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Turning Trash to Treasure: A Case Study of Madhya Pradesh's Waste Management Innovations

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ABSTRACT

Madhya Pradesh, India's second-largest state by area and fifth most populous, has emerged as a national exemplar in sustainable municipal solid waste (MSW) management. Over the past decade, the state has implemented a multi-tiered strategy combining large-scale infrastructure, public–private partnerships, and community-based interventions. Key developments include a 6 MW waste-to-energy facility in Rewa; Bhopal's attainment of a 7-star Garbage Free City rating; and Indore's Devguradia GOBARdhan plant Asia's largest MSW-based Bio-CNG facility producing 17,000 kg of Bio-CNG per day. Plastic recycling capacity has expanded more than threefold, with approximately 2.8 lakh metric tonnes processed in 2021–22 through granulation, cement co-processing, and road construction applications. Complementing these technological advances are grassroots initiatives such as Jhabua's waste-derived public art and Chhindwara's extensive NADEP composting programme involving 68,000 participants across 1,900 villages. Collectively, these interventions illustrate a robust "waste-to-wealth" paradigm that integrates technological innovation, participatory governance, and supportive policy frameworks. Madhya Pradesh's experience provides a significant case study for scalable, integrated MSW management in rapidly urbanizing regions.

Keywords: Municipal solid waste, waste-to-energy, waste-to-wealth, MSW management.

1. Introduction

The state of Madhya Pradesh (MP) is witnessing a rapidly growing challenge with municipal and industrial waste what we might call the rising tide of waste (MOSPI, n.d.). In the city of Indore (one of MP's major urban centres) total waste generation is around

1,115 metric tonnes per day (MTPD), with wet waste ~650 MTPD and dry waste ~465 MTPD (Smart City Indore, n.d.). In the district of Rewa, per-capita generation was about 0.35 kg/day and 86 tonnes per day in total at the time of study (Ganaie et al., 2023). State-level data show that the number of urban local bodies and their waste generation has been increasing. As population, urbanisation, consumption pattern rise, so does waste generation. With rising incomes, more packaging, more non-biodegradable items (plastics, e-waste) are entering the waste stream, making management more complex. This shift means the "waste mountain" is not just getting bigger but also more heterogeneous-requiring more sophisticated handling. The infrastructure to manage it is under pressure.

Unmanaged or poorly managed waste can leach into water, cause soil contamination, emit greenhouse gases (e.g., methane from organic waste in landfills). One study notes such risks in MP (Sen, 2022). Accumulation of waste in urban neighbourhoods leads to vector-borne disease risks, blocked drains, the spread of litter. A study in Bhopal found that even in a "clean city" there were significant gaps in waste management and public perceptions of it (Wadghane, 2024). Costs of transportation, processing, land-filling are rising; cities need to invest more, the gap between what's generated and what's processed grows. Without proper systems, the "waste" becomes a liability rather than a resource.

Madhya Pradesh, which is the second largest state in India by area and ranks fifth in terms of population, has emerged as a leader in sustainable waste management. The urban areas of the state, which are home to over 70 million people, have overhauled their Municipal Solid Waste management practices, received numerous awards and set benchmarks for other states to emulate (Swachh Survekshan, 2024). The Indian state of Madhya Pradesh has emerged as an inspiring example of how waste can be converted into valuable resources. Through innovative policies, public participation, and the use of modern technology, the state has successfully implemented several "Waste to Wealth" initiatives that not only help in environmental conservation but also contribute to economic growth. This article enlists such innovations adapted by different regions of Madhya Pradesh.

2. Key Projects

Major projects are being operated in metro cities of the state, viz Indore, Bhopal, Gwalior and Jabalpur. But, other cities or townships are walking hand-in-hand in this campaign. It is this teamwork which has made Madhya Pradesh set standards for others. Multiple projects are being carried out in smart city Indore and Bhopal. The key projects ongoing in these metropolitans have been separately studied in this work.

