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Solid Waste Management Scenario in Two National University Campuses: Govt. Brajalal College and Govt. women's college Khulna

Sujoy Kumar Nandy[1], Mousumi Mitra[2]
[1]*Lecturer, Govt. Brajalal College, Khulna*
[2]*Khulna Zila School, Khulna*

Abstract: *Solid Waste Management (SWM) at the university and college level is crucial for maintaining the health and safety of students, teachers, and staff, while also enhancing the campus environment and aesthetic appeal. Govt. Brajalal College and Govt. Women's College are two of the most prominent educational institutions in Khulna district, spanning 42 acres and 16.10 acres of land, respectively. Currently, Govt. Brajalal College has 25,356 students, 198 teachers, and 196 staff members, while Govt. Women's College has 10,260 students, 94 teachers, and 65 staff members. Waste bins provided by Khulna City Corporation are placed at various points on the Govt. Brajalal College campus. Wastes from student halls, staff and teacher quarters, academic buildings, and administrative areas are collected separately into putrescible and non-putrescible categories. Daily putrescible and non-putrescible waste generation at Govt. Brajalal College is approximately 299 kg and 75 kg, respectively. Putrescible wastes have long been converted into compost through natural decomposition for use in campus flowers, plants, and gardens, while non-putrescible wastes are screened, sold, or incinerated at the SWM plant. In contrast, Govt. Women's College generates about 77 kg of putrescible and 21 kg of non-putrescible waste per day. No formalized SWM system exists there, though waste bins at various campus locations indicate initial efforts. Wastes from student halls and other areas are regularly collected by cleaners and transported by Khulna City Corporation (KCC) for disposal at landfill sites.*

Keywords: *Solid Waste Management (SWM), Waste Composition Analysis, Govt. Brajalal College, Govt. Women's College, Environmental Impacts, Sustainable Waste Practices*

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I. Introduction

Solid waste has emerged as a critical environmental challenge in contemporary society. Rapid population growth has led to a proportional increase in waste generation, and inadequate management practices contribute significantly to environmental degradation, public health risks, and resource depletion (Hoornweg & Bhada-Tata, 2012). Effective solid waste management (SWM) systems are essential for ensuring environmental safety, sustainability, and aesthetic quality in human settlements (United Nations Environment Programme [UNEP], 2021).

Institutional SWM represents a structured managerial process widely practiced globally across various organizations, including educational institutions, government offices, and corporate entities (Alam & Ahmade, 2013). Among these, educational institutions hold particular significance due to their large and diverse populations—comprising students, faculty, and staff—and the substantial volumes of waste they generate daily (Smyth et al., 2010). These campuses serve not only as centers of learning but also as potential models for sustainable behavior and environmental stewardship.

In the 21st century, higher education institutions face mounting pressure to integrate sustainable practices into their operations, including active participation from students, faculty, and administrative staff in waste reduction, segregation, and recycling initiatives (Aleluia & Ferrão, 2016). A notable example is the Philippines, where Republic Act No. 9003 (Ecological Solid Waste Management Act of 2000) mandates educational institutions to implement comprehensive SWM programs, including waste segregation, recycling, and community-based composting, while imposing penalties for illegal dumping (Congress of the Philippines, 2001).

Educational institutions typically generate two primary categories of solid waste: putrescible (organic/biodegradable) and non-putrescible (non-biodegradable). Putrescible waste includes food scraps, vegetable peels, and paper, which decompose naturally, whereas non-putrescible waste comprises plastics, metals, and synthetic materials that persist in the environment (Tchobanoglous et al., 1993). Waste disposal practices in such settings often begin with classroom or hallway bins, followed by collection and transfer to central dumping points by cleaning staff. However, in many developing countries like Bangladesh, improper disposal remains

prevalent despite the availability of bins, reflecting gaps in awareness, infrastructure, and enforcement (Bari et al., 2012).

Although theoretical knowledge on SWM is included in academic curricula, practical implementation lags significantly among students and institutional authorities (Ahsan et al., 2014). Regulatory oversight is often weak or absent in public colleges, exacerbating the problem. Therefore, systematic studies on SWM practices in government educational institutions—particularly national colleges—are essential to identify deficiencies, propose context-specific solutions, and promote sustainable campus environments.

