KRMU – Waste Management Improvement

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November 2025

1 Introduction

Effective waste management has become an essential requirement for modern educational institutions, where thousands of students, faculty members, and staff interact daily. On university campuses, waste is generated continuously through cafeterias, classrooms, hostels, events, and recreational areas. When this waste is not handled systematically, it leads to overflowing bins, scattered litter, hygiene concerns, and environmental damage—ultimately affecting the quality of campus life.

K.R. Mangalam University (KRMU), Sohna, is no exception. Although the campus is well-maintained in many respects, visible patterns of improper waste disposal, mixed waste in bins, inconsistent collection schedules, and limited awareness of segregation reveal an underlying systemic issue. These challenges are not merely aesthetic problems; they influence health, student satisfaction, university reputation, and long-term sustainability.

This project applies structured critical-thinking and problem-solving frameworks to understand the real causes behind inefficient waste management at KRMU. Through evidence analysis, bias identification, root-cause exploration, and creative solution development, the project aims to design a practical, high-impact waste-management model tailored specifically to the university's needs. By integrating behavioural insights with technological and organizational improvements, the goal is to propose a solution that is realistic, sustainable, and capable of transforming the campus into a cleaner and more responsible environment.

2 Detailed Problem Definition

The campus is facing a persistent issue of **inefficient waste management**, visible in multiple areas such as corridors, canteens, hostels, lawns, and near academic buildings. The problem is not limited to the presence of litter—it's systemic.

Three layers make the problem serious:

2.1 Collection Issues

Bins overflow frequently because collection schedules don't match actual waste generation patterns. Canteens generate more waste in peak hours, but pick-ups remain fixed and infrequent.

2.2 Segregation Failure

Recycling bins exist, but students rarely use them properly. Food waste ends up with plastics, and plastics end up with paper waste. Once mixed, segregation becomes nearly impossible, leading to everything being dumped in landfills.

2.3 Behavioral Neglect

Even when dustbins are available within meters, students still drop wrappers or cups on the ground. Convenience beats responsibility.

Together, these issues create a feedback loop: bad habits leads to more waste in turn creating more overload making more visible dirt ultimately leading to more neglect.

Instead of a clean, sustainable campus, the environment becomes unpleasant, unhealthy, and resource-intensive for cleaning staff.

This makes the problem not just an "aesthetic inconvenience" but an operational and behavioural failure that affects everyone on campus.

3 Why This Problem Is Significant

3.1 Health Impact

Poorly managed waste attracts flies, stray animals, and pests, which carry germs. In humid weather, waste decomposes faster, spreading odor and bacteria. This increases risks of infection, allergies, and respiratory irritation.

3.2 Environmental Impact

Mixed waste usually ends up in landfills. Plastics contaminate soil, food waste releases methane, and recyclables—if not separated—are lost forever.

3.3 Campus Reputation

Cleanliness strongly affects how visitors perceive the institution. A dirty campus signals poor management, weak student discipline, and low standards.

3.4 Economic Cost

The institute spends extra on:
- emergency cleaning drives
- additional labour
- pest control
- disinfecting services
- replacing damaged bins

All of which are avoidable with a proper system.

3.5 Student Experience

Students avoid certain places (common rooms, lawns) because of litter or smell. A messy environment reduces comfort, motivation, and campus pride. The problem becomes a multi-dimension threat: health, environment, reputation, and cost.

4 Cognitive Biases Influencing Perception

4.0.1 Normalcy Bias

When people see the same problem daily—overflowing bins, scattered cups—they stop reacting. The brain treats an abnormal situation as normal simply because it's repeated.

Result: Students underestimate urgency and accept dirt as "regular campus life."

4.1 Diffusion of Responsibility

When hundreds of students share a space, responsibility becomes diluted. Everyone assumes someone else—cleaners, guards, faculty will manage the waste.

Result: No one feels personally accountable.

4.2 Status Quo Bias

Many students resist changes like waste segregation bins, strict penalties, or awareness drives because sticking to old habits feels easier.

Result: Sustainable initiatives fail because the community prefers "how things were."

4.3 Optimism Bias

People believe things will magically improve.

Result: Students think the cleaners will "soon collect the trash," so they keep adding more waste even if the bin is already overflowing.

4.4 Availability Heuristic

If the campus was recently cleaned, students assume "everything is fine now," ignoring long-term patterns.
Result: Temporary cleanliness hides structural issues.

5 Real Examples of Bias Affecting Decisions

5.1 Normalcy Bias in Common Areas

Canteen tables often have leftover plates and cups. Students walk past them because they've normalized the sight. Instead of complaining or cleaning up, they accept the mess as part of campus culture.

