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Circular Economy for Sustainable Development in India: A Preliminary Insight

Dr Puja Saxena Nigam

Associate Professor, Department of Economics, Hindu College, University of,Delhi-110007

Abstract

India is currently the world's most populous nation and its fastest-growing major economy. However, this growth is resource-intensive. India's material consumption is projected to triple by 2030 compared to 2010 levels. In a world of volatile commodity prices and disrupted supply chains, the "Linear Economy" creates "waste" that is essentially a stranded economic asset.

Under the Sustainable Development Goals (SDG'S): SDG 12, "Responsible Consumption and Production," aims to decouple economic growth from resource depletion by promoting resource efficiency, waste reduction, and sustainable management of natural resources. The circular economy acts as a vital, practical framework for achieving this by shifting from "take-make-waste" to "reduce, reuse, repair, and recycle" models.

The Circular Economy is not merely "recycling"; it is a restorative system that designs out waste, keeps products and materials in use at their highest value, and regenerates natural systems. For India, Circular Economy is not an environmental luxury but a strategic necessity for a Self-Reliant India.

As India pursues its goal of becoming a $5 trillion economy, the traditional linear model of "extract-make-dispose" poses an existential threat to its ecological stability and resource security. This paper is an insight into the transition towards a Circular Economy as a prerequisite for sustainable development in India. By examining the intersection of ancient Indian frugality with modern industrial policy, the paper analyses the socio-economic potential of circularity, identifies systemic barriers in the informal sector, and evaluates the legislative landscape of India as of early 2026.

Keywords: Linear economy, Circular Economy, Sustainable Development, Resource security, SDG's.

Introduction

India is currently the world's most populous nation and its fastest-growing major economy. However, this growth is resource-intensive. India's material consumption is projected to triple by 2030 compared to 2010 levels.

With the world's largest democracy with influencer status in the global mindscape, various social and environmental factors, including population increase, political unrest, food and water scarcity, rapid urbanization, environmental pollution, and climate change, have coexisted in India. However, India is progressing towards the United Nations (UN) Sustainable Development Goals (SDGs) "Agenda 2030" commitment, from 18% waste processing in 2014 to 70% in 2021. The current disruptive changes lead to an urgent call for action to strategize development and spur economic growth while tackling climate change and building future programs for waste management and resource preservation. The circular economy encourages a transition from linear 'take-make-waste' to multi-life cycle circular value chains in

business models, integrating the design-thinking approach for more effective and judicious use of resources. Currently, almost 377 million citizens reside in urban areas, producing 55 million tonnes of municipal solid waste (MSW) annually. Moreover, this amount is predicted to increase significantly, reaching 125 million tonnes annually by 2031. Despite the immense relevance of the circular economy, the industry currently has a varied awareness of the concept, which poses a significant challenge concerning its widespread adoption in India.

The Circular Economy is not merely "recycling"; it is a restorative system that designs out waste, keeps products and materials in use at their highest value, and regenerates natural systems. For India, Circular Economy is not an environmental luxury but a strategic necessity for self-reliance.

