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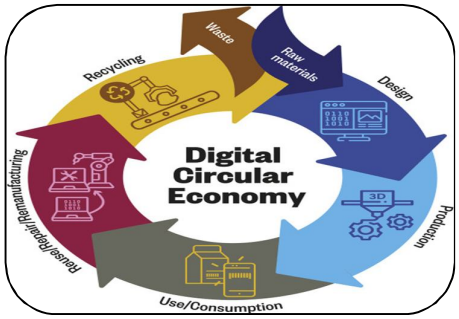
INTERCONNECTIONS AMONG SOCIAL ENTREPRENEURSHIP, DIGITAL TECHNOLOGY AND CIRCULAR ECONOMY: A PATHWAY TO ACHIEVE SUSTAINABILITY



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ABSTRACT

Social entrepreneurship involves in socially responsible business practices and provides innovative solutions of several social and environmental problems by following sustainable business models. In this context applications of digital technology enable them to do their works effectively and help to reach the larger part of the society. On the other hand, circular economy initiates recycling and reuse of materials which leads to sustainable consumption through regenerative approach by reducing waste and pollution. Social entrepreneurs can follow circular economy based innovative business model and at the same time adopt digital technologies like AI, IoT, Blockchain which ultimately follow the path of sustainability. This paper considers and synthesises available existing literatures and data sources to understand the interconnections among social entrepreneurship, digital technology and circular economy and how their interplay helps to achieve the sustainable development of a society in Indian context. The present study has adopted the descriptive research design. This paper has identified the areas where Indian social entrepreneurs are involved in circular economy and how they are contributing towards the sustainable development. At the end, this paper has also highlighted the associated challenges and opportunities.

KEYWORDS: *Social entrepreneurships, Digital technology, Circular economy, Sustainability, Sustainable development.*

INTRODUCTION

The concept of sustainability is the need of the hour. Sustainable development increasingly requires innovative approaches that harmonize economic growth with social equity and environmental preservation. Social entrepreneurship, characterized by mission-driven business models addressing societal challenges, is emerging as a key driver of inclusive economic progress. Social entrepreneurships are involved in socially responsible business practices and provides innovative solutions of several social and environmental problems by following sustainable business models. Concurrently, the circular economy paradigm offers a systemic approach to decoupling economic activity from resource depletion by emphasizing waste minimization and resource efficiency. The advent of digital technologies, especially artificial intelligence (AI), has further transformed business

models and operational efficiencies. Social entrepreneurs are increasingly using AI along with human resources to address multifaceted social challenges. It helps them to get innovative, scalable, effective, efficient, and socially inclusive solutions. As social enterprises follow sustainable business model through bridging profit, purpose and planet, the adoption of circular economy and digital technology are utmost important. It expands market reach, creates benefits particularly for rural and small-scale enterprises. They also contribute to job creation, poverty reduction, and community empowerment.

Social entrepreneurship addresses environmental and social challenges by integrating circular economy principles as resource-efficient business models. Waste reduction (Urban India generates about 150,000 tons of waste per day, according to Press Information Bureau, Government of India), reuse, recycling, and resource recovery are some key aspects of circular economy which create the scope for social entrepreneurs to do their job. Social entrepreneurship and circular economy are necessary to protect environment through low carbon emission, recycling and renewable practices. Innovative technology like AI and Internet of Things (IoT) enables social entrepreneurship to quantify the necessary parameters by measuring and tracking of emissions reductions

Digital technologies, including AI, big data analytics, and digital platforms, serve as crucial enablers of the 'Smart Circular Economy.' They facilitate product redesign, innovative business models, and optimization of value chains, thereby improving resource efficiency and sustainability. Digital transformation also supports social entrepreneurship by broadening market access, enhancing operational efficiency, and fostering stakeholder collaboration. Through the series of socially aligned and environment friendly activities, circular economy model based social entrepreneurs contribute towards Sustainable Development Goals (SDG).

In this backdrop, this study investigates the interconnections among social entrepreneurship, circular economy, and digital technologies in Indian context.

LITERATURE REVIEW

Kumar, S. *et al.* (2021) discussed the relationship between social entrepreneurship and the circular economy and also analyzed key concepts and theories underpinning both fields, highlighting how social enterprises can serve as catalysts for circular initiatives. Their paper identified some barriers to the integration of social entrepreneurship and circular economy practices like regulatory challenges, funding gaps, and the need for greater awareness and education.