5.2 Diffusion of Responsibility During Events

After large college fests, the venue stays covered in plastic cups and wrappers for hours because every student thinks volunteers or staff will handle it. The collective assumption leads to collective inaction.

5.3 Status Quo Bias Against New Bins

When color-coded waste bins were introduced, most students still threw everything into one bin. They found sorting "too much work," so the initiative couldn't succeed.

5.4 Optimism Bias With Overflowing Bins

Students continue stacking waste on top of full bins, believing workers will come "any moment now." Instead, the trash spills onto the ground, spreads during wind, and attracts dogs or birds.

5.5 Availability Heuristic After Cleaning Drives

After NSS or environmental clubs conduct clean-up drives, people assume the problem is solved. For the next few days, littering returns because the memory of a clean campus temporarily hides the long-term waste management weakness.

6 Credible Evidence Supporting the Problem

To understand the waste-management challenges at KRMU, we examined research studies from Indian campuses, global reviews, and higher-education sustainability frameworks. These sources provide a comparable reference for student density, infrastructure, behavioural patterns, and waste composition found in universities similar to ours.

6.1 IIT Roorkee Campus Waste Study

Citation:
Parvez, N., Agrawal, A., & Kumar, A. (2019). *Solid Waste Management on a Campus in a Developing Country: A Study of the Indian Institute of Technology Roorkee.* Recycling, 4(3), 28.

Relevance to KRMU:

Although IIT-R is larger, it experiences similar issues: waste segregation failure, inadequate collection frequency, litter in public areas, and student non-compliance. The study offers campus-scaled data that parallels what is visible in KRMU's canteens, lawns, and hostel blocks.

6.2 Indian College Campus Case Study (South India)

Citation:
Krishna, A., Nandanan, K., Kumar, P. S. S., & Srihari, K. S. (2013). *Case Study of Solid Waste Management at a College Campus.* International Journal of Applied Engineering Research, 8(16), 1871–1878.

Relevance to KRMU:

This study provides quantitative data on waste types — especially food waste, paper waste, plastic cups, and packaging — exactly like the waste generated in KRMU's cafeteria and academic spaces. The findings show similar behavioural patterns among students and similar systemic flaws in collection and segregation.

6.3 Global Review of Waste Management in Educational Institutions

Citation:

Sharma, S., & Anamika (2022). *Waste Management Practices in Educational Institutions: A Review.* Journal of Critical Reviews, 7(12).

Relevance to KRMU:

This review highlights issues common in universities: absence of segregation culture, insufficient monitoring, lack of awareness, and heavy reliance on cleaning staff — all of which mirror KRMU's current reality.

6.4 MNIT Jaipur Campus Case Study

Citation:

Solid Waste Management of MNIT Campus: A Case Study. IJERT (2018).

Relevance to KRMU:

MNIT's findings — overflowing bins, inconsistent collection, excessive food waste — strongly match patterns observed at KRMU, especially near the main canteen, parking areas, and lawns.

6.5 Waste-Management Framework for Higher Education Institutions

Citation:

El-Halwagy, E. (2024). *Towards Waste Management in Higher Education Institutes.* ScienceDirect.

Relevance to KRMU:

This provides a "checklist framework" for universities, outlining what an efficient waste-management system must include. It serves as a benchmark for evaluating gaps between ideal practice and KRMU's current system.

7 Assumptions Identified in These Sources

Each study relies on certain assumptions that may not fully match K.R. Mangalam University's context. Identifying these assumptions strengthens the critical-thinking element of this project.

7.1 Students Will Engage in Segregation if Provided Bins

Most studies assume availability of colour-coded bins will lead to correct use.

Reality: Students rarely follow segregation instructions; most waste ends up mixed, especially during peak hours in the cafeteria.

7.2 Waste Generation Patterns Are Stable

Studies assume predictable waste generation.

Reality: Waste spikes during events, weekends, and festival weeks; hostels and canteen waste vary drastically.

7.3 Adequate Staffing and Timely Collection

Many studies assume sufficient sanitation staff for regular waste pickup.

Reality: Staff-to-student ratio is low, especially in high-traffic areas like B-Block, H-Block, and the central café.

7.4 Infrastructure Budgets Allow Implementation of Solutions

Some papers assume campuses have spare budget for composting units, recycling stations, or awareness programs.

Reality: Budget allocation is limited and scattered, requiring cost-efficient solutions.

7.5 Student Behaviour Changes with Awareness Campaigns

Research often assumes that awareness $\rightarrow$ behaviour change.

Reality: Posters and announcements help briefly, but habits revert quickly without accountability systems.

8 Argument Analysis – Strengths, Weaknesses & Evidence Quality

8.1 Strengths of the Evidence

- **High similarity to KRMU's situation:** Issues like littering, bin overflow, poor segregation, and reliance on cleaning staff are consistent across all the sources, giving strong external validation of the problem's seriousness.