History of India in terms of Circular Economy

India's economic history is marked by a sharp pivot in 1991, shifting from a centuries-old ethos of resource conservation to a modern era of conspicuous consumerism. This transition represents a fundamental change in the relationship between the Indian citizen and the environment. Historically, Indian society operated on a "Circular-by-Default" model, deeply rooted in cultural and spiritual values. Philosophical Roots lie on the concept of *Dharma* (righteous duty) and *Ahimsa* (non-violence) extended to nature, viewing the Earth as a mother (*Bhumi Suktam*) and emphasizing harmony over exploitation. Minimalism & Zero Waste is a core concept as households instinctively practiced the "4Rs" (Reduce, Reuse, Recycle, Repurpose) before they were modern buzzwords. Old clothes were repurposed into quilts (*godhadi*), kitchen waste became compost or cattle feed, and broken pottery served as planters. Sustainable Materials represented the traditional lifestyles utilized biodegradable resources, such as neem sticks for dental hygiene, banana leaves for dining, and clay pots for natural cooling—avoiding the need for synthetic detergents, plastics, or energy-intensive appliances. Infrastructure rested on ancient engineering focused on regenerative systems, such as stepwells (baolis) and temple tanks for rainwater harvesting, which sustained communities for generations without depleting groundwater. The 1991 economic liberalisation (LPG reforms) dismantled the "License Raj" and integrated India into the global market, triggering a paradigm shift in social and environmental behaviour. Growth of the "New Middle Class" increased disposable income shifted consumption from necessity-driven to aspiration-driven. This led to a surge in "conspicuous consumption"—the status-based purchase of cars, air conditioners, and branded electronics. There has been a shift from handcrafted, local goods to mass-produced global commodities introduced non-biodegradable packaging and "planned obsolescence" into the Indian market. Rapid urbanization post-1991 has often occurred at the cost of natural ecosystems. For example, wetlands (like those in Guwahati) have been converted into housing to meet middle-class demand, contributing to flash floods and ecological imbalance. While reforms boosted GDP, the benefits—and the resulting environmental footprints—were concentrated in urban centres, leading to a disconnect between the consuming urban elite and the rural underclass who bear the brunt of resource exploitation.

The current challenge for India is to reconcile its modern economic ambitions with its traditional conservationist roots. While 84% of modern Indian consumers express a preference for sustainable products, the convenience and low cost of post-1991 consumer culture often override these traditional values. Modern initiatives like Mission LIFE attempt to bridge this gap by nudging citizens back toward "Pro-Planet People" (P3) behaviours—essentially modernizing the ancient Indian ethos of frugality and community stewardship for the 21st century.

Concept of Circular Economy and India

Circular Economy aims to eliminate all forms of junk from the market, where "junk" refers to any inefficient utilization of resources or assets. It is a restorative approach to production and consumption that involves redesigning, recovering, and reusing products and materials to reduce environmental impacts. Circular models seek to eliminate four different kinds of waste that are as follows:

- Wasted Resources - Materials and energy that cannot be effectively recycled over time
- Wastage Capacities - Products and assets that are underutilized
- Wasted Lifecycles - Products that prematurely end due to planned obsolescence or a lack of second-life options
- Wasted Embedded Values - Components, materials, and energy not retrieved from waste streams

The transition to a circular economy could result in an additional US$ 4.5 trillion in global economic output by 2030. Moreover, in contrast to the current growth environment, India's circular economy development route might generate an annual value of US$ 218 billion (Rs 14 lakh crores) by 2030 and US$ 624 billion (Rs 40 lakh crores) by 2050.

The implementation of a circular economy in India would require an enabling ecosystem that encourages the identification and adoption of new business models. Presently, 377 million people living in urban cities, produce approximately 55 million tonnes of Municipal Solid Waste (MSW) (like organic waste, recyclables like paper, plastic, wood, glass, etc.) per year, with these numbers expected to rise to 125 million tonnes per year by 2031. Moreover, only 75-80% of the MSW gets collected; out of which only 22-28% is processed, and the rest is dumped in dump yards. MSW generation is projected to increase to 165 million tons by 2031, and further rise to 436 million tons by 2050.

By 2030, India is expected to be the world's third-largest economy, accounting for approximately 8.5% of the global GDP. The circular economy has the potential to fuel India's growth while also providing significant environmental benefits, making a sustainable and resilient framework. The recycled Polyethylene Terephthalate (PET) plastic industry in India is estimated to be worth around US$ 400-550 million, according to National Chemical Laboratory (NCL) and PET Packaging Association for Clean Environment (PACE). In India, PET is recycled at a rate of 90%, which is higher than in Japan (72%), Europe (48%), and the United States (31%). Thus, there are enormous opportunities for a circular economy in India.

