging. Materials that are biodegradable and renewable can be used to create environment friendly packaging, and these materials include cornstarch, sugarcane bagasse, bamboo, banana leaves, coconut, mycelium, millet, and other agricultural residues. There are also innovative approaches to create packaging materials based on dry leaves, rice bran, and other agricultural residues. However, there are some barriers for the wide distribution of alternative packaging materials due to their relatively high price, insufficient infrastructure for composting and waste management, inconsistency of the materials, and lack of information among producers and consumers. It means that the transition to sustainable agricultural packaging requires additional research, development, policies, education of farmers and other stakeholders, creation of the proper infrastructure for composting, and effective technology development. Such an approach can not only decrease dependence on plastics but promote circularity and adding value to the agricultural residues.

Keywords: Agricultural Packaging, Sustainable Packaging, Plastic Pollution, Biodegradable Packaging, Agricultural Waste, Circular Economy

Submitted: 19-08-2026

Accepted: 23-08-2026

Online: 01-09-2026

1. INTRODUCTION

Escalation of plastic pollution, particularly in agriculture, a sector that supports millions of livelihoods in India has become a pressing in recent times. In contemporary agriculture, plastics have become essential as they are everywhere starting from

seed packing to the bulk transportation of products, because of their cost-effectiveness and durability.

However, this affordability and durability come at a steep environmental cost. India alone generates approximately 26,000 tonnes of plastic waste every day (Majumdar, 2026). About 60% of this is contributed to by packaging, as highlighted by recent

studies by India's Central Pollution Control Board. Bihar's agriculture sector is abundant in agricultural production with rich crop diversity, which contributes significantly to this cause. Plastics disposed of in agriculture do not biodegrade, and the microplastics seep into the soil as time passes, affecting crop health and invading the human food chain.

2. SUSTAINABLE PACKAGING: A STEP TOWARDS ENVIRONMENTAL RESTORATION

The impact of plastic overload is profound in agriculture as seepage of plastic debris in agriculture lands hamper, soil structure, water retention and plant growth. The tiny fragments formed from the breakdown of larger plastic items known as microplastics are now increasingly found in soil and water, which is alarming and contradictory to sustainable farming. Several farmers burn agricultural plastics due to a lack of proper waste management infrastructure. This burning of plastic waste in farm lands can release harmful toxins into the air, causing respiratory problems in rural areas.

New developments that indicate a shift to environmentally friendly agricultural packaging methods give new hope to these problems. Biodegradable packaging from natural materials such as cornstarch, sugarcane bagasse, bamboo, banana leaf, coconuts, etc., is gaining national and global traction. These packaging materials decompose naturally by avoiding the accumulation of waste for a long duration. According to a recent market analysis, India's biodegradable packaging sector might grow at an annual rate of 7.5%, reaching USD 5.4 billion by 2032. Government regulations such as ban on single-use plastics and increasing outreach programme creating awareness among people have led to this shift.

An innovative development in packaging material made from mycelium (root structures of mushrooms) is biodegradable and compostable, which offers a sustainable alternative to plastic foam packaging widely used in agriculture and transportation. Research organizations and companies are also probing to find ways to transform agricultural waste into packaging material to create a circular economy that reduces agricultural and plastic Residue. Bengaluru-based Solutions is one such company which has pioneered technologies for producing eco-friendly packaging materials from crop residues.



Figure 1. Zero waste food shopping

Millet-based packaging material such as edible cups and plates prepared from Kodo-millet is gaining popularity in some regions of India. This edible packaging material can be used for packaging and, interestingly, is also edible. Such innovative packaging material, though in nascent stages, address waste reduction and consumer engagement, offering environmental and cultural benefits.

A Patna-based startup, Milkvilla Private Limited has revolutionized dairy delivery by using booth-enabled dispensers to eliminate milk packaging in plastic. Milkvilla has also incorporated biodegradable packaging material, such as banana leaves to wrap paneer and coconut shells to pack butter. Within the context of contributing to sustainability, this strategy encourages the use of local sources of supply and community involvement.

India commendably implemented policies such as ban of single-use plastics, Eco mark certification to promote environmentally friendly products and manufacturing practices. Challenges, such as expensive biodegradable packaging material over conventional plastics deterring its widespread usage and limited facilities for composting and recycling these materials exist.

A comprehensive solution is needed to overcome the above-stated problems. Government subsidies and incentives may help lower down the initial cost of sustainable packages. Campaigns specifically for farmers and other stakeholders in agribusiness industry should be conducted to create awareness about the long-term advantages of using less plastic and creating their own composting facilities for managing the biodegradable packaging materials efficiently. Besides, apart from the government officials

and the stakeholders of the business sector, educational institutions such as agricultural universities and research agencies should take part in the process of creating awareness. It is vital to introduce the concept of sustainability and eco-friendliness in the curriculum of educational institutes and also run outreach programs for farmers and rural population to conduct research in the area of region-specific packaging solutions that are cost-effective and functional. It has been stated earlier that Bihar is rich in traditional knowledge and diverse crops that would make it an ideal place to experiment with new ideas of packaging that are biodegradable.

It is important to address the menace of plastic pollution using environment friendly agricultural packaging, not only from the aspect of environmental conservation but also as a major step in the development of agriculture in the nation. Every one of us needs to take up the task of sustainability to ensure our future. It is high time we think about developing a green agriculture in India.



Figure 2. Biodegradable filler in parcel packaging

3. CONCLUSION

Eco-friendly agricultural packaging can bring down plastic pollution while converting agricultural residues into products. Banana leaves, coconut leaves, bamboo leaves, turmeric, millet dry leaves, rice crops, etc., may have potential for biodegradable packaging and cushioning materials. Increased use demands solutions to cost, functionality, availability, composting infrastructure and awareness restrictions. This transition can be accelerated through government incentives and supportive policies, farmer programmes, and researchers, industry and community collaboration. Agricultural institutes

should enhance R&D and education on package technologies local to the region.

REFERENCES

- Kim, M. Y., Park, G., & Seo, C. H. (2026). Application of Artificial Intelligence and Machine Learning in Vertical Farming: A Comprehensive Review. *Sustainability*, 18(16), 8261.
- Majumdar, R. (2026). Nondegradable Waste Incursion, Environment and Ecology: A Case of Densely Populated Urban Settings in India. In *Geospatial Science for Urban Ecosystems: Insights from India and Beyond* (pp. 257-285). Cham: Springer Nature Switzerland.