TAKSHASHILA INSTITUTION

Bio-Plastics - Biomanufacturing Opportunity for India

A report analysing opportunity bioplastics provide for biomanufacturing in India

Shambhavi Naik, Saurabh Todi

Takshashila Report
Version 1.0, December 2025.

A report analysing opportunity bioplastics provide for biomanufacturing in India

Recommended Citation:
Shambhavi Naik, Saurabh Todi, ``Bio-Plastics - Biomanufacturing Opportunity for India'', Takshashila Report, Version 1.0, December 2025., The Takshashila Institution

Contents

Shambhavi is the Chairperson of the Advanced Biology Programme at Takshashila Institution.

Saurabh is a Programme Manager for the Network for Advanced Study of Technology Geopolitics (NAST) Fellowship at the Takshashila Institution.

1 Executive Summary

Bioplastics present a strategic biomanufacturing opportunity for India, aligning environmental sustainability with industrial growth and economic resilience. Among bioplastics, polylactic acid (PLA) is the most commercially mature, with applications across packaging, textiles, automotive components, agriculture, and healthcare. The global bioplastics market is projected to exceed USD 30 billion by 2030, while India's domestic bioplastics market, valued at USD 447 million in 2023, is growing rapidly at over 22% annually. Yet India currently accounts for just 0.46% of the global market, underscoring a significant opportunity for domestic production and exports.

India possesses strong fundamentals for PLA manufacturing, including abundant sugarcane and maize feedstocks, established fermentation expertise, and large downstream manufacturing sectors. However, continued import dependence, limited polymerisation capacity, and feedstock competition from food and biofuels remain key challenges. This paper argues for a state-clustered approach supported by BioE3, targeted R&D investment, feedstock productivity improvements, and regulatory incentives to enable India to scale PLA manufacturing, create jobs, support farmer incomes, and emerge as a competitive global bioplastics hub.

2 Introduction

Bio-manufacturing is the use of biological systems and organisms to produce commercial products such as pharmaceuticals, chemicals, and materials. One such example is bioplastics. Bioplastics are derived from sources such as cornstarch or sugarcane, are industry-compostable[1], and can be used as substitutes for conventional plastics. Globally, the bioplastics market is projected to exceed USD 30 billion by 2030, driven by increasing demand resulting from green packaging mandates, circular economy goals, and consumer preference for sustainable products.

Bioplastics are already penetrating multiple sectors, particularly those under regulatory and consumer pressure to decarbonise. Table below provides an overview of the industries in which bioplastics can be used, and Appendix I contains details of established and emerging applications.

Table 1: Current and emerging applications of bioplastics

Sector	Key Use Cases	Market Readiness
Packaging	Compostable food service items, films, and bottles	Commercially established
Automotive & Textiles	Biobased interiors, fabrics, and footwear	Scaling phase
Consumer Goods	Electronics casings, toys, and personal care products	Early adoption
Agriculture	Biodegradable mulch films, controlled-release coatings	Pilot scale
Healthcare	Biodegradable sutures, tissue scaffolds	R&D and clinical validation stage

Based on the type of feedstock used, there are several types of bioplastics, such as polylactic acid (PLA), polyhydroxyalkanoates (PHA), starch-based blends, cellulose-based, and Bio-PET. Appendix 2 outlines the key applications and technology/commercial readiness of different types of bioplastics. Of these, the production of PLA-based bioplastics is at the most advanced stage[2]. Hence, this report will focus on the development of a PLA-based bioplastics hub in India. The following section will discuss why an investment in bioplastics is necessary, followed by a landscape analysis of the bioplastics industry in India.

3 Why Should India Invest in Bioplastics?

There are four main reasons - promoting economic growth, meeting waste reduction targets, creating jobs, and reducing import dependence, which make an investment in bioplastics manufacturing a strategic choice for India.

3.1 Promote economic growth

India's bioplastics market, valued at US$447.25 million in 2023, is projected to grow at an annual rate of 22.1%[3], at which rate it will reach US$1.8 billion by 2030 and approximately US$3.0 billion by 2033. This trajectory highlights both the strong economic potential of the sector and its importance for sustainable industrial growth. Within this market, PLA alone could account for 30–40% of total bioplastics demand[4].