- **Quantitative support:** Studies like MNIT and South India campus analyses provide data on waste composition (organic vs dry waste), enabling KRMU to build data-backed solutions.

- **Practical frameworks:** Papers like El-Halwagy offer structured campus waste-management frameworks that KRMU can adopt without starting from scratch.

- **Health and environmental connection:** Global research links improper waste handling with pests, disease, methane emissions, and long-term environmental harm—giving scientific backing to the urgency of solving the issue.

8.2 Weaknesses & Limitations of the Evidence

- **Context variability:** IIT-Roorkee and MNIT have different campus sizes, budgets, and student behaviour — their solutions may not scale directly to KRMU.

- **Behavioural assumptions may not apply:** Many studies assume students will cooperate; KRMU's real behaviour suggests otherwise.

- **Outdated infrastructure assumptions:** Some older studies assume availability of compost pits, recyclers, or municipal support — not guaranteed for KRMU.

- **Not all waste categories match:** For instance, the studies emphasize organic waste, but KRMU generates large amounts of non-biodegradable packaging from modern food outlets.

8.3 Overall Argument Strength

The combined evidence presents a **clear, multi-layered argument** that waste management on campuses—especially KRMU—is a serious and systemic issue. The argument is strengthened by:

- Consistency across multiple independent studies

- Clear parallels between evidence and KRMU's daily conditions

- Recognition of human behaviour (biases, habits) as a recurring root-cause

- Frameworks that provide pathways towards feasible solutions

By acknowledging the limitations and contextual differences, the analysis remains balanced, rigorous, and grounded in critical thinking.

9 Finding the Root Cause

Problem: Waste accumulates in public areas on KRMU campus.

9.1 Why is waste accumulating?

Because dustbins overflow and students continue adding more waste.

9.2 Why do dustbins overflow?

Because the waste collection schedule does not match peak usage times.

9.3 Why doesn't the collection match usage?

Because there is no real-time monitoring or flexible cleaning schedule.

9.4 Why is there no real-time monitoring?

Because the current waste-management system is static and understaffed.

9.5 Why is the system static and understaffed?

Because there is no central waste-management policy or coordinated plan at KRMU.

9.6 Root Cause Identified:

Absence of a structured, campus-wide waste-management system with defined roles, monitoring, and flexible collection schedules.

Behaviour problems (students not segregating, littering) only worsen the core issue.

10 Six Thinking Hats – Creative Solution Design

Using Edward de Bono's method, here is a comprehensive idea-generation + evaluation from each hat's perspective.

10.1 White Hat

- KRMU generates large amounts of mixed waste daily, especially from canteen and hostels.
- Waste collection is fixed-timing, not demand-based.
- Students rarely follow segregation practices.
- Infrastructure is inadequate: limited bins, no composting, no recycling partnership.

10.2 Red Hat

- Students feel annoyed by dirty canteen areas and lawns.
- They also feel segregation is "extra work."
- Staff feels overwhelmed and undervalued.
- Visitors often feel the campus looks unmanaged.

10.3 Black Hat

- Composting units may attract pests if poorly managed.
- Segregated bins fail if students don't cooperate.
- Vendor restrictions may cause conflicts or resistance.
- Monitoring requires manpower and budgeting.

10.4 Yellow Hat

- Clean campus improves student experience + university reputation.
- Segregation opens possibilities for recycling partnerships.
- Composting reduces waste and provides manure for campus gardens.
- Smart-bin or sensor-based systems reduce workload.
- Better systems improve health and hygiene.

10.5 Green Hat

Here are creative, workable solutions for KRMU:

10.5.1 Smart Waste-Bin System

Bins with fill-level sensors that alert staff when full.
Low-cost IoT system (Arduino-based) can be set up by engineering students.

10.5.2 Vendor Packaging Rules

Only compostable plates/cups allowed on campus.
Ban plastics in canteen/food trucks.

10.5.3 Waste Segregation Stations

Install three-station segregation units at canteen and lawn areas:
Wet Waste — Dry Waste — Recyclables.

10.5.4 Compost Pit + Gardening Use

Set up a mini composting unit behind the cafeteria.
Use compost for campus plants and landscape.

10.5.5 Student Led "Green Marshals" Team

Weekly rotating volunteer groups who monitor waste in peak zones.

10.5.6 Behaviour Nudges

Funny, sarcastic signboards — proven more effective than boring posters.

10.6 Blue Hat

Conduct a campus waste audit every month. Create a Waste-Management Committee (WMC) with admin + faculty + student reps. Implement segregation stations in phase 1, composting in phase 2. Evaluate vendor compliance every semester. Install at least 10 new bins in high-traffic areas as the first step. Track improvements and revise strategy quarterly.