II. Literature Review

Solid waste management (SWM) has become a critical sustainability concern across higher education institutions (HEIs) globally. Universities generate diverse waste streams—paper, plastics, food waste, e-waste—reflecting both academic and residential activities. The waste hierarchy, commonly implemented as the 3R framework (reduce, reuse, recycle), serves as the dominant theoretical foundation for campus-based waste audits and sustainable material flow management (UNEP, 2018). International studies demonstrate that comprehensive waste segregation, recycling facilities, and awareness campaigns significantly reduce waste volumes on campuses. For example, research on Malaysian and Indian universities shows that student behavior, administrative commitment, and availability of bins strongly determine SWM effectiveness (Ahmad et al., 2016; Sharma & Gupta, 2018). In the United States, campus waste audits highlight the importance of integrating behavioral change programs and institutional policies within sustainability plans (Alshuwaikhat & Abubakar, 2008).

In South Asia, particularly Bangladesh, literature on SWM in educational institutions is growing but still limited. Existing research focuses primarily on urban municipal waste challenges, including improper disposal, lack of segregation, and infrastructural gaps in cities like Khulna and Dhaka (Alam & Billah, 2020). A few campus-based studies—such as those conducted in Dhaka University, Jahangirnagar University, and Khulna University—point to issues like bin shortages, irregular collection, and minimal recycling initiatives (Sultana et al., 2019; Hasan & Chowdhury, 2021). However, most of these studies examine single institutions and do not explore comparative waste generation trends across campuses. Importantly, there is almost no research comparing waste management between a general public college and a women's college, which may reveal gender-differentiated waste types (e.g., sanitary waste) and unique infrastructural needs.

A clear research gap therefore exists in understanding SWM practices specifically within National University (NU) affiliated colleges, which host large student populations but operate under limited budgets and receive less scholarly attention. Moreover, the integration of the circular economy concept, which encourages resource recovery and closed-loop systems, remains largely absent in Bangladeshi campus studies. This study addresses these gaps by conducting a comparative assessment of the SWM scenario in Govt. Brajalal College and Govt. Women's College Khulna, contributing new empirical evidence to support policy development, campus planning, and sustainable waste governance within NU colleges.

III. Methodology of the study:

This study employed a mixed-methods approach, combining primary data collection through surveys, interviews, observations, and photography with a review of secondary sources to assess solid waste management (SWM) practices at Govt. Brajalal College and Govt. Women's College, Khulna.

The research began with topic selection in consultation with the project supervisor. A structured questionnaire and checklist were developed to evaluate SWM facilities, operational practices, challenges, and stakeholder perceptions (Creswell & Plano Clark, 2017).

Primary data collection was conducted sequentially. At Govt. Brajalal College, the survey commenced in the administrative building, followed by eight student halls: Titumir Hall, Haji Mohsin Hall, Dr. Joha Hall, Kabi Kazi Nazrul Islam Hall, Subodh Chandra Hall (male), and Begum Fazilatunnessa Mujib Hall, Monnujan Sufian Hall, and Begum Khaleda Zia Hall (female). Relevant photographs of waste bins, collection points, and disposal areas were documented.

Subsequently, formal permission was obtained from the principal of Govt. Women's College, Khulna. Data collection proceeded in the administrative building and two student halls, accompanied by photographic evidence.

Semi-structured interviews were conducted with key stakeholders—students, teachers, administrative officers, and waste management staff—to gather qualitative insights into existing SWM systems, infrastructure availability, segregation practices, and operational limitations (Kvale & Brinkmann, 2015). Quantitative data on waste generation, bin placement, and collection frequency were recorded using the questionnaire and checklist.

Collected data from both institutions were compiled, compared, and analyzed thematically. Findings were presented using tables, charts, and diagrams for clarity and visual representation representation (Bernard, 2017).

Secondary data were reviewed from peer-reviewed journals, conference proceedings, government reports, and institutional records to contextualize findings within broader SWM frameworks in Bangladesh (Bari et al., 2012).