Despite this promise, India currently holds only about 0.46% of the global bioplastics market[5], a strikingly small share given India's manufacturing capacity and agricultural strengths. This gap represents a major opportunity: India can not only meet its domestic bioplastic needs but also position itself as an export hub for global markets.

Beyond industrial benefits, bioplastics also create new value chains for farmers. As agricultural productivity rises, additional biomass and crop outputs will require new end-uses, and bioplastics provide a high-value outlet for this surplus.

3.2 Reach waste reduction targets

India generates approximately 9.3 million tonnes of plastic waste annually[6], with a significant portion ending up uncollected or in the environment. The scale of India's plastic problem is immense. To reduce pollution caused by traditional plastics, bioplastics can serve as a sustainable alternative. However, to adequately address waste disposal, industrial composting facilities for PLA-based bioplastics, as well as appropriate labelling and public education, would be required. But with the correct roadmap, PLA offers a scalable, compostable alternative to non-degradable plastics.

3.3 Job creation

Bioplastics manufacturing offers job creation opportunities across the value chain. An analyses of jobs created specifically in PLA-based bioplastics is not available. According to one simulation study in the US, an additional $1 billion in bioplastics manufacturing output could support 5,215 jobs across the U.S. economy through direct (operations), indirect (agricultural, logistics, etc) and induced (consumer-led) effects. Refer to table below for projections[7].

Table 2: Projected economic impact of bioplastics investment

	Employment	Labour Income ($ million)	**Output ($ million)**
Direct Effect	609	97	1,000
Indirect Effect	2,455	251	1,450
Induced Effect	2,151	148	462
Total Effect	5,215	496	2,912

In the EU, the bioplastics industry alone has been estimated to have created around 15,000 jobs in 2023[8]. It is apparent that the investment in biomanufacturing would lead to jobs in R&D, industry, agriculture, and logistics. The quantum of jobs created will vary depending on the scale of the set-up. But it is likely that similar investments in India would lead to more jobs, since the scale of set-ups would be larger.

3.4 Import dependence

Currently, India imports PLA to meet its domestic demand. Under the HSN code 39077000, India has routinely imported millions of US dollars' worth of PLA[9]. Thailand, China and Vietnam are the biggest exporters of PLA to India. The development of indigenous biomanufacturing would reduce this import dependence, saving the economy precious US dollars.

Table 3: Annual PLA import values in US$ million

	2019-20	2020-21	2021-22	2022-23	2023-24
Net Import	2.48	1.00	3.42	9.04	7.05
Total Import	2.86	2.69	3.99	10.49	10.19

These factors combined showcase the importance of bioplastics biomanufacturing in India. However, the demand for bioplastics also needs to be matched with a supply potential. The next section will outline the current landscape of the PLA value chain in India.

4 Bioplastics Manufacturing Supply Chain in India

The supply chain for bioplastics is both similar to and more complex than that of conventional plastics, because it integrates agricultural, chemical, and industrial manufacturing systems.

4.1 Feedstock Production

India is a leading producer of sugarcane and corn, which are the primary feedstocks for PLA-based bioplastics[10]. India ranks fourth globally in corn cultivation area and seventh in total maize production, accounting for about 2% of the world's total. India is also the second-largest producer of sugarcane globally, accounting for approximately 20% of global production.

Table 4: Feedstock production levels in India

Country	Maize/Corn Production (t/year)	Sugarcane Production (t/year)
India	~ 37 million	~ 405 million

Major maize-producing states include Karnataka, Madhya Pradesh, Bihar, Tamil Nadu, Telangana, Maharashtra and Andhra Pradesh[11]. In India, about 61% of maize is used as animal feed (77% for poultry), 26% for industrial use (mainly for the starch industry), 7% for food, and 6% for export and other uses[12]. Furthermore, as ethanol blending targets rise, domestic Maize is being increasingly diverted to ethanol production, and hence, India is now importing maize to bridge the gap. It imported about one million tonnes in 2024-25, mainly from Myanmar[13].

