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Household Solid Waste Management and The Impact of Urban Health of Rajshahi City Corporation

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ABSTRACT : The rapid urbanization of Rajshahi City Corporation (RCC), Bangladesh, has significantly strained its household solid waste management (HSWM) systems, creating adverse consequences for urban health, environmental integrity, and municipal efficiency. This dissertation investigates the linkages between existing HSWM practices and urban public health in RCC and explores economically viable, socially inclusive strategies to transform waste into valuable resources. Employing a mixed-methods approach—including household surveys, field observations, stakeholder interviews, and cost-benefit analysis—the study identifies key systemic weaknesses in RCC's current waste infrastructure. Only 45–50% of household waste is formally collected, while the remainder contributes to open dumping, blocked drains, and vector breeding—exacerbating waterborne diseases, respiratory infections, and environmental degradation. Economic modelling reveals that decentralized composting units, small-scale anaerobic digestion (AD), and community-level Material Recovery Facilities (MRFs) are financially feasible. For example, a 20 t/day composting unit could generate a net benefit of USD 200,000 annually; AD facilities offer energy returns with payback periods of 3–3.5 years. Combined, these systems could divert over 50% of household waste, reduce public health burdens, and create 200–300 sustainable jobs. Further revenue opportunities include compost sales to peri-urban farmers, recyclable recovery for regional markets, and carbon offset credits via methane avoidance. However, barriers such as budget constraints, volatile commodity prices, and limited private sector incentives hinder system transformation. The dissertation proposes a phased, public-private-partnership (PPP) driven model: beginning with low-cost pilots in priority wards, scaling through digital monitoring and inclusive policies, and culminating in regional waste-to-resource infrastructure. Drawing from best practices in cities like Pune, Curitiba, and Seoul, the research outlines a roadmap for RCC to transition from linear waste disposal to a circular, health-focused urban economy. By reimagining waste as a resource, RCC can unlock environmental, economic, and public health co-benefits—contributing to a more resilient and liveable urban future.

I. INTRODUCTION

Rajshahi is one of the eight divisional capitals of Bangladesh and lies on the northwestern side of the country, along the banks of the Padma River, which forms part of the border with India's West Bengal. Spanning an area of approximately 96.68 square kilometres, the city serves as the administrative headquarters of the Rajshahi Division and is governed by the Rajshahi City Corporation (RCC). Urbanization in Bangladesh has accelerated rapidly over the past two decades, placing increasing pressure on municipal services, particularly solid waste management. Rajshahi City Corporation, a major secondary city in northwestern Bangladesh, has experienced steady population growth, expansion of residential areas, and rising household waste generation. However, municipal waste management systems have not evolved at the same pace, resulting in inefficient collection, inadequate disposal, and growing environmental and public health concerns.

Household solid waste, when poorly managed, becomes a major determinant of urban health. Accumulated waste obstructs drainage systems, contaminates surface and groundwater, and creates breeding grounds for disease vectors such as mosquitoes and rodents. In developing city contexts like RCC, these conditions contribute directly to dengue fever, diarrhoea, cholera, skin diseases, and respiratory infections. Understanding the relationship between HSWM and urban health is therefore essential for sustainable urban governance.

This article investigates the interaction between household solid waste management practices and urban health conditions in RCC, with a focus on identifying pathways for improvement through resource recovery and circular economy approaches.

II. STUDY AREA AND METHODOLOGY

2.1 Study Area

Rajshahi City Corporation is located on the northern bank of the Padma River and covers approximately 96 square kilometres. The city comprises 30 administrative wards and has a population exceeding half a million. RCC serves as an educational, commercial, and administrative hub, generating significant quantities of household waste dominated by organic materials.

Figure 1: Map of Rajshahi City Corporation and District Showing Study Area

Rajshahi is located in the Barind Tract, a dry agro-ecological zone characterized by clayey soils and low annual rainfall (approx. 1,300–1,500 mm/year). The region is susceptible to:

- **Heatwaves**, with summer temperatures often exceeding 40°C;
- **Water scarcity**, due to over-extraction of groundwater;
- **Riverbank erosion**, along the Padma;
- **Air pollution**, historically among the highest in the country.

2.2 Research Design and Data Collection

A mixed methods approach was adopted. Primary data were collected through:

- Household surveys conducted across selected wards
- Field observations of waste collection, storage, and disposal sites
- Key informant interviews with municipal officials, waste workers, and informal recyclers
- Focus group discussions with community members

Secondary data were obtained from RCC records, health department reports, and published literature. Descriptive statistics and comparative analysis were applied to assess waste management practices and health outcomes.