11 Final Proposal

11.1 Selection of the Best Solution

From the Six Thinking Hats analysis, several solutions emerged. After evaluating them based on **feasibility**, **cost**, **student compliance**, **impact**, and **ease of implementation**, the most effective and realistic solution for KRMU is:

11.1.1 Hybrid Waste-Management System

Why this combination wins:
High Feasibility

- Uses infrastructure KRMU already has (bins, staff, designated waste areas).

- Student-friendly and easy to follow.

- Can be implemented in **phases**, reducing budget strain.

High Impact

- Segregation cuts landfill waste drastically.

- Composting converts cafeteria waste into usable manure.

- Smart alerts prevent overflow — the biggest cause of visible campus litter.

- Vendor rules reduce plastic at the source.

Low–Medium Cost

- Smart-bin sensors can be built in-house by engineering students (500–900 per sensor).

- Composting pit construction is low-cost.

- Segregation stations require only structured bins.

12   Implementation Plan

12.1   Phase 1 — Immediate Actions (Week 1–2)

12.1.1   Stakeholders:

Campus Admin, Housekeeping Lead, Student Council

12.1.2   Actions:

- Identify high-waste zones (canteen, lawns, parking, hostel entrances).
- Add **10–15 new bins** in these hotspots.
- Install **Segregation Stations**: Wet — Dry — Recyclable.
- Conduct a **one-week waste audit** to measure baseline waste volume.

12.2   Phase 2 — Smart Bin System (Week 2–4)

12.2.1   Stakeholders:

SOET Engineering Faculty + 4 volunteer students

12.2.2   Actions:

- Build IoT-based fill-level sensors using Arduino/ultrasonic sensors.
- Attach sensors to major bins in canteen & hostels.
- Set up live dashboard/WhatsApp alerts for housekeeping staff.
- rain staff on responsive waste collection.

12.2.3   Outcome:

No more overflowing bins $\rightarrow$ drastic reduction in visible waste.

12.3   Phase 3 — Vendor Regulation Rollout (Week 3–6)

12.3.1   Stakeholders:

Canteen Committee, University Legal/Policy Team

12.3.2   Actions:

- Mandate use of **biodegradable plates & cups** only.
- Ban single-use plastics on campus.
- Require food vendors to manage their own waste bags.
- Monthly compliance review.

12.4   Phase 4 — Composting Unit Setup (Week 4–8)

12.4.1   Stakeholders:

Campus Maintenance, Environmental Club

12.4.2 Actions:

- Build a compost pit behind the cafeteria.

- Train staff on compost layering (dry leaves + food waste).

- Use compost for gardens, lawns, landscaping.

- Track compost production monthly.

12.5   Phase 5 — Awareness & Behaviour Change (Ongoing)

12.5.1   Stakeholders:

Student Council, NSS, Clubs

12.5.2   Actions:

- Creative posters, memes, sarcasm-based nudges around campus.

- Monthly "Clean Campus Day."

- Competitions: Best Waste-Free Hostel, Best Bin Logging Team.

- Orientation sessions for new students.

12.6   Phase 6 — Monitoring & Review System (Monthly)

12.6.1   Stakeholders:

Waste Management Committee (WMC)

12.6.2   Actions:

- Monthly waste audit.

- Track waste reduction percentage.

- Review vendor compliance.

- Upgrade infrastructure every semester.

  Overall Timeline: 2 Months to Functional System

13   Reflection – How Critical Thinking Improved the Solution

This project required more than simple problem-solving. It demanded structured thinking, evidence-based reasoning, and behavioural understanding. Working on this waste-management project transformed the way our team understands problems. Initially, the issue looked simple — "the campus is dirty." But critical-thinking frameworks revealed how deep and interconnected the real causes are. Tools like the **Fishbone Diagram** helped us uncover the hidden layers of the problem: behavioural habits, infrastructure gaps, management issues, and environmental factors. The **5 Whys** technique pushed us past surface-level explanations and exposed the true root cause — the absence of a structured, coordinated waste-management system at KRMU. Using the **Six Thinking Hats** shifted our perspective entirely. It allowed us to examine the issue emotionally, logically, optimistically, and creatively. This prevented one-dimensional thinking and resulted in a blended, practical solution that balances feasibility with innovation. The project taught us that real-world problems rarely have a single cause or a single answer. They require questioning assumptions, validating evidence, and considering diverse viewpoints. In the process, we learned to challenge our own biases and design solutions that account for actual human behavior, not idealized expectations. Most importantly, this project showed us that critical thinking is not just a classroom skill — it's a tool for designing real, meaningful change on campus.