Similarly, the primary use of the sugarcane crop is for sugar production, with a portion of production being exported to manage surplus. In India, 35% of sugar is used for household consumption, and 65% is used for industrial purposes, including beverages and food manufacturing[14]. The remaining sugarcane is consumed to make end products such as jaggery and khandsari sugar. Furthermore, the higher demand for bioethanol is incentivising a significant diversion of sugarcane towards that goal, driven by government policies and industry recommendations.

4.2 Feedstock Processing and Conversion

At this stage, the biological feedstock is converted into intermediate chemicals or monomers, which are used to produce polymers. For PLA, this would be a fermentation process, for which India has many precedents across sectors such as vaccines, pharmaceuticals, biofuels, etc.

4.3 Polymerisation of Lactic Acid

The polymerisation of lactic acid to lactide is a bottleneck step for Indian companies. Praj Industries has developed domestic PLA polymerisation technology at demonstration, expected to scale to capacities of 100 tons per annum (TPA) for Lactic Acid, and 60 TPA for Lactide, equivalent to 55 TPA for PLA[15]. Additionally, Balrampur Chini Mills is constructing the country's first large integrated sugarcane-to-PLA facility, expected to produce PLA from sugarcane with an annual capacity of 75,000 tonnes[16]. While these are encouraging first steps, more capacity needs to be built to compete with other players.

Globally, the leaders in polymerising lactic acid into PLA are NatureWorks (based in USA with a second facility in Thailand) and TotalEnergies Corbion (a joint venture between TotalEnergies of France and Corbion of the Netherlands, operating a plant in Thailand), which together dominate commercial-scale PLA production through advanced lactide purification and ring-opening polymerisation technologies. China is also rapidly expanding capacity through companies like Hisun Biomaterials and BBCA/COFCO, now major integrated producers scaling from lactic acid to PLA.

Table 5: Overview of select global and Indian PLA companies

Company	Country	Approximate PLA Capacity
NatureWorks	USA / Thailand	~ 225,000 t/year
TotalEnergies Corbion	New Zealand / Singapore / Thailand	75,000 t/year
Hisun Biomaterials	China	>50,000 t/year
BBCA/COFCO	China	Scaling to 100,000 t/year
Futerro/Galactic	EU / Asia	Expanding
Praj Industries	India	Demo (commercial in progress)
Balrampur Chini Mills	India	75,000 t/year (under construction)

4.4 Product Manufacturing

Bioplastic pellets are now used to manufacture a variety of finished goods. For example, at this step, one would mould the pellets into packaging, cutlery, textiles, or films. Furthermore, some products would necessitate blending bioplastics with other additives to balance cost or performance. This step would also include quality control processes.

4.5 Distribution & End Use

The final products are distributed through standard channels to retailers and consumers. Depending on the bioplastic product, these can feed into a wide variety of industries currently manufacturing in India, either as core equipment parts or packaging.

The main levers of setting up bioplastic manufacturing would be the availability of feedstocks, water, talent and consumer industries that can buy the bioplastic. Of these, talent can be easily mobilised. The following section assesses the availability of feedstock and the customer base to analyse the potential of select states in India to establish a bioplastic manufacturing hub.

5 State-level analysis

There is clear potential for India to accelerate its PLA production. However, it is important to build such hubs based on the strengths of individual states to get the best value for investment and ensure smooth functioning of the hub. Based on the factors that would determine the operations of the hub, access to consistent supply of feedstock and market opportunities would act as the best incentives. This section therefore presents a preliminary analysis of select Indian states based on their suitability for hosting biomanufacturing hubs.