2.2.1 Sampling Strategy

To ensure representativeness, a stratified random sampling technique was used. Rajshahi City Corporation is divided into 30 administrative wards, and for logistical feasibility, five wards were selected using purposive criteria (based on socio-economic diversity, population density, and waste management challenges). Within each ward, households were randomly selected from municipal household listings.

Approximately 75–80 households per ward were surveyed, balancing geographic coverage with resource constraints. This stratification allowed for comparative analysis between high-income and low-income neighbourhoods, as well as between wards with formal vs. informal waste collection systems.

III. EXISTING HOUSEHOLD SOLID WASTE MANAGEMENT PRACTICES IN RCC

3.1 Waste Generation and Collection

Household waste generation in RCC averages 0.45 to 0.55 kg per capita per day, with organic waste constituting more than 70 percent. Collection coverage remains limited to approximately 50 percent of total generated waste.

Waste is commonly stored in open containers or roadside heaps before collection by handcarts and limited motorized vehicles.

Current Management Strategies for collection of HSW

Table 1: Via of collection of waste from respondent's household

Via of collection of waste		
	Frequency	Percent frequency
Local city authority	332	95.1
Private waste collector (Constructor)	1	0.3
Don't know	10	2.9
Others	6	1.7
Total	349	100

Table 2: Occupation of the respondents among all 30 words

Occupation of the respondents		
	Frequency	Percent frequency
Farmer	1	0.3
Teacher	20	5.7
Business	59	16.9
Worker	50	14.3
Housewife	105	30.1
Service holder	60	17.2
Others	54	15.5
Total	349	100

3.2 Disposal Practices

Collected waste is transported to open dumping sites located at the urban periphery. These sites lack engineered landfill facilities, leachate control, or methane capture systems, contributing to environmental contamination and public health risks.

Existing practices:

a) Door to door collection services
b) Community bins
c) Street sweeping

Table 3: Association between most common types of household waste and monthly family income of the respondents

Variables	Monthly family income			Total	Chi-square value	P-value
		Low income (<=20000)	High income (>20000)			
Most common types of household waste	Perishable/Kitchen waste	136	137	273	4.324	0.364
	Newspapers/Papers	1	5	6		
	Can/Plastic/ Glass	4	4	8		
	Iron/Metal/Batteries	2	2	4		
	Other materials	34	24	58		
Total		177	172	349		

Table 4: Association between gender and monthly family income of the respondents

Variables	Monthly family income			Total	Chi-square value	P-value
		Low income (<=20000)	High income (>20000)			
Gender of the respondent	Male	87	117	204	12.791	0.000
	Female	90	55	145		
Total		177	172	349		

IV. URBAN HEALTH IMPACTS OF POOR WASTE MANAGEMENT

4.1 Direct Public Health Impacts:

a) Vector-Borne and Infectious Diseases

b) Respiratory and Skin Disorders

4.2 Indirect Public Health Risks
a) Water and Soil Contamination
b) Mental Health and Community Well-being
4.3 Occupational Health factors of Waste Workers
4.4 Vulnerable Groups at Greater Risk

4.5 Disease Burden and Environmental Exposure
Poorly managed household waste has a direct and indirect impact on urban health. Stagnant water around waste piles facilitates mosquito breeding, increasing dengue and malaria risk. Decomposing organic waste emits foul Odors and particulate matter, affecting respiratory health.
Table 5: Common Health Impacts Linked to Poor Waste Management in RCC

Waste Related Condition	Health Impact
Open dumping	Dengue, malaria
Blocked drains	Diarrheal, cholera
Waste burning	Asthma, bronchitis
Informal handling	Skin infections

4.6 Vulnerable Populations
Children, elderly residents, and informal waste workers are particularly vulnerable. Waste handlers often work without protective equipment, increasing exposure to pathogens and hazardous materials.