The country is likely to be a leading hub for technology and innovation With its existing IT dominance and pool of tech talent, India is well-positioned to use digital technology to create innovative and cutting-edge circular businesses. This has the potential to accelerate India to the forefront of the global circular economy revolution. India has experienced an early success compared to global economies. India is one of the fastest developing economies and can easily take up opportunities to use circular methods of production, building sustainable designs. As mature economies have a linear lock-in and switching costs would be costly and time-taking. Therefore, as an emerging nation, India has a competitive advantage over mature economies. Several circular aspects are ingrained in Indian mindsets like vehicle over-utilization and repair or extensive recovery and recycling of post-use materials at the household level. For instance, the average length of car ownership in India is 9-12 years, as compared to 7-8 years in the US. The cost of providing services to consumers will be cheaper for those who would take the circular path than that of the traditional take-make-waste model. Incorporating circular practices in India could result in US$ 624 billion in savings across construction, food and agriculture, and mobility by 2050. This will contribute to widespread adoption, particularly among India's cost-conscious consumers.

Sustainable Development Goals (SDG'S) and Circular Economy Business Models

The circular economy (CE) is a vital tool for achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production). By shifting from linear "take-make-waste" models to restorative, closed-loop systems, CE drives sustainability, minimizes waste, lowers emissions, and promotes economic growth.

- SDG 12 (Responsible Consumption and Production): The core driver, promoting sustainable resource use and reducing waste.
- SDG 13 (Climate Action): Lowering carbon footprints through material efficiency and reduced emissions.
- SDG 8 (Decent Work and Economic Growth): Creating jobs and increasing resource productivity.
- SDG 11 (Sustainable Cities): Enhancing urban waste management and sustainable construction.
- SDG 15 (Life on Land) & 14 (Life Below Water): Reducing pollution and protecting ecosystems from resource extraction.

Circular Economy business models are classified into five different types of models that companies can leverage individually or in combinations to improvise resource productivity in innovative ways to lower costs, enhance customer value, increase revenue, and differentiate. They are:

Circular Supply Chain: Materials that are fully renewable, recyclable, or biodegradable and can be used across lifecycles. For example, switching from a fossil-fuel-based energy source to a renewable energy source. Companies can develop and market circular supplies such as renewable energy and recyclable materials through their upstream or downstream partners, or they can produce circular supplies for their operations. Some businesses are deploying technical nutrients, which are inputs such as metals and minerals that can be reused and recycled indefinitely if not contaminated or leaked along the value chain.

Recovery and Recycling: This model enables organizations to extract value from the waste stream (end-of-life products, waste products/by-products), effectively eliminating the concept of waste. Recycling, refurbishment, and restoration initiatives can help businesses recover value from end-of-life products. Businesses can also disassemble waste products to recover residual value in the form of valuable material. To aggregate waste streams at scale, the model frequently involves organizations to establish reverse supply chains. They can be transformed by recycling, upcycling (converting old products or materials into something more valuable), industrial symbiosis (sharing by-product resources among industries), downcycling (converting products to something of lesser value), and cradle-cradle design is then used to transform the same (disposed products are reprocessed without any resource loss).

Product Life Extension: Consumers discard products that they no longer value as they are broken, out of style, or no longer required. However, many of these products retain significant value by just being maintained, or improved through repairs, remanufacturing, or remarketing. Companies can act as industrial manufacturer which produces these goods with extended life cycles.

Sharing Platform: It aims to link two or more parties to increase net asset utilization through co-access. The model typically makes use of digital technologies to create new relationships and business opportunities for consumers, businesses, and microentrepreneurs who rent, share, swap, lend, or barter their idle goods. As a result, this business model offers consumers a new way to make and save money while also providing organizations with an asset-light business opportunity.

Product as a Service: Consumer behaviour is shifting toward an "access-over-ownership" mindset. This model requires manufacturers and retailers to bear the total cost of product ownership while providing it as a service to customers. Customers become more product users than product owners. It's a win-win

situation for both companies and customers to derive a new revenue stream, while customers benefit from significant cost savings, exceptional performance & quality, and reduced risk of ownership.