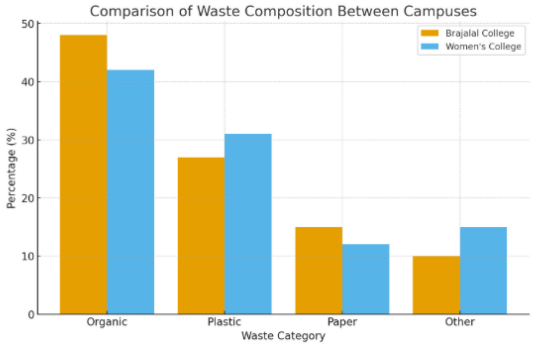
IV. Results

4.1 Waste Generation in the two Campuses

The assessment revealed clear differences in daily waste generation between the two National University campuses. Govt. Brajalal College generated an estimated 185–200 kg/day of solid waste, whereas Govt. Women's College generated approximately 95–110 kg/day. When calculated per capita, the rates were 0.12 kg/student/day at Brajalal College and 0.09 kg/student/day at Women's College. Seasonal variations were minimal, though slightly higher waste quantities were noted during examination periods due to increased paper use.

4.2 Waste Composition Analysis

Waste composition audits indicated that both campuses were dominated by organic and plastic waste, though proportions varied. At Govt. Brajalal College, the waste composition consisted of 48% organic waste, 27% plastic, 15% paper, and 10% other materials (e.g., textiles, glass, miscellaneous items). In contrast, Govt. Women's College generated 42% organic waste, 31% plastic, 12% paper, and 15% other materials, with a noticeable portion of sanitary waste due to the all-female student population. Waste composition tables and pie charts are provided to visually illustrate these proportions.



4.3 Existing Waste Collection and Disposal Practices

Both campuses employed a similar routine for waste collection, involving manual sweeping, centralized collection bins, and transport to designated disposal areas. However, neither institution practiced systematic waste segregation at the source. In Govt. Brajalal College, waste was collected twice daily and transferred to an on-campus open dumping site before being removed by Khulna City Corporation. Govt. Women's College followed a once-daily collection pattern, with waste temporarily stored in covered concrete containers. Neither college had formal recycling partnerships, though informal recycling through local collectors was observed in both cases.

4.4 Comparative Analysis Between Campuses

Comparative findings show that Govt. Brajalal College produced a larger volume of organic waste due to its extensive canteen and hostel facilities, whereas Govt. Women's College demonstrated a higher proportion of plastic waste, partly attributed to packaged food consumption patterns. Sanitary waste was a distinct category in Govt. Women's College. Waste collection frequency and storage conditions also differed, with Brajalal College showing more irregular disposal due to higher waste load, while Women's College exhibited more structured temporary storage practices.

4.5 Awareness Levels and Waste Management Behaviours

Survey results revealed moderate awareness but low practice of proper waste management in both campuses. At Govt. Brajalal College, **62%** of respondents reported awareness of the 3R (reduce–reuse–recycle) principles, yet only **38%** practiced them regularly. At Govt. Women's College, awareness was slightly higher (**68%**), but actual practice remained low (**42%**). Only 20–25% of students in both colleges reported having access to separate bins for recyclables. Respondents indicated that lack of infrastructure, absence of institutional guidelines, and insufficient student engagement activities were major barriers to effective waste management.

Photo 1: Waste bin in front of Administrative building of Govt. Brajalal college.

Photo 2: Roadside waste bin Guljan city in Govt. Brajalal college campus.

Photo 3: Waste bin in front of Classroom in Govt. Brajalal college.

Photo 4: Waste bin in Student halls of Govt. Brajalal college.

Photo 5: Open burning of waste in Govt. Brajalal college.

Photo 6: Open waste disposal in student halls of Govt. Brajalal college

The photos show that Govt. Brajalal College has scattered small bins near administrative areas, classrooms, and hostels, but they are mostly uncovered, inadequate, and poorly maintained. Waste is thrown in mixed form without any segregation system. Hostel areas rely on makeshift containers and informal dumping. Open waste heaps and direct burning indicate the absence of proper collection, storage, and disposal facilities. Overall, the images reveal an unstructured and environmentally unsafe solid waste management system on the campus.

Photo 1: Waste bin in front of Administrative building of Govt. Women`s college.

