# 5. India's Bioeconomy Growth - Economy

India's bioeconomy expanded from USD 10 billion (2014) to USD 165.7 billion (2024), with a target of USD 300 billion by 2030, marking it as one of the fastest-growing in the world.

## Biotechnology as a Driver of Sustainable and Inclusive Growth

### Introduction

**Concept of Bioeconomy -** The bioeconomy refers to the sustainable use of renewable biological resources—plants, animals, and microorganisms—to create food, energy, medicines, and industrial products. It combines biotechnology, agriculture, healthcare, and industrial sciences with sustainability principles.

**India's Contribution -** India's bioeconomy contributes around 25% to the national GDP, reflecting its role as a major growth driver across sectors such as biotechnology, bio-agriculture, bio-industrial products, healthcare, and renewable energy.

**Policy and Youth Engagement -** With the introduction of the BioE³ Policy (2024), India aims to align the bioeconomy with its economic, environmental, and employment strategies. Youth-focused initiatives such as the BioE³ Challenge encourage innovation, entrepreneurship, and skills development in biotechnology, ensuring that the next generation actively contributes to green growth.

### Key Drivers of India's Bioeconomy

**BioIndustrial (47% share, USD 78.2 bn) -** The largest segment, dominated by biofuels, bioplastics, enzymatic industrial applications, and biosynthetic chemicals. India achieved 20% ethanol blending by 2025, five years ahead of schedule, significantly reducing crude oil imports and foreign exchange expenditure. Supports the circular economy by reducing dependence on fossil fuels, recycling waste into valuable inputs, and promoting sustainable manufacturing.

**BioPharma and BioMedical (35.2% share, USD 58.4 bn) -** India has emerged as a global vaccine hub, with the Serum Institute commanding a 24% share of the world vaccine market (2024). Strong research focus on gene editing, immunotherapies, CAR T-cell therapy, and AI-based diagnostics, which are revolutionizing precision healthcare. Expanding MedTech devices, affordable biologics, and biosimilars enhances accessibility to advanced healthcare solutions both in India and globally.

**BioAgri (8.1% share, USD 13.5 bn) -** Growth driven by GM crops, precision farming, bio-fertilizers, bio-based pesticides, and plant biotechnology.

*Success story* - Bt cotton, which boosted productivity and improved farmer incomes significantly. Strengthens food security and sustainable agriculture, reducing dependency on chemical inputs and addressing climate-resilient farming needs.

**BioResearch & BioIT (9.4% share, USD 15.6 bn) -** Covers contract research, bioinformatics, biotech-driven software, and clinical trials. India is becoming a global hub for cost-effective R&D services, attracting international pharmaceutical and biotech investments. Supports drug discovery pipelines, genomics research, and AI-driven healthcare analytics, integrating data science with biological research.

### Policy Framework and Institutional Support

**BioE³ Policy (2024) -** Focused on the three "E's"—Economy, Environment, and Employment. It promotes sustainable biomanufacturing, green jobs, and innovation ecosystems.

**BioEnabler Facilities -** 21 dedicated centres established to assist startups and SMEs in areas such as smart proteins, marine biotechnology, carbon capture, and bioenergy technologies.

**Biofoundry Network (2025) -** India's first national-level initiative to support the biomanufacturing ecosystem, providing infrastructure for designing, testing, and scaling synthetic biology solutions.

**Biotech Startup Growth** - From 5,365 in 2021 to nearly 13,000 in 2025, supported by $600 million in funding, producing 800+ biotech products across healthcare, agri-tech, and industry.

### Climate Change Mitigation and Sustainability

Bioeconomy contributes to climate resilience by reducing greenhouse gas (GHG) emissions, encouraging renewable energy adoption, recycling, forest restoration, and sustainable agricultural practices. The ethanol blending programme saved ₹1.44 lakh crore in foreign exchange while substituting 245 LMT of crude oil imports, strengthening energy security. Promotes energy independence, supports food security by enhancing crop resilience, and aligns with India's commitment to green growth and Net Zero targets.

## Regional Contribution

Maharashtra (21.4%), Karnataka (19.5%), and Telangana (12%) are the leading contributors to India's bioeconomy. The Southern region dominates (41.4% share) due to strong research institutions, biotechnology clusters, and industry–academia collaborations. The Western region contributes 30.3%, followed by the Northern (18.5%) and Eastern (5.8%) regions, reflecting varying levels of industrialization and innovation ecosystems. Regional clustering highlights how South and West India act as bioeconomy hubs, attracting foreign investment and nurturing startups.

## Global Context and Future Outlook

Globally, the bioeconomy is expected to grow from $4 trillion in 2020 to $30 trillion by 2050, contributing nearly 12% of global GDP. India's bioeconomy could expand to $1.4–2.7 trillion by 2050, representing 6.5–12% of its projected GDP of $22 trillion. India's leadership in vaccine production, ethanol blending, green biomanufacturing, and affordable bio-based products strengthens its position as a global bioeconomy powerhouse.

## Challenges

**Regulatory Gaps** - Stronger and harmonized regulatory frameworks are required for biotech, biosafety, and ethical concerns such as gene editing and synthetic biology.

**Dependence on Global Collaborations** - India still relies on advanced economies for cutting-edge technologies, particularly in synthetic biology and genomics.

**Workforce Gap -** Limited skilled manpower in specialized domains such as bioinformatics, gene editing, and synthetic biology, slowing down innovation.

**Equity Issues -** Need to ensure that farmers and small stakeholders benefit equitably from biofuel adoption, GM crops, and bio-agriculture initiatives.

## Way Forward

**Strengthen R&D** - Expand Centres of Excellence, increase public funding, and promote indigenous biotech innovations to reduce import dependency.

**Promote Biomanufacturing -** Scale up the Biofoundry Network and encourage private sector participation to make India a leader in global supply chains.

**Invest in Human Capital -** Develop biotechnology-focused curricula, fellowships, and youth entrepreneurship programs to address the skilled workforce gap.

**Expand Global Partnerships -** Strengthen ties with EU, U.S., and Asia-Pacific countries to harmonize biotech standards, access new markets, and share best practices.

**Sustainability Integration -** Ensure all bio-based industries align with climate action goals, biodiversity conservation, and environmental safeguards, balancing growth with ecological responsibility.

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