Table 6: Overview of the suitability of select states in hosting biomanufacturing hubs

State	Suitability	Feedstock Strength	Industrial / PLA Customer Base	Why It's Suitable
Maharashtra	Most Suitable	High sugarcane & strong maize	Very strong: chemicals, packaging, auto, FMCG, pharma	Best overall balance of feedstock + PLA demand; Praj's PLA demo plant nearby; strong industrial ecosystem
Uttar Pradesh	Most Suitable	India's #1 sugarcane producer	Large industrial belts: Noida, Ghaziabad, Kanpur, Lucknow	Ideal for cane-based PLA; home of Balrampur's 75,000 t/y PLA plant; major packaging & FMCG consumers

State	Suitability	Feedstock Strength	Industrial / PLA Customer Base	Why It's Suitable
Gujarat	Most Suitable	Moderate cane, some maize	One of India's largest chemical & polymer hubs	Premier state for selling PLA to chemical, polymer, packaging, textile, and auto supply chains
Karnataka	Most Suitable	Strong cane and top maize state	High-tech + industrial: Bengaluru, Mysuru, Dharwad	Attractive for fermentation talent + dual feedstock; strong packaging, auto, electronics clusters
Tamil Nadu	Most Suitable	High productivity cane and significant maize	Major auto, textile, electronics clusters	Excellent for South India PLA customers; reliable cane supply and industrial scale-up infrastructure
Telangana	Suitable	Good maize; some cane	Pharma & chemical heavy (Hyderabad)	Strong for grain-based fermentation and PLA for pharma/food packaging
Andhra Pradesh	Suitable	Good maize; some cane	Pharma, textiles; port access (Vizag, Krishnapatnam)	Good for export-oriented PLA and fermentation projects

State	Suitability	Feedstock Strength	Industrial / PLA Customer Base	Why It's Suitable
Madhya Pradesh	Suitable	Major maize state	Industrial hubs around Indore / Pithampur	Ideal for maize-first fermentation and supplying central/west India packaging & auto
Bihar	Suitable	Strong maize & good cane	Developing an industrial base	Suitable for upstream fermentation; products shipped to Tier 1 states
Punjab & Haryana	Targeted	Good cane; some maize	Dairy, food processing, light manufacturing	Niche PLA for agri/dairy packaging; feedstock good, but manufacturing is weaker
West Bengal & Odisha	Targeted	Moderate maize; limited cane	Steel, cement, growing packaging	Could work for specific customer partnerships; not PLA-heavy regions
Rajasthan, Chhattisgarh and Jharkhand	Targeted	Limited cane/maize	Select industrial pockets	Useful only with a strong anchor customer or state incentives

6 Recommendations for India

India imports maize and sometimes raw sugar, indicating that supply does not match demand or is highly seasonal. The problem is only going to get worse, with ethanol blending targets further depleting already limited supply and the potential for bioplastics to consume a notable share of production as well. Therefore, efforts need to be made to increase productivity, reduce transit costs and increase competition in the bioplastics sector:

The development and deployment of high-yielding (HYV) sugarcane and maize varieties would help increase productivity. More HYV breeding sites should be encouraged nationwide to improve farmers' access to HYV seeds. Gene editing technologies may help develop such seeds, particularly those that can increase yield while requiring less water intake indigenously. Such projects can be developed under DST and DBT's umbrella schemes for precision agriculture and climate-resilient agriculture.

The import of genetically modified or edited maize and sugarcane exclusively for bioplastics production could reduce the risk of diversion of domestic output that could satisfy public consumption needs and ensure domestic food security. Furthermore, as sugarcane is a highly water-intensive crop, it would be ideal to regulate its consumption to specific industries to avoid exacerbating water stress.

Active research on bioplastic chemistry through research grants to agricultural universities and other departments should be encouraged to develop technologies and IP in India. Funding for these projects can be routed through initiatives such as BioE3, ANRF, etc. Furthermore, startups can be encouraged to scale piloted ideas for commercialisation. Bilateral research cooperation to co-develop PLA pathways could be considered with countries such as Australia or Thailand.

Farmer-producer organisations (FPOs) can play a vital role in sourcing raw materials while also increasing farmer incomes. States with high feedstock crop production and manufacturing capabilities should incentivise companies to set up PLA manufacturing plants in those areas. Existing players in the sugarcane, poultry feed, or food processing industries can be further incentivised to diversify into the bioplastics sector. Additionally, allowing foreign investment in this sector would help bring in the latest technology, foster competition, and support the development of upstream and downstream industries and professions.