Photo 2: Waste bin in Student halls of Govt. Women`s college.

Photo 3: Waste bin in front of Classroom in Govt. Women`s college.

Photo 4: Open burning of waste in Govt. women`s college.

Photo 5: waste collection by van in Govt. women`s college.

The photos show that Govt. Women's College has bins placed in administrative areas, classrooms, and hostels, but these bins are mostly small, uncovered, and insufficient for daily waste generation. Hostel waste is stored in basic plastic containers without segregation, leading to mixed waste accumulation. Open burning of waste is practiced, indicating the absence of safe disposal facilities. A manual van is used for waste collection, but the system appears irregular and poorly structured. Overall, the images reveal a partially functional but largely inadequate solid waste management system with significant environmental and health risks.

Table: Solid waste management components in Govt. Brajalal college and Govt. women's college.

Components on SWM	Colleges with staffs of SWM components	
	Govt. Brajalal College	Govt. Women`s College
Waste bin in the corridoor and classroom	Yes	Yes
Waste bin in the Teachers/staffrooms	Yes	Yes
SWM.commmmittees by teachers/students/wm	Yes	Yes
SWM and campus environment meeting	Yes	No
SWM by students committee Association	No	No
Composting from waste	No	No
Income from composting	No	No
Recyclable waste are solid	No	No
Income by selling of recyclable wastes	No	No
Open burning of wastes	Yes	Yes
Controlled burning of waste	Yes	Yes
Stakeholderes are actively involved	Yes	Yes
Designated site or land for composting	No	No
Exist open dustbins in the campus	Yes	Yes
SWM related conference or seminer	No	No

V. Conclusion & Recommendations

This study assessed the solid waste management (SWM) scenario of two National University campuses—Govt. Brajalal College and Govt. Women's College, Khulna—by examining waste types, generation patterns, collection practices, institutional arrangements, and existing challenges. The findings clearly indicate

that both campuses produce significant quantities of biodegradable, non-biodegradable, and sanitary waste, yet the overall management system remains inadequate. Critical gaps such as the absence of waste segregation, insufficient bins, weak monitoring, limited awareness, and irregular disposal practices reflect the need for immediate intervention. The research objectives were successfully achieved by documenting the existing conditions and comparing the management approaches of the two colleges.

5.1. Recommendations

Based on the study, the following recommendations are presented in a practical and prioritized order:

5.1.1. Short-Term Recommendations

1. Introduce color-coded bins to ensure basic segregation at source.
2. Conduct awareness campaigns targeting students, teachers, and cleaning staff.
3. Implement simple 3R (Reduce–Reuse–Recycle) activities, such as reducing single-use plastics, reusing paper, and encouraging student-led recycling initiatives.
4. Ensure proper waste collection and disposal through improved coordination with Khulna City Corporation (KCC).
5. Train cleaning staff on safe handling of sanitary and hazardous waste.

5.1.2. Long-Term Recommendations

1. Develop campus-specific SWM policies, including roles, responsibilities, and monitoring mechanisms.
2. Establish composting units to process biodegradable waste from canteens and green areas.
3. Set up recycling partnerships with NGOs or private organizations for plastic, paper, and e-waste.
4. Implement digital monitoring (QR-coded bins, reporting apps) to ensure accountability and efficiency.
5. Install sanitary waste disposal systems (sealed containers or small incinerators) especially in Women's College.

5.2. Future Research Directions

The study highlights opportunities for further investigation. Longitudinal research can examine how waste generation varies over time or after implementing new interventions. Future studies may also include additional National University campuses to allow broader comparison. Moreover, exploring student behavior, willingness to segregate waste, and the cost–benefit analysis of recycling initiatives can provide deeper insights for policy and implementation.

5.3. Policy Implications

The findings underline the necessity for developing campus-specific solid waste management guidelines aligned with Bangladesh's National Environment Policy and the Solid Waste Management Rules 2021. Policymakers, the National University authority, and the Ministry of Education should consider mandating SWM frameworks for affiliated colleges, including segregation requirements, monitoring tools, and sustainability indicators. Such policies would promote cleaner, healthier, and environmentally responsible campuses nationwide.

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