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Bridging International Benchmarks and Local Practices: A Framework for Green Campus Waste Management in Pakistani HEIs

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Abstract: *Sustainability has become one of the main criteria in evaluating Higher Education Institutions (HEIs), which is officially recognised by ranking systems such as the UI GreenMetric world university rankings and Pakistan's Higher Education Commission Green Campus initiative. Among the six key categories evaluated by UI GreenMetric, waste management is still a crucial but understudied issue, especially for HEIs in developing countries looking for feasible, context-appropriate solutions. The top three universities in the world, as well as the top three universities in Pakistan, are compared in this study based on the 2025 UI GreenMetric world university ranking. The waste management strategy of each university is studied separately, and a within-group comparison of methods of international and Pakistani institutions is conducted. A cross-group comparison enabled identification of the gaps, transferable methods, and contextual restrictions that set high-performing international institutions apart from their Pakistani counterparts. These differences are interpreted in the context of the recognised administrative and resource challenges faced by Pakistani public sector universities and intensified by limited sustainability awareness among stakeholders. Based on these results, the study suggests a phased framework for implementing sustainable waste management practices in Pakistani HEIs. Starting with basic administrative measures and awareness, the recommended phased framework progresses through structured reuse, recycling, and behavioural change strategies and closes with long-term waste circularity targets. The findings aim to support Green Campus efforts and enhance institutional performance in national and international sustainability rankings by providing practical insights for policymakers, sustainability offices, and university administrators.*

Keywords: Sustainability, Green Campus, Waste Management, HEIs, UI GreenMetric

Introduction

Environmental sustainability has paved its way in the evaluation of Higher Education Institutions (HEIs). Sustainability performance and green-campus practices are officially recognised through grading and ranking systems like UI GreenMetric World University Rankings, Pakistan's Higher Education Commission (HEC) Green Campus initiative, and other international frameworks. Institutions gain points for their commitment to environmentally sustainable development and the adoption of resource-efficient green activities through these systems. The UI GreenMetric ranking has become the most popular worldwide standard. This ranking evaluates the institutions based on six key indicators, including campus environment and infrastructure, energy and climate action, waste management, water use, transportation, and education and research (Abakumov & Beresten, 2023; Air University Quality Enhancement, n.d.; the UI GreenMetric, 2025).

The UI GreenMetric assessment framework is used in this study, with a focus on waste management practices, to examine and contrast the Green Campus projects of the top three universities worldwide and the top three Pakistani universities, according to the 2025 UI GreenMetric World University Rankings. The top three positions worldwide are held by Wageningen University & Research (Netherlands), University College Cork (Ireland), and Nottingham Trent University (United Kingdom), while The University of Lahore,

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Khwaja Fareed University of Engineering and Information Technology, and Muhammad Nawaz Shareef University of Agriculture, Multan, are the top three institutions in Pakistan (UI GreenMetric, 2025). The evaluation of the publicly documented and verified practices of these leading institutions enables the identification of the practical and transferable strategies to guide the feasible implementation of Green Campus initiatives, especially sustainable waste management, across HEIs in Pakistan.

The primary objective of this study is to develop a context-appropriate framework for Green Campus waste management in Pakistani HEIs, informed by a comparative analysis of sustainable waste management practices at top-ranked international and Pakistani universities according to the 2025 UI GreenMetric World University Rankings. Specific objects include

1. To examine and document the waste management initiatives and practices of UI GreenMetric 2025's three top-ranked universities as international benchmarks of sustainable campus waste management.
2. To examine and document the waste management initiatives and practices of UI GreenMetric 2025's three top-ranked Pakistani universities as representative of current best campus waste management practices within the local context.
3. To conduct a comparative analysis of the waste management practices of the above-mentioned 6 universities, identifying gaps and areas of convergence between international and Pakistani institutions in terms of administrative structures, waste management initiatives, and policies.
4. To identify contextual constraints and enabling factors that shape the feasibility of adopting international practices within Pakistani HEIs.
5. To propose a context-sensitive framework that Pakistani HEIs can follow, adjusted to their current institutional capacity and resources.

This paper is structured as follows: Section 2 establishes the conceptual background and reviews the global and national sustainability assessment frameworks related to this study, including UI GreenMetric, HEC's Green Campus initiative, the Green Youth Movement, and the THE Impact Rankings. Section 3 outlines the research methodology of this study. Section 4 summarizes the waste management practices of each of the three top-ranked world universities and each of the three Pakistani top-ranked universities individually. Section 5 identifies the convergences and gaps in reporting maturity, guiding strategy, and institutional practices of waste management by comparing the international and Pakistani groups. Building on findings from the previous section, Section 6 suggests a phased, evidence-based framework around which Pakistani HEIs can realistically implement and adjust international waste management practices, considering the HEIs' documented awareness and administrative and resource constraints. Section 7 discusses the conclusion, while Section 8 examines limitations, broader implications, and directions for future research on waste management practice in HEIs in Pakistan.