To reduce the upfront costs of setting up PLA production plants and generate economies of scale until bioplastics become commercially competitive with traditional plastics, bioplastic use can be incentivised by amending the Plastic Waste Management Rules.

7 Appendix I:

7.1 Established Commercial Applications

Bioplastics are increasingly being used in packaging applications, both flexible and rigid. Flexible forms (such as bags, films, and wraps) and rigid formats (like bottles, containers, and trays) are already commercially available[17].

In the food service sector, bioplastics are used to produce compostable cutlery, cups, and straws. Furthermore, major brands such as Samsung and Dell are using bioplastics in electronic packaging and some device housings.

In agriculture, biodegradable mulch films, seed coatings, and controlled-release fertiliser coatings reduce soil pollution and eliminate the need for film collection and disposal[18]. Similarly, compostable plant pots and trays reduce waste in nursery operations[19].

Bioplastics can also be used in fast-moving consumer goods, such as toothbrush handles, razors, toys, and electronic casings, making an impact in a high-volume industry.

In the textile and fashion industry, biobased polyesters (e.g., Sorona[20] , PLA blends) are used to produce sustainable fabrics, footwear soles, and fashion accessories, potentially reducing dependence on fossil-fuel-derived polymers like PET and nylon.

In the automotive and transportation sector, interior panels, seat fabrics, dashboards, and trims made with bioplastic composites help reduce vehicle weight and carbon footprint. Industry leaders such as Toyota and Mazda utilise bioplastics in their car interiors.

7.2 Emerging and Potential Use Cases

In the medical and healthcare sector, biodegradable sutures, drug delivery systems, tissue scaffolds, and implants can be made from PLA or PHA. These materials break down naturally, reducing surgical waste and the need for removal surgeries.

PLA is already the most widely used filament in desktop 3D printing. Furthermore, research is ongoing on PHA and biocomposites to improve strength and biocompatibility.

In the electronics and electrical industries, the development of biobased circuit boards and insulation materials is underway. Furthermore, there's potential for fully compostable electronic components as part of e-waste reduction strategies.

In the marine and fishing industry, biodegradable fishing nets and gear could be developed to prevent "ghost fishing" and reduce marine plastic pollution[21].

In the construction industry, bioplastic composites can be used in insulation panels, paints, flooring materials, and 3D-printed architectural components. Furthermore, they can be used as binders or fillers in eco-friendly concrete and coatings.

8 Appendix 2:

Table 7: Key Applications and Technology / Commercial Readiness of Different Types of Bioplastics

Type	Feedstock	Key Applications	Bio degredable	Technology Readiness Level (1-10)	Commercial Readiness
PLA (Polylactic Acid)	Corn, sugarcane	Packaging, food service, textiles	Compostable (industrial)	9	Widely commercial
PHA (Poly hydroxy alkanoates)	Vegetable oils, sugar, agri-waste	Medical devices, agri-films, packaging	Fully biodegradable (including marine)	6-8	Emerging scale-up
Starch based Blends	Potato, cassava, maize starch	Bags, films, containers	Yes	9	Commercial
Cellulose based	Wood pulp, cotton linters	Films, coatings, hygiene products	Some	7-9	Moderate scale
Bio-PET / Bio-PE	Sugarcane ethanol	Bottles, rigid packaging	No (but recyclable)	9	Commercial

Endnotes

1. Industry-compostable refers to materials that are designed to biodegrade only under controlled industrial composting conditions, where temperatures are typically above 55–60°C, humidity is regulated, and microbial activity is optimised. Such conditions allow the material to break down into carbon dioxide, water, and biomass within a specified time frame, as defined by standards like EN 13432 or ASTM D6400. Industry-compostable materials generally do not decompose effectively in home composting systems or in the natural environment and require access to specialised composting facilities for proper end-of-life treatment.

