Exploring Solid Waste Management in Bihar: Drawing Insights from Global Success Stories for a Cleaner and Greener State

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ABSTRACT

Bihar, one of India's most densely populated states, faces substantial hurdles in effective management of solid waste originated from different sources. If looked around, prime reasons might include huge population expansion, inadequate infrastructure, swift urban transformation and primarily lack of education and awareness. This article tends to explore the present complex scenario of solid waste management in the lands of Bihar while highlighting challenges and future substantial solutions. Any solid material which is produced in the course of daily human actions which is discarded or undesirable is termed as solid waste. The key components of solid waste management are waste generation, storage, waste collection, transportation and waste disposal. Solid waste management is based on the principles of waste generation, storage, systematic collection, handling, transportation

and safe disposal. The hierarchy of solid waste management involves Waste reduction, recycling practices and appropriate disposal methods to mitigate environmental risks, preserve resources and foster sustainability. In Bihar, concerted efforts are of utmost importance in each component. The "Dolphin Man" of India, an environmental conservationist Dr. R K Sinha says "Patna is one of the worst cities in terms solid waste management". According to the National Green Tribunal, in 2023 Bihar generated 3,000 metric tons (MT) of solid waste per day and plastic waste accounts for 5-6% of the total waste. In addition to that, less than 50% of the total waste generated is properly collected and maintained. However, Bihar is witnessing a paradigm shift in the sustainable management of solid waste. From biogas plants to pyrolysis that converts waste into energy are being implemented in the state. The state can learn from Zero waste initiatives in San Francisco. Therefore, collective action is needed while advocating for policies and interventions that will prioritize sustainability.

INTRODUCTION

The challenging present scenario from environmental and ecological consideration is causing global threats to the entire mankind and mother earth. This article is to shed light on sustainable practices, recycling initiatives, and the critical role each of us play in minimizing solid waste and maximizing effective and sustainable practices for a cleaner and healthier tomorrow. There is utmost need to understand the complexities of solid waste, to uncover the challenges and to explore emerging trends for informed decision making and actions and to actively participate for a resilient future. In Bihar, for managing solid waste there are 143 Urban Local Bodies (ULB), under which 12 Corporations, 45 Municipal Councils, and 86 Nagar panchayats are there (MSW annual report, 2018). Department of Urban Development and Housing has the responsibility to formulate the policies and strategies for managing solid waste. They are further responsible for the effective implementation of guidelines and provisions according to solid waste management rules, 2016. Bihar State Pollution Control Board (BSPCB) also plays a key role in monitoring and regulation of solid waste management practices (MSW annual report, 2018). Huge population expansion and swift urban transformation is found to be the prime reason for major solid waste generation (Asnani, 2006). The state is adopting leading edge solutions to maximise waste recovery. The policy makers, governmental organizations and non-governmental organizations are coming together with different awareness campaigns, outreach programs, school programmes, public programmes to motivate the grass root people for a change. Bihar is also making great efforts to nurture the youths of the state towards environmental responsibility. Fortunately, this bottom-up approach is strengthening social participation and mobility and thus effective implementation of the sustainable practices at the ground level.

Solid waste: an unavoidable reality

Waste is anything which is discarded, unwanted, unusable and undesirable but produced in the course of daily human activities. Waste might be garbage from homes, commercial and industrial activities, institutional, agricultural operations etc (Nathanson, 2023). The waste which is not soft enough is regarded as solid waste.

Types of waste: extending beyond the bin

The wide range of solid waste includes household waste, industrial waste, commercial waste, biological, biomedical, construction and demolition debris, radioactive waste and certain types of hazardous waste (Wikipedia, 2024). Societies adopting modern amenities, urban lifestyle and technological progress, there is a continuous surge in the generation of solid waste, mainly municipal solid waste (Hoornweg & Bhada-Tata, 2012) causing mounting challenge to environmental and delicate balance of ecosystems and human well-being on a global scale, demanding more innovative and sustainable practices.

Poor waste management: the undeniable effect

Starting from the air we breathe, water we drink and the earth we live, the poor waste management is causing threat to entire humankind. From habitat and biodiversity destruction to ecological imbalance, from health hazards to global climate change, waste management is urgent and multifaceted concern on a global scale.

Table1: amount of solid waste generation and its projection

Year	Per capita solid waste generation
2011	1010 TPD
2016	1277 TPD
2021	1514 TPD
2026	1836 TPD
2031	2299 TPD
2036	2570 TPD

Source: Pandey, 2011 (TPD=Tonnes per day)

According to another estimate by the Centre for Science and Environment (CSE), India in 21st December, **2016** states that Bihar generates **2,500 tonnes per day (TPD)** of solid waste (CSE, 2016). This indicates that solid waste generation in the state is exceeding the projection (Table 1) at a much higher rate. As per recent data of National Green Tribunal, Bihar generated **3,000 metric tons (MT) of solid waste per day** in **2023** and plastic waste accounted for **5-6%** of the total solid waste (National Green Tribunal, 2023).