Conceptual Background

Green Campus Initiatives

A Green Campus initiative refers to an effort of an HEI that integrates environmental sustainability into its policy, operations, infrastructure, education, and research within and beyond the campus. Rather than solely greening a campus, it encompasses the adoption of quantifiable policies and practices that lower environmental impact, improve resource efficiency, enhance social well-being, and align institutional actions with global sustainability goals (UNESCO, 2025). Being increasingly tracked and measured through national and international evaluation frameworks, these initiatives have become a benchmark for assessing institutional environmental performance across higher education.

International and National Sustainability Assessment Frameworks

Today, universities are expected to prove genuine environmental action instead of just making sustainability claims. In response, formal rating systems have been developed to guide universities on what steps to take, measure progress, and publicly show their sustainability performance.

UI GreenMetric World University Rankings

The UI GreenMetric ranking system, launched in 2010 by Universitas Indonesia, is the most widely adopted international framework for assessing university sustainability performance. This system expanded to include 1,745 universities from 105 countries by 2025.

A structured set of indicators covering six core criteria, including setting and infrastructure, energy and climate change, waste management, water, transportation, and education and research, with governance and digitalisation more recently included as an additional assessment attribute, is used to evaluate participating institutions through this ranking system. This points system not only assesses institutions comparatively but also serves as a workable parameter that can be used by the universities to plan their own sustainability developments (U. GreenMetric, 2026; Tiyarattanachai & Hollmann, 2016).

HEC's Pakistan Green Campus Initiative and the Green Youth Movement

The Green Campus concept was formally introduced at the national level in Pakistan by the HEC in 2018. HEC Pakistan organised a consultative meeting of a 15-university working group in June 2018 to deliberate on the UI GreenMetric ranking system and evaluate participating universities' policies against global climate standards. The decision to establish a dedicated "Green Office" to coordinate Pakistani HEIs' participation in the UI GreenMetric process was announced the same day. At this meeting, HEC presented the same six evaluative indicators used by UI GreenMetric as the basis for self-assessment of campus sustainability. HEC has not published a formally titled framework document like UI GreenMetric; rather, its Green Campus initiative became operational through this 2018 launch and the later program described below (The Express, 2018; The News, 2018).

This initiative was later expanded through the Green Youth Movement (GYM), a joint program of HEC and Pakistan's Ministry of Climate Change delivered under the Prime Minister's Youth Program, in partnership with the British Council. GYM clubs have since been established in 137 public-sector universities across Pakistan, with each institution selecting core focus areas from five HEC-defined sustainability themes: agriculture and forestry, liquid and solid waste management, water conservation, renewable energy, and eco-tourism. Waste management occupies a particularly prominent place within this structure—practically, GYM clubs that adopt the waste theme conduct solid- and food-waste audits, cleanliness campaigns, and staff and student training and collaborate internationally with organisations such as Reach Out To Asia, British Council, and Zero Waste International Alliance (ZWIA) to strengthen campus waste-reduction capacity (Higher Education, n.d.; International Islamic University, 2024; International Islamic University Islamabad, 2025; National University of Medical Sciences (NUMS) Rawalpindi, n.d.; ZWIA, 2024).

In a study grounded in the Theory of Planned Behaviour and covering 281 students across several Pakistani HEIs, Tariq, Ahmed, and Usman (Tariq, Ahmed, & Usman, 2021) found that university-led green initiatives positively predicted students' willingness to participate in green activities such as waste reduction and recycling; as such, these initiatives have a significant positive effect on their attitudes toward environmental concern. This indicates that institution-driven, formal programs like HEC's GYM clubs do not just satisfy compliance or ranking requirements; they can meaningfully affect student attitudes and behavioural participation in campus sustainability, and that supports the practical value of embedding waste management within national-level initiatives even in the absence of a single formal policy framework.

THE Impact Rankings

The Times Higher Education (THE) Impact Rankings provides another international assessment system that evaluates universities based on how they advance sustainability in line with the United Nations' Sustainable Development Goals (SDGs). In 2026, the ranking evaluated 1,646 universities from 116 countries and territories. THE's assessment is based on four pillars, including teaching, research, outreach, and stewardship (Baty, 2025; Times Higher Education, 2026a, 2026b).

These frameworks provide both measurable indicators and motivation for universities to incorporate sustainability into campus day-to-day operations, education, research, and institutional and outside communities (Abakumov & Beresten, 2023; My University, n.d.; Tiyarattanachai & Hollmann, 2016).