2. Aayog, N. I. T. I. *Report on alternative products and technologies to plastics and their applications*. 2022. Link

3. 'India Bio Plastics Market: Environmental Awareness and Sustainability to Boost the Market Growth'. *MAXIMIZE MARKET RESEARCH*, n.d. Accessed 16 December 2025. Link.

4. Ishimwe, Sandrine. 'BIOPLASTICS MARKET DEVELOPMENT UPDATE 2024'. *European Bioplastics e.V.*, 10 December 2024. Link.

5. India, Ey. 2025. "How Policy and Fiscal Benefits Can Boost India's Bioplastics Industry." June 12, 2025. Link.

6. Press Information Bureau, "More than 94 lakh tonnes of plastic waste is generated in India every year," New India Samachar, Vol 5, no. 7 (September 2024): Page 24. Link.

7. Plastics Industry Association. 'Economic Impact of Bioplastics'. Accessed 16 December 2025. Link.

8. 'Exciting Careers in the Bioplastics Industry - Bioplastics MAGAZINE'. 22 August 2023. Link.

9. India, Ey. 2025. "How Policy and Fiscal Benefits Can Boost India's Bioplastics Industry." June 12, 2025. Link.

10. ChiniMandi. 'Agriculture Ministry Releases Final Estimates of Sugarcane, Maize and Other Crops for 2023-24'. ChiniMandi, 25 September 2024. Link.

11. 'Maize | Agricultural and Processed Food Products Export Development Authority'. Accessed 16 December 2025. Link.

12. Raghav, Arun. 2024. "The Rise of Maize in India: A Bright 5-Year Outlook." *Agritechboost* (blog). August 25, 2024. Link.

13. Jadhav, Rajendra. 'Ethanol Push Turns India into Corn Importer, Shaking up Global Market'. *Reuters*, 4 September 2024. Link.

14. Aayog, N. I. T. I. "Final Report of the Task Force on Sugarcane and Sugar Industry." *NITI Aayog, Delhi* (2020). Link

15. Hindustan Times. 'India's First "Demonstration Facility for Biopolymers" Inaugurated in Pune'. 17 October 2024. Link.

16. Khan, Shariq. 'Sugarcane to Sustainability: India Gets Its First Fully Integrated PLA Plant as Balrampur Chini Unveils Bioyug'. The Economic Times, 3 July 2025. Link.

17. Mehran Ghasemlou, Colin J. Barrow, Benu Adhikari, The future of bioplastics in food packaging: An industrial perspective, Food Packaging and Shelf Life, Volume 43, 2024, 101279, ISSN 2214-2894. Link.

18. Kasirajan, S., Ngouajio, M. Polyethylene and biodegradable mulches for agricultural applications: a review. *Agron. Sustain. Dev.* 32, 501–529 (2012). Link.

19. Rocío A. Fuentes, Jazmín A. Berthe, Silvia E. Barbosa, Luciana A. Castillo, Development of biodegradable pots from different agroindustrial wastes and byproducts, Sustainable Materials and Technologies, Volume 30, 2021, e00338, ISSN 2214-9937. Link.

20. Sorona® is a bio-based polymer developed by DuPont, made in part from plant-derived sugars (typically corn). This bio-based component is polymerised with petrochemical inputs to create a high-performance material used mainly in textiles, carpets, and engineered plastics

21. Ghost fishing refers to the phenomenon in which lost, abandoned, or discarded fishing gear, such as nets, lines, traps, and pots, continues to capture and kill marine life long after it is no longer in use. These "ghost" gears can persist in oceans for years, entangling fish, turtles, marine mammals, and seabirds, damaging coral reefs, and contributing to marine plastic pollution.

TAKSHASHILA INSTITUTION

The Takshashila Institution is an independent centre for research and education in public policy. It is a non-partisan, non-profit organisation that advocates the values of freedom, openness, tolerance, pluralism, and responsible citizenship. It seeks to transform India through better public policies, bridging the governance gap by developing better public servants, civil society leaders, professionals, and informed citizens.

Takshashila creates change by connecting good people, to good ideas and good networks. It produces independent policy research in a number of areas of governance, it grooms civic leaders through its online education programmes and engages in public discourse through its publications and digital media.