V. RESOURCE RECOVERY AS A HEALTH IMPROVING STRATEGY

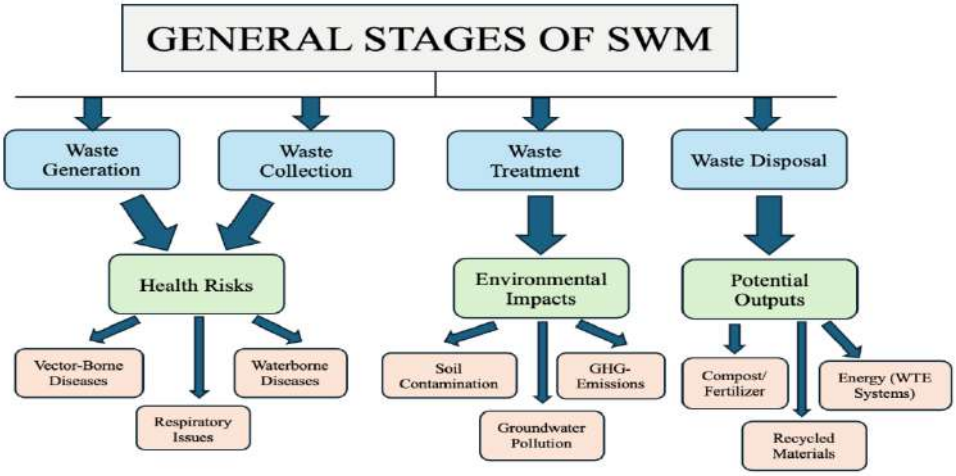

Figure 2**:** Stages of Solid Waste Management, Associated Health and Environmental Impacts, and Potential Resource Outputs. Created by the Researcher.

5.1 Pathways Linking Waste Management to Urban Health Improvement

Figure 3: Integrated Sustainable Waste Management (ISWM) Framework converting to energy. Modified by researcher

Description: A conceptual diagram showing improved collection, segregation, composting, recycling, and energy recovery leading to reduced pollution, improved sanitation, and better public health outcomes.

5.1 Composting and Organic Waste Treatment

Decentralized composting of household organic waste reduces open dumping and improves sanitation. Compost production also supports peri urban agriculture, reducing chemical fertilizer dependence and improving soil health.

5.2 Recycling and Material Recovery

Formalizing recycling through Material Recovery Facilities can significantly reduce environmental pollution while providing safer working conditions for informal waste pickers.

5.3 Carbon Credit and Climate Co Benefits

Avoiding methane emissions through composting and anaerobic digestion contributes to greenhouse gas reduction and creates opportunities for carbon credit financing.

VI. COMPARATIVE ANALYSIS WITH GLOBAL BEST PRACTICES

Cities such as Pune, Curitiba, and Seoul demonstrate that integrated waste management systems improve public health while generating economic value. Key features include source segregation, decentralized composting, strong community participation, and public private partnerships.

While vulnerable groups exist in both contexts, but their exposure levels and consequences differ:

Table 6: The difference between the exposure levels and consequences of developed and developing countries:

Group	Developed Countries	Developing Countries
Children	Mild risk (school-based hygiene education common)	High risk due to exposure to open waste, contaminated water
Waste workers	Often unionized, protected by safety regulations	Largely informal, with no PPE, low pay, and poor health access
Low-income communities	Live farther from disposal sites due to zoning laws	Often live adjacent to dumps or landfills due to affordability

In cities like Accra, Dhaka, and Nairobi, informal settlements frequently emerge on or near waste sites, compounding vulnerability to disease and displacement.

Table: RCC Practices Compared with Global Best Practices

Aspect	RCC	Global Best Practice
Collection coverage	50 percent	Over 90 percent
Segregation	Minimal	Mandatory
Disposal	Open dumping	Sanitary landfill or recovery
Health protection	Limited	Integrated

VII. Policy Implications and Recommendations

To strengthen the relationship between waste management and urban health, RCC should:

RCC can adopt a well-known Zero Waste Strategy, rejecting incineration projects in favour of a circular economy model built around the 9Rs: Reuse, Rethink, Reduce, Refuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover. The RCERO Ljubljana facility—recognized as one of the most advanced in the region—converts organic waste into biogas and compost, thereby minimizing dependence on landfills and fossil fuels. For Rajshahi City Corporation, the circular economy presents an opportunity to:

- Reduce dependency on landfilling and open dumping,
- Harness the high organic content of household waste for compost and biogas,
- Integrate informal recyclers into formal value chains,
- Create a regenerative urban system that enhances environmental resilience and social equity.
- Introduce source segregation at household level
- Invest in decentralized composting and recycling facilities
- Formalize informal waste workers with training and protection
- Promote public private partnerships for waste infrastructure

- Integrate waste management with urban health planning

VIII. CONCLUSION

This study confirms a strong relationship between household solid waste management and urban health in Rajshahi City Corporation. Inefficient waste practices exacerbate disease risks and environmental degradation, while resource-oriented waste management offers significant health, economic, and environmental benefits. Transitioning toward a circular waste management system can substantially improve urban health outcomes and enhance the sustainability of RCC.

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