Core Areas of Green Campus Implementation

Sustainable infrastructure and campus resource reuse, waste reduction and recycling systems, sustainable transportation initiatives, education, research, community engagement, awareness campaigns, formal sustainability policies, dedicated committees, and long-term strategic plans for environmental management are the areas typically covered by the Green Campus framework (Habib University 2025; Izmir Institute of Technology, 2021; My University, n.d.; UNESCO, 2025; University of Peshawar, n.d.).

Sustainable Municipal Solid Waste Management is of particular importance and generally follows a planned 5R solution, including refuse, reduce, reuse, recycle, and rot, which allows universities to practically minimise environmental impact by promoting a circular economy and providing students with practical and applied sustainability education.

The Value of Green Campus Case Studies

Case studies demonstrate how sustainability theory is implemented practically in real institutional settings, identify replicable best practices, and explain the conditions that contribute to their success. Comparing high-performing, internationally ranked universities with Pakistani HEIs helps identify which practices can be adopted directly and which need to be adapted to Pakistan's financial, administrative, and institutional conditions. Therefore, case studies can support the development of a phased, resource-sensitive, and context-appropriate Green Campus model for Pakistani HEIs rather than a direct replication of international approaches (Tiyarattanachai & Hollmann, 2016).

Selection of Universities for Comparative Analysis

This paper selects six universities for comparative case analysis, drawn from the 2025 UI GreenMetric World University Rankings. Globally, the top three ranked institutions are Wageningen University & Research (Netherlands, World Rank 1), University College Cork (Ireland, World Rank 2), and Nottingham Trent University (United Kingdom, World Rank 3). The top three ranked universities within Pakistan are The University of Lahore (World Rank 141, Pakistan Rank 1), Khwaja Fareed University of Engineering and Information Technology (World Rank 144, Pakistan Rank 2), and Muhammad Nawaz Shareef University of Agriculture, Multan (World Rank 145, Pakistan Rank 3) (UI GreenMetric, 2025).

Research Methodology

A qualitative, comparative case study design is adopted for this study. The study examines green campus waste management practices across two groups of institutions. Group 1 consists of top-ranked international universities while group 2 comprises top-ranked Pakistani universities, as classified by the UI GreenMetric World University Rankings 2025. The comparative approach enables the study to identify practical and transferable strategies and develop a phased framework applicable to Pakistani HEIs.

Primary data collection was not part of this study. Instead, the study relies entirely on secondary data, extracted from publicly available sources including official websites of the six selected universities, rankings, institutional sustainability documents and published policies by the universities themselves, peer-reviewed literature and published case studies on campus waste management. The following sections outline the waste management practices of each of these six institutions individually before comparing them within and across the world-class and Pakistani groups.

Case Studies: Waste Management Practices at Top-Ranked Universities

This section outlines waste management practices at the six universities identified in Section 2.6, using only publicly verifiable institutional sources.

Global Case Studies

Wageningen University & Research (WUR) — Global Rank #1

WUR's policy on waste is in line with the national waste management policies of the Dutch Government; WUR's waste practices are supported by the Netherlands' strong national waste-management system, infrastructure, regulations, and recycling facilities.

WUR manages waste under its official Circular Economy Policy (2019–2030), which targets cutting resource use and waste by 50% by 2030. To reach this target, WUR follows a clear order of priorities, including buying fewer products, using existing products more efficiently, extending product lifespans, and reusing items, either within WUR or by passing them on to outside partners. Buildings; products providing general services, such as furniture, electronics, and food; and research- and education-specific items, such as lab equipment and chemicals; purchases are grouped into these three categories, and the reduction target of 50% is applied to each category rather than to individual products. WUR has also replaced its standard waste contracts with broader "resource management contracts," under which contractors help find new users for discarded items, advise on more circular purchasing alternatives, and push for higher-grade recycling over lower-grade options (Maters & Luttik, 2021; Potting, Haas, Benthem, & Booman, 2019).

WUR applies waste prevention and reduction in practical ways by reducing paper consumption through default double-sided printing and digital alternatives such as apps, electronic procurement, ordering, and invoicing; replacing single-use plastics by promoting reusable bottles, mugs, and cups and providing drinking-water refill points; separating organic waste and composting around 600 tonnes of green waste annually to produce approximately 400 tonnes of compost for reuse in agricultural areas; and incorporating circularity into building renovation through sustainable materials, circular carpets, Cradle2Cradle furniture, and reduced packaging from suppliers.

Material Flow Management, a WUR system for tracking materials entering and leaving campus, is used to operationalise day-to-day waste management from tissues and laptops to food waste and construction materials, with field labs used across campus to pilot new waste-reduction ideas before scaling up what works. By