Manea *et al.* (2021) provided insights on the influence of factors such as the circular economy, digital innovation and sustainable entrepreneurship on social progress by applying multivariate analysis methods at EU level for 2019. Their results emphasized the importance of developing new policies and implementing new technologies and innovative sustainable models that make the transition to a circular economy, especially in countries such as Romania, Bulgaria, Hungary.

Skivko (2021) examined digital technologies, social entrepreneurship and governance together to the realization of sustainable development goals and emphasized the use of digital technologies and applying the principles of digital culture by considering the Russian social entrepreneurship business to foster technological innovations. The article explained the importance of social and technological innovations in the modern business context.

Bressanelli *et al.* (2022) reviewed the literature to provide a definition of the smart circular economy paradigm as an emergent phenomenon and proposed a framework to consolidate the main concepts underlying the smart circular economy paradigm. Their paper advocated the creation of value and the achievement of enhanced sustainability performance in terms of environmental, economic, and social benefits.

Sharma and Johri (2023) delved the interplay between social entrepreneurship and India's economic development through mixed-methods research approach. Their paper revealed the innovative models, socio-economic impacts, and challenges faced by the social entrepreneurs in Indian

context. They found the emergence of social entrepreneurship as a potential catalyst for inclusive economic growth and sustainable solutions in spite of several obstacles.

Nagaraju and Shubha (2024) studied the growth of social enterprise in the context of India's transition to Industry 5.0, with a particular focus on the bridging role of human capital and artificial intelligence (AI). Their study examined how social entrepreneurs in India are leveraging human capital and AI to solve social challenges in light of complexity of Industry 5.0.

Redko (2024) investigated circular economy and AI empowerment in context of social entrepreneurship and provided valuable insights into the potential of merging technological advancements with socially conscious business strategies to achieve long-term sustainability. The paper also highlighted the advantages and challenges associated with integrating technologies.

Shinde *et al.* (2025) explored the impact of social entrepreneurship on sustainable economic development by addressing societal challenges such as poverty, unemployment, and environmental degradation. Their study examined the key factors influencing social entrepreneurship, including access to finance, government policies, stakeholder engagement, and technological advancements. They found that successful social enterprises leverage innovative financing mechanisms, technology-driven solutions, and collaborative networks to maximize their impact.

Sula (2025) emphasized the role and linkage of social entrepreneurship in building a circular economy ecosystem in the Western Balkans region focusing on one particular Western Balkans country, Albania. The study developed a conceptual framework to connect social entrepreneurship and the circular economy ecosystem, encompassing social orientation in circular economy ecosystems, market orientation in circular economy ecosystems, innovation in circular economy ecosystems, opportunity recognition, and community orientation in circular economy ecosystems.

OBJECTIVES OF THE STUDY

Social entrepreneurships are considered critical for promoting sustainable, inclusive, and innovation-driven development. The primary objective of the study is to understand the interconnections among social entrepreneurship, digital technology and circular economy and how their interplay helps to achieve the sustainable development of a society in Indian context. To achieve this objective, following sub-objectives have been framed:

(i) to understand the arears, functions and contributions of social entrepreneurship.
(ii) to show the linkage between social entrepreneurship and SDG.
(iii) to demonstrate the circular-economy linkage with social enterprises and applications of digital technology.
(iv) to point out the challenges and opportunities.