2.1 Indore: Indore, often called the Cleanest City of India, has become a national model for converting waste into useful resources. Instead of treating waste as a problem, the city

has adopted the principle of "Waste is Wealth", where garbage is processed scientifically to create compost, biogas, fuel, and recyclable products (Tiwari & Sharma, 2024; Tiwari & Sharma, 2021). Indore runs one of Asia's largest bio-methanation plants at Devguradia. The Bio-CNG (GOBARdhan) Plant processes wet waste and produces Bio-CNG, which is used to fuel 1500+ city buses and municipal vehicles (Smart City Indore, n.d.). The city also operates an Automated Dry Waste Processing Plant that recycles nearly 100% of the dry waste, recovering materials like aluminum, iron, and plastic for reuse in industries. Additionally, wooden pellets are produced from garden and horticultural waste and are used as an eco-friendly fuel in industrial units such as NTPC, helping reduce coal consumption. Indore has also promoted creativity through Waste-to-Art Initiatives (Mahajan & Navin, 2025), where artists like Sunil Vyas and Deval Verma have transformed scrap materials into artworks, including a remarkable replica of the Sanchi Stupa displayed by the Indore Municipal Corporation. Indore's success is driven by active citizen participation. Under Plastic Waste Management, the campaign "Jhola Dhari Indore" encourages people to use cloth bags instead of single-use plastic. Moreover, large quantities of green waste from parks and gardens are composted to produce organic manure, promoting sustainable urban greenery. These efforts have not only reduced landfill waste but also generated employment, improved public health, and created economic value, truly transforming "trash into treasure" in Indore.

2.2 Bhopal: Bhopal has emerged as a leading example in sustainable waste management, ranking as the 2nd cleanest city in India in the Swachh Survekshan 2024-25 survey, and earning both a 7-Star "Garbage Free City" rating and "Water+" status (Parihar et al., 2019; Down to Earth, 2024). The city has adopted key technological innovations, including the 200-ton biogas plant at Adampur Chhavani, which produces about 65 MT of Bio-CNG daily, helping reduce landfill waste while generating clean fuel for municipal use. Another major milestone is the remediation of the Bhanpur Khanti dumpsite, which has successfully reclaimed nearly 37 acres of land, turning a former waste mountain into usable urban space (Down to Earth, 2024). However, despite these achievements, Bhopal's waste management system currently generates limited direct revenue. A District Panchayat is reported to earn around ₹4.5 lakh annually from its Material Recovery Facility, highlighting the need for stronger financial sustainability. Through such measures, Bhopal continues to move towards the goal of turning waste into wealth sustainably.

2.3 Rewa: In Rewa, a significant "waste to wealth" project involves a state-of-the-art waste-to-energy (WTE) plant operated by Re Sustainability Limited (ReSL). Inaugurated in February 2024, the facility serves Rewa and 27 other urban local bodies in the surrounding districts and promotes a circular economy through initiatives aligned with

the Swachh Bharat Mission. This integrated solid waste management (ISWM) (Ganaie, et.al. 2023) facility is designed to process 600 metric tons of municipal solid waste daily, converting 350-380 tons per day of refuse-derived fuel (RDF) into 6 megawatts of electricity. The project, operating on a build, own, and operate (BOO) model with an ₹87 crore government capital grant, provides comprehensive waste management solutions for about 235,000 households and transforming regional waste into a valuable energy resource.

2.4 Chhindwara: This district is implementing waste to wealth initiatives through projects focused on biodegradable waste management and community-based solid waste management, including a partnership with Development Alternatives and HUL Prabhat. Under the Swachh Bharat Mission (Grameen) Phase II, around 8,507 NADEP compost pits were constructed across 784 Gram Panchayats and 1,898 villages to convert biodegradable waste like cow dung, kitchen scraps, and leaves into organic compost (MP Info, 2025). This initiative not only reduces chemical fertilizer use but also provides additional income to farmers, with each pit generating up to ₹30,000 annually through multiple composting cycles. Alongside rural efforts, the Chhindwara Municipal Corporation, in partnership with Fusion Waste Management & Consultancy Pvt. Ltd., has introduced urban waste management projects focusing on door-to-door segregated waste collection, home composting, and reuse programmes such as the "Bartan Bank" and "Thaila Bank," which promote reusable utensils and cloth bags to minimize single-use waste. Other efforts include "Neki Ki Deewar" collection points for reusable items and e-waste recycling services. Together, these rural and urban initiatives promote environmental sustainability, community participation, and economic benefits by effectively turning waste materials into valuable resources and reducing the burden on landfills.

3. Other initiatives

Small level projects weather entrepreneurial level or community level tasks can be observed in small townships of the state. These small projects contribute to major changes in the state.

3.1 Bio-CNG Plants: Before the main Gobar-Dhan plant, Indore had two smaller-scale bio-CNG plants at Choithram Mandi and Kabit Khedi, which process fruit and vegetable market waste (NITI Aayog, n.d.). Two more prominent bio-CNG plants are operational in Madhya Pradesh - one in Gwalior's Laltipara Adarsh Gaushala and a recent one in Raisen. State promotes this sector through policies like the Biofuel Policy 2025. Gwalior's plant was inaugurated in October 2024, has a capacity to process 100 tons of cow dung and wet waste to produce 2-3 tons of Bio-CNG as a clean fuel and 10–15 tons of organic manure that is supplied to local farmers. It is India's first modern and self-reliant gaushala of its kind and was developed in collaboration with Indian Oil Corporation (IOC)16. These plants support organic agriculture, reducing greenhouse gas emissions,

and creating employment. Reliance Industries is in the process of setting up 10 compressed biogas (CBG) plants in various districts including Bhopal, Indore, Jabalpur, Satna, and Balaghat.

3.2 Waste to Artifacts: Madhya Pradesh has showcased several creative waste-to-art initiatives that transform discarded materials into meaningful public artworks (The Better India, 2020). The Indore Municipal Corporation created a striking replica of the Sanchi Stupa gate using scrap items such as plywood, metal waste, and other discarded materials, which was recognized under a national initiative by the Ministry of Culture. In Jhabua, sanitation workers contributed to the Swachh Bharat Mission 2024 by producing sculptures and artistic items for Dr. Bhimrao Ambedkar Park, including decorated plant beds, benches, and pots each crafted from repurposed waste (ANI News, 2024). Similarly, Mohammed Kashif, an artist from Bhopal, gained a world record in 2020 for having the largest collection of artworks made entirely from waste, using materials like coconut jute, waste wood powder, and leftover textile fibers. Another landmark initiative is the Gwalior Safari (Waste-to-Art Park), where large animal sculptures and structures are crafted entirely from scrap metal and discarded materials, transforming waste into creative public art while spreading awareness about recycling. On a broader level, the Ministry of Electronics and Information Technology (MeitY) launched a national "Waste to Art" campaign in 2025, encouraging citizens across the country to create art from waste and share it online, with selected works displayed at the MeitY office. Together, these efforts highlight how waste can be reimagined as a resource for creativity, cultural expression, and environmental awareness.

33 Madhya Pradesh contributed substantially to crop-burning emissions, being the second-largest crop-burning emission state in 2020. To tackle this issue, an entrepreneurial initiative by a **Morena**-based company called (Craste, n.d.) has been transforming crop stubble and agricultural waste into valuable products like paper and furniture boards. The founder, Shubham Singh, moved his operations to Morena to leverage the area's agricultural resources as raw material for his business. The company prepares a pulp from the straw, which is then mixed with chemicals and glue before being pressed into molds to create the final product.

In addition to this private sector effort, other waste-to-wealth activities in Morena include educational initiatives. Students at the Neil World School, for example, have participated in campaigns to transform waste into wealth. This shows a focus on both entrepreneurial innovation and community-level awareness building in the region.

4. Conclusion

The state manages municipal solid waste, hazardous waste, and plastic waste through a combination of source segregation, Material Recovery Facilities (MRFs), composting, and

co-processing. Reports say that the state could generate between ₹ 1,000 crore and ₹ 6,000 crore annually in gross value from compost and energy derived from municipal waste, depending on efficiency and market prices20. Additionally, state has potential to avoid 0.7–2.4 million tonnes of CO_2 emission per year, improve soil fertility, reduce landfill usage, and enhance urban cleanliness.

In total, waste-to-wealth initiatives in Madhya Pradesh are making meaningful contributions both economically and environmentally. They're turning previously unutilised waste into compost, energy, reusable materials and businesses creating incomes, reducing costs, improving resource use, and helping environmental sustainability. However, the scale of the opportunity is large, and the full benefits will only come if issues of segregation, awareness, infrastructure investment, operations & maintenance, and scaling are addressed.

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Dr. Divya Patel- Conceptualization, Formal Analysis and Interpretation
Preeti Kourav- Data Collection, Writing
Pooja Patel- Writing

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Statement of Conflict of Interest

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