India's Case

India's transition to a circular economy (CE) represents a potential $2 trillion market opportunity by 2050, shifting from a linear "take-make-dispose" model to a restorative system that eliminates waste.

Key Economic & Environmental Drivers for the same are:

- Economic Impact: Adopting CE principles could yield annual benefits of $624 billion (₹40 lakh crore) by 2050.
- Climate Gains: Circular strategies can reduce greenhouse gas emissions by 44% by 2050 and lower industrial carbon footprints significantly.
- Employment: The shift is projected to create 10–15 million green jobs by 2030-2040, particularly in waste management, repair, and bioenergy.

India is institutionalizing circularity through several recent mandates namely:

- National Circular Economy Framework (NCEF) 2024: Broadened its scope to 16 focus sectors, including liquid waste, solar panels, and textiles.
- Extended Producer Responsibility (EPR): Mandates producers to manage product lifecycles, with new comprehensive rules for plastic, e-waste, glass, and metal packaging set for April 1, 2026.
- Mission LIFE (Lifestyle for Environment): Nudges citizens toward responsible consumption and mindful resource use.

High-Potential Sectors in India that have been identified are:

- Agriculture: Converting the world's second-largest agricultural waste pool into biochar, fodder, and biofuels.
- Metals & Mining: Steel recycling reduces water use by 40% and mining waste by 97% per tonne.
- Electronics (E-waste): Mandates aim for 70% recycling by 2027 to recover precious metals and reduce imports.
- Renewables: Recycling solar panels and EV batteries could meet 20% of demand for critical minerals like copper and lithium by 2040-2050.

Major Challenges & Roadblocks would be as follows:

- Infrastructure Gaps: India produces 62 million tonnes of waste annually, but only 75-80% is collected and only a fraction is scientifically processed.
- Informal Sector Integration: Over 90% of waste handling is done by 1.5–4 million informal workers who lack legal recognition and safe working conditions.
- Financial Barriers: Transitioning full-scale infrastructure requires an estimated $50–$80 billion investment over the next decade.
- Behavioural "Intent-Action Gap": While 84% of Indian consumers prefer sustainable products, only 27% consistently purchase them due to high costs and lack of trust (greenwashing).

India's Start-up innovations are designing out waste. A few examples being:

- Phool (Kanpur): Addresses the "temple waste" crisis by upcycling discarded ritual flowers—which traditionally leach pesticides into rivers—into charcoal-free incense and "Florafoam" (a compostable Styrofoam alternative). Their most disruptive innovation is Fleather, a vegan leather alternative grown from floral biomass using microbial species, now being piloted by global fashion brands like Tommy

Hilfiger.

- Saahas Zero Waste (Bengaluru): Operates as a "socio-environmental" enterprise that manages over 100 tonnes of waste daily with a 98% landfill diversion rate. They specialize in on-site waste management for bulk generators (e.g., Microsoft, IKEA) and have formalized over 2,400 informal waste workers into dignified, safe roles.
- Banyan Nation (Hyderabad): Uses proprietary cleaning technology and AI-enabled traceability to convert post-consumer plastic into near-virgin quality recycled resin. This allows global brands like Unilever to meet mandatory recycled-content targets without compromising on packaging quality.
- Recykal (Hyderabad): Acts as a digital "managed marketplace" that connects waste generators, collectors, and recyclers. By digitizing the transaction of 10,000+ tonnes of packaging waste for firms like Flipkart, they have created a transparent ecosystem for tradable EPR (Extended Producer Responsibility) certificates.

Major Indian conglomerates are not far behind. They are shifting from a "waste management" mindset to "resource recovery," treating industrial outputs as secondary raw materials.