RESEARCH METHODOLOGY

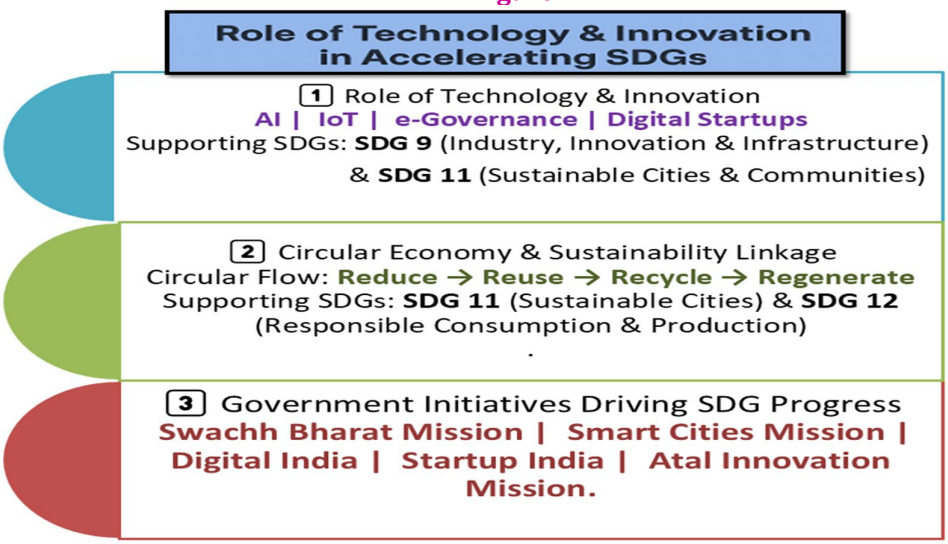
The research approach of the present paper is purely descriptive in nature. It is based on secondary data. This paper considers and synthesises available existing literatures and data sources to accomplish the objectives of the study. All data are used in this study in Indian context. A group of Indian social enterprises working on circular economy model have been chosen as per the availability of data. This involves the collection and analysis of relevant data sets in tabular form to identify patterns and to get in-depth insights about their practices and outcomes.

ANALYSIS AND FINDINGS

Social entrepreneurships help the society in various ways like job creation, environment protection, communities support, accomplishment of SDGs. Circular-economy model based social entrepreneurs in India play a vital role in promoting sustainable development by embedding resource circularity, social inclusion, and environmental responsibility within their business models. Use of digital technology enables them to achieve their purposes in a more impactful way. Different

government programmes help social entrepreneurship (especially circular-economy based) to act towards sustainability. Following figure shows the role of technology and innovation in accelerating SDGs in context of circular economy and government initiatives.

Figure: 1



Source: Authors' compilation

Social Entrepreneurs have different functions and areas to contribute towards society to achieve sustainability. The next table presents them with reference to different SDGs.

Table 1: Arears, Functions and Contributions of Social Entrepreneurship

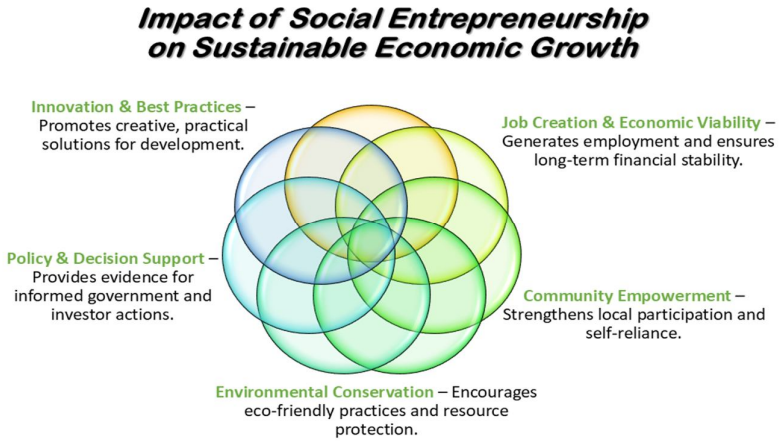
Areas	Functions	Contributions
Environmental sustainability and resource efficiency	Segregation of solid waste, multilayer plastics, e-waste, textile waste, floral waste, and organic waste from landfills and open dumps	• Waste minimization • Resource recovery • Decreases in greenhouse gas emissions, air and water pollution, and the depletion of natural resources
Social inclusion and community empowerment	Engagement with marginalized people loke waste pickers, rural women, informal workers and low-income households	• Integration of marginalized people into mainstream economic systems
Public health and urban sustainability	Recycle of hazardous waste (like e-waste, sanitary waste, chemical waste), reduction of exposure to toxic materials and mitigation of health risks	• Enhancement of public health and urban environmental quality
Economic resilience and green innovation	Encouragement of green entrepreneurship and localized production	• Expansion of India's green economy • Creation of new green jobs in areas such as waste collection,

		segregation, decentralized recycling
Sustainability issues	Application of all the abovementioned functions	• Alignment with multiple SDGs, including SDG 1 (No Poverty), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Source: Authors' compilation

Following figure depicts the impact of social entrepreneurship on sustainable economic growth through the multifaceted interconnected activities.

Figure: 2



Source: Authors' compilation

India is the world's top plastic polluter, emits 9.3 million tonnes annually, about 20% of global plastic emissions. India produces over 159,000 tonnes of waste each day. It is estimated that rural India generates 15,000 to 18,000 million liters of liquid waste (greywater) and 0.3 to 0.4 million metric tons of solid waste per day. India generates approximately 4 to 9 million tonnes plastic waste per year out of which only 13 % to 60 % are reliably recycled. According to a report by The Energy and Resources Institute (TERI), India, on average, generates 62 million tonnes (MT) of waste annually, including 7.9 MT of hazardous waste, 5.6 MT of plastic waste, 1.5 MT of e-waste, and 0.17 MT of biomedical waste but only 43 MT of total waste generated gets collected, with 12 MT being treated before disposal, and the remaining 31 MT simply discarded in wasteyards. The Central Pollution Control Board (CPCB) projects that India's waste generation will increase to 165 MT by 2030. These gaps affect both environmental sustainability (GHG reduction, resource efficiency) and generate scope for social entrepreneurship (market size, business viability, technology adoption). This scenario highlights the urgent need for circular-economy interventions.

Social entrepreneurs are linked with SDG through their socially aligned activities. Applications of digital technology adds wings to it. Following table establishes the linkage.

Table 2: Linkage between Social Entrepreneurs and SDG (through selected parameters)

Parameters	Role of Social Entrepreneurs	SDG Link
Digital Technology	Social entrepreneurs can use AI for waste segregation, Blockchain for supply chain traceability, or Quantum-secured data for privacy in health/social data.	SDG 9 (Industry, Innovation, and Infrastructure)
Environmental Initiatives	Social entrepreneurs do innovation around waste recycling, composting, plastic reduction, and urban cleanliness and convert waste to wealth.	SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption and Production)
Technology-Driven Education and Inclusion	Social entrepreneurs can embrace social innovation model to reduce inequality through Use of mobile apps, digital platforms, and AI.	SDG 4 (Quality Education)
Digital Economy	Social entrepreneurs use digital platforms as viable tools for scaling social and circular initiatives	SDG 9 (Innovation), SDG 8 (Decent Work), SDG 13 (Climate Action)
Green Policy	Use of AI, IoT to optimize resource use, reduce waste, and track emissions	SDG 13 (Climate Action), SDG 7 (Clean Energy)
Policy Documents for Sustainability	Social entrepreneurs are guided by Government and institutional frameworks to align their work with sustainability in prominent areas like startups in renewable energy, waste recycling.	SDG 17 (Partnerships for Goals)

Source: Authors' compilation

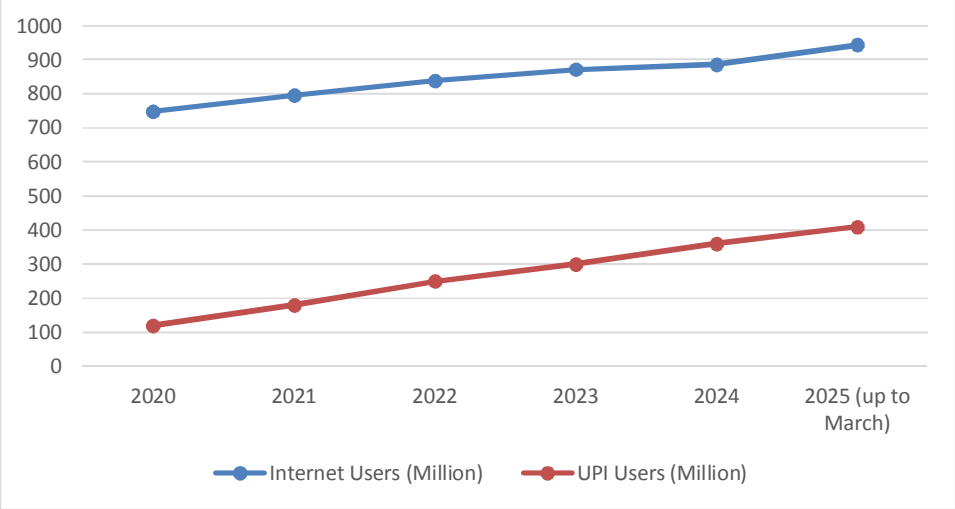
To leverage the advantages of digital technology, the access to it is one of the key points. We can use 'Internet Users' and 'UPI Users' as the proxy to understand the state of digital progress in India as shown in the following table.

Table 3: State of Digital Progress in India

Year	2020	2021	2022	2023	2024	2025 (up to March)
Internet Users (Million)	749	795	839	871	886	944
UPI Users (Million)	120	180	250	300	360	410

Source: Source: Authors' compilation

Figure 3: Internet Users and UPI Users in India



If we keep focus on 2025 then following insights are found material (Table 4).

Table 4: Summary Insights (2025)

Mobile Subscribers	Internet Users	5G Coverage	Smartphone Ownership	Digital Payment Adoption	UPI Users	UPI Transactions	Rural Internet Penetration
1.16 billion	944 million (↑ 26 % since 2020)	99 % of districts	85.5 % of households	99.5 % of youth use UPI	410 million active users (↑ 241% since 2020)	>13,000 crore in FY 2024; ▪ 180 lakh crore value	↑ 12 % since 2021

Source: Authors' compilation

The above table shows the digital penetration status in India in 2025. It is quite high.

AI is the highest level of application of digital technology which can be used for sustainable circular economy in various means. An AI empowered social entrepreneurship can achieve its success in a sustainable manner while working under circular economy model. Table 5 provides a snapshot of it.

Table 5: AI Applications for Sustainable Circular Economy

Application of AI	Description
Optimizing Resource Management	AI can analyse large datasets to optimize the use of resources, predict demand, and optimize logistics and supply chains.
Enhancing Product Design	AI can assist in designing products that are easier to recycle, by analysing materials and suggesting alternative recyclable or biodegradable materials.
Facilitating Circular Business Models	AI can enable the development of circular business models, such as product-as-a-service, by tracking and managing product usage.
Improving Waste Sorting and	AI-powered robots can identify and sort different types of

Recycling	materials in waste streams, increasing recycling rates and reducing contamination.
Enabling Predictive Maintenance	AI can predict equipment failure, enabling proactive maintenance and extending lifespan, reducing the need for premature replacements.

Source: Redko, K. (2024). Circular economy and AI empowerment in social entrepreneurship: A path to sustainability. *International Science Journal of Management, Economics & Finance, 3*(3), 27-35.

Now, to understand the way social enterprises in India are functioning under circular economy framework by applying digital technology, purposively we have selected eleven social enterprises. The basic working areas of our selected social enterprises are waste collection, recycling and reduction. Following table shows the circular-economy linkage with social enterprise and applications of digital technology in their work.

Table 6: Circular-Economy Linkage with Social Enterprises and applications of Digital Technology

Sl. No.	Social Enterprises and Location	Functions	Circular-Economy Link	Applications of Digital Technology	Use of Digital Technology
1	Saahas Zero Waste (Bengaluru/pan-India)	Waste collection → recycling/ Composting	Turning waste → resources (compost, recyclables)	IoT sensors, Digital EPR (Extended Producer Responsibility) platforms, Automated MRF machines	Track waste volume; automate sorting; upload EPR compliance data
2	Hasiru Dala (Bengaluru)	Integrates informal waste pickers	Resource recovery + livelihoods	QR codes, Digital ID system, Mechanized sorting	Track waste-picker work; monitor collection; use trommels & separators
3	GEM Enviro Management (Pan-India)	PET recycling	Plastic → recycled granules	Reverse Vending Machines (RVMs), Digital EPR Credit System, Barcode tracking	Consumers deposit bottles; system generates EPR credits; trace PET
4	Bare Necessities (Bengaluru)	Zero-waste personal-care brand	Zero-waste production + reuse	Digital supply-chain tracking, Eco-material R&D	Manage zero-waste production; research biodegradable inputs
5	Ecolibrium Energy (Ahmedabad)	Energy-efficiency solutions	Reduces energy waste	IoT sensors, AI analytics dashboards	Monitor energy waste; optimise industrial consumption
6	Green Worms (Kerala)	Coastal waste recycling	Material recovery from coastal waste	GIS mapping, Route-optimization software, Mechanised MRF	Map waste hotspots; optimise collection routes; coastal baling machines
7	Banyan Nation (Hyderabad)	Clean plastic recycling	Recycled plastic for manufacturing	AI + ML plastic recognition, IoT quality checks, Advanced washing tech	Identify polymer types; clean & process plastic with precision

8	EcoKaari (Pune)	Upcycled fabric bags	Upcycling waste → fashion	Digital design tools, E-commerce tech	Create upcycled product designs; sell through online platforms
9	Goonj (Pan-India)	Cloth & material reuse	Reuse of urban surplus	RFID logistics tracking, GPS-enabled transport, Data dashboards	Track material movement across India; classify reusable items
10	Phool.co (Kanpur)	Upcycled floral waste	Organic upcycling	Biotechnology (microbial fermentation), Automated extraction	Convert floral waste → "Fleather" (bio-leather)
11	Recykal (pan-India)	Connects brands, recyclers, aggregators; real time bidding and EPR certificate management; digital traceability for recyclables	Enables transparent EPR compliance and platform-driven circularity across stakeholders	Cloud SaaS marketplace, EPR compliance platform, AI-assisted operations	SaaS-based track and trace platform to monitor industrial waste flow

Source: Authors' compilation

- **Challenges in integrating circular economy and digital technologies in social entrepreneurship**

Despite the promising potential, following are the challenges for adoption of circular economy models and digital technologies by social enterprises:

i. Limited access to capital particularly to adopt circular economy model.
ii. Presence of digital divide due to disparities in digital infrastructure and skills particularly affecting rural entrepreneurs.
iii. Lack of awareness, lack of proper digital literacy, and cybersecurity are also challenges for technology integration.
iv. Lack of comprehensive Waste Audits, underreporting of waste generation and inadequate infrastructure.

- **OPPORTUNITIES**

Proper management of waste through recycling is the need of the hour. Indian is still lagging behind. It creates the opportunities for the social entrepreneurs. Following points highlight some of them.

i. Waste generation is huge in India. So, opportunity for expanding circular economy-based business model is growing.
ii. Different initiatives have been taken in India related to waste management. Swachh Bharat Mission was launched in 2014, Waste to Wealth initiative was taken under the Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC), Waste Management Rules and Guidelines were introduced time to time under the Environment (Protection) Act, 1986 (e.g. Plastic Waste Management Rules, 2016; E-waste Management Rules, 2022; Battery Waste

Management Rules, 2022). These serious initiatives create the growing ecosystem of circular economy model based social entrepreneurship.

iii. The median age in India is 28.8 years (2025). A large portion of them have access to digital technology. Moreover the 'Zen Z' of India are aware about environmental issues. This demographic profile creates a favourable situation to the circular economy-based social entrepreneurs.

CONCLUSION

This paper concludes that by following circular economy based innovative business model and at the same time adopting digital technologies like AI and IoT, the social entrepreneurs lead us towards sustainability. The interconnection among social entrepreneurship, circular economy, and digital technology creates a pivotal framework for sustainable and inclusive development. India's rapid economic growth and urbanisation have led to significant challenges, such as resource depletion, environmental degradation, and increased waste generation. Adopting circular model is the solution. In India, social enterprises such as Saahas Zero Waste, Hasiru Dala, and Goonj are showing how community-based innovation addresses social and environmental challenges. India's circular economy future involves massive growth ($2 Trillion by 2050) driven by E-Waste Management (UNDP-backed projects for formal recycling), Plastic Waste innovations (road use, fuel, bio-alternatives), Waste-to-Wealth (dairy, textiles, food waste-to-feed/leather), EV Battery Recycling, and Sustainable Design. The circular economy through recycling, reuse, and repair, could generate nearly ₹ 40 lakh crore (≈ USD 624 billion) annually by 2050 and reduce greenhouse-gas emissions by 44 per cent. On the other hand, judicious use of digital technology enhances waste tracking, resource utility and energy efficiency. The convergence of social entrepreneurship, digital technology and circular economy contributes to a more resilient and sustainable economy and is much required for India to be *Viksit Bharat @2047*.

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