Table 2: Recommended strategies for effective solid waste management

SI NO	STAGE	STRATEGIES
1	Generation	• 3Rs: Reduce, Reuse, Recycle
		• Awareness campaigns, public programs
		• Use of easily recyclable and biodegradable products
		• Promote waste composting eg. Organic waste
		• Waste to wealth approaches
2	Storage	• Waste segregation at different places according to sources
		• Properly sized durable waste bins or containers for temporary storage of waste
		• Plastic bins, communal bins etc.
		• Communal depots, shallow pits
		• Storage places away from residential areas and must be covered
3	Collection	• Volume and time interval for waste collection must be taken care of
		• Door to door collection
		• Collection according to types and sources example organic, non-biodegradable, sewage etc.

		• Active participation of responsible bodies and agencies along with each citizen and communities
4	Transportation	• Availability of waste collection vehicles
		• Use of fuel and energy efficient vehicles
		• Proper routes for efficient transfer of waste
		• Use of cost and energy effective mode of transportation
5	Disposal	• Proper sanitary landfills
		• Waste to wealth options to optimize the waste disposal at landfills
		• Recycling and recovery are the key

Innovative Approaches to solid waste management

Parallel to the technological advancements, innovative approaches might be sound option. Further research and development should be oriented to know how the entire globe is turning waste into valuable resources. Improved storage facilities, Smart waste bins, family bins, communal bins, human powered, animal powered, motorised transportation options, waste-to-energy projects, different community-based initiatives, awareness campaign, Reusing and recycling programs, to separate recyclables and initiate practices to turn those into new products, creating economic opportunities, Composting projects must be incorporated into the practices of solid waste management (Watsan, 2005).

Global success story: Zero waste initiatives in San Francisco

San Francisco is adopting an exemplary initiative with its pioneering zero waste initiatives for a sustainable environment. According to United States Environmental Protection Agency, the city's Mandatory Recycling and Composting Ordinance, enacted in 2009, mandate every citizen to separate recyclables, compostable and trash and keep in separate bins (EPA, 2023). The city implemented iconic three stream citywide collection program. The outreach program for residential and commercial collection used images and many languages primarily Chinese, Spanish with customer service to communicate in any languages. In 2018, the city further committed to reduce solid waste generation by 15% and landfill disposal by 50% by 2030 (EPA, 2023). The city has implemented maxims and regulations, community engagement, and innovative programs to keep a substantial portion of its waste away from landfills. It also aims to encourage residents and businesses to adopt 3R including reduce, reuse, and recycle. It is further contributing to San Francisco's ambitious goal of achieving zero waste and serving as an inspiring model across the globe.

States admiring approaches

Patna Municipal Corporation: Patna Municipal Corporation and UNFPA is promoting "Swacchangni" which is a women led enterprise model and here all the sanitation worker community comes together from slums (Green Tribunal, 2023).

Ghoghardia Nagar Panchayat: it is working on "eco-bricking", an inventive, cost effective, and environment friendly scheme which calls for packing plastic bottles with solid non bio degradable waste to get a desired density (Green Tribunal, 2023).

Gaya Municipal Corporation: A biomethanation plant is set up by Bihiya Nagar Panchayat which is producing 150 kg biogas each day and this biogas is used to prepare meals for the workers under solid waste management (Green Tribunal, 2023).

Opportunities the state commits

A solid waste management strategy is being proposed in PPP and it is cluster based. However, this strategic intervention is under the approval of Government of India. Considering the lack of facilities and large processing, PPP mode is taken (Green Tribunal, 2023). 24 clusters are being developed by considering the solid waste management components including waste generated from different sources, collection facilities, storage facilities, land availability, transportation facilities with optimal distance of 40 kms (Green Tribunal, 2023).

Citizen's critical role: minute action; Major outcome

Every action count in the longer run. Collective action and conscious choices can create tremendous change. Responsible purchasing & consumption of necessities and generation of waste, championing reusing and recycling initiatives, advocating policies that prioritize environmental and ecological sustainability must be practiced. We need to implement our theoretical knowledge in everyday lives to have a world where waste isn't a problem but a valuable resource. The conscious effort could further help to make a cleaner and greener world for the generations to come. There is a pivotal role to be played by individuals, communities, and policymakers to contribute towards a sustainable planet.

CONCLUSION

In conclusion, the detailed framework of solid waste management has shed light on understanding and practicing the principles and innovative approaches of managing and handling waste to build a lasting legacy of sustainability. Bihar, a green state needs to take more conscious actions and strategies that will help the state to be a more cleaner and greener. Perhaps, encouraging conscious behaviours of each citizen towards environment, supporting recycling endeavours, and acknowledging the significant impact individuals have in minimizing solid waste are pivotal steps toward cultivating a future that is both cleaner and resilient. As Bihar walks towards a more sustainable future, it acts as an example for the remaining regions that is also struggling with same concerns. This article has emphasized the importance of embracing sustainable initiatives to reduce waste and its substantial impact on both humanity and the planet. The application of theoretical knowledge in everyday life is a key to create a world. As we navigate towards a cleaner and greener future, individuals, communities, and policymakers at large must collaborate to secure a perpetual environmental harmony. Let's pave the way for a more sustainable and eco-friendlier Bihar and beyond.

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