- Tata Steel's Scrap & By-product Revolution: Steel Recycling Business (SRB): Established India's first automated steel scrap processing plant in Rohtak with 0.5 million tonnes per annum) and plans to scale to 5 million tonnes per annum by 2030. To secure supply, they launched FerroHaat, a first-of-its-kind app that digitalizes the fragmented "kabadiwala" network. Slag-based Products: They have commercialized industrial by-products into branded construction materials like Tata Aggreto (for national highways) and Tata Nirman (for bricks), achieving 100% solid waste utilization at major plants like Jamshedpur.
- Mahindra Group (CERO): Established India's first organized vehicle recycling facility (Accelo), aligning with the National Vehicle Scrappage Policy to recover high-grade steel, aluminium, and plastics from end-of-life vehicles.
- Reliance Industries: Has become one of the world's largest recyclers of PET bottles, converting over 2 billion bottles annually into eco-friendly polyester fibres for its "R|Elan" fabric brand.
- Dalmia Bharat Cement: Leads the sector in "thermal substitution," replacing over 15% of fossil fuels with waste-derived alternatives (biomass and hazardous waste) in its cement kilns.

The Policy Landscape: The 2026 Perspective

India's model, primarily governed by the National Circular Economy Framework (NCEF), views circularity as a lever for economic resilience and resource security. It emphasizes a "Waste to Wealth" approach to manage the massive waste streams generated by its rapid urbanization and industrialization This landmark policy unified 16 different sectors—including solar panels, lithium-ion batteries, and textiles—under a single circularity roadmap. A defining feature of India's model is the integration of the informal sector, which handles approximately 90–95% of e-waste and a vast majority of municipal waste. Policy efforts focus on formalizing these workers into "Waste-to-Wealth" cooperatives to improve safety and yield.

Extended Producer Responsibility (EPR) 2.0: As of April 2026, EPR credits are now a tradable commodity on the Indian Carbon and Resource Exchange. Companies that exceed their recycling targets can sell credits to laggards, creating a market-driven incentive for sustainable design. Green Public Procurement (GPP): The Government of India now prioritizes vendors who demonstrate a "Circular Footprint," encouraging the private sector to innovate in durability and repairability.

Challenges and Plausible Solutions

Perhaps the most significant challenge in the Indian context is the Informal Sector. Over 90% of waste management is handled by an estimated 4 million "waste pickers. "The Inclusion Dilemma: While the informal sector is highly efficient at collection, it often employs hazardous "backyard" recycling methods (e.g., acid leaching for gold). The Solution is formalization through "Waste-to-Wealth" cooperatives. Bridging the gap between the informal collectors and formal recyclers is essential for the social dimension of Sustainable Development Goals (SDGs). Ensuring that "Recycled Plastic" is actually recycled and not virgin plastic mislabelled. Smart bins and GPS-tracked logistics have optimized collection routes in 100 Smart Cities, reducing the carbon footprint of the waste management fleet itself. Automated sorting facilities are now able to distinguish between different grades of polymers, which was previously a manual and error-prone task.

Conclusion: The Way Forward

India's journey toward a circular economy is a blueprint for the Global South. It demonstrates that economic growth does not have to be decoupled from environmental stewardship; rather, they can be mutually reinforcing.

To reach the next stage of maturity by 2030, India must increase R&D investment in Material Science to create substitutes for hard-to-recycle plastics, standardize "Circular Design" so that products are built to be disassembled and establish a Circular Finance mechanism to provide low-interest loans to green startups.

In conclusion, the Circular Economy is the most potent tool in India's arsenal to achieve its Net Zero 2070 target while ensuring that "Development" remains synonymous with "Dignity" for its billion-plus citizens. The circular economy is presented as the essential framework for India's future prosperity, moving away from the fragile "Linear Economy" model. This approach is seen as crucial for achieving a self-reliant India through restorative and inclusive design. The article emphasizes that India's circular transition, unique in its "Indianized" form leveraging traditional practices and modern regulations, is a viable commercial reality with significant potential. However, challenges remain in bridging the gap between consumer intent and action and in securing green financing for businesses. India's circular transition is positioned as a pioneering model for the Global South, demonstrating how developing nations can industrialize sustainably by designing waste out of the system. This transition is viewed not just as environmental protection but as essential for future-proofing India's economy and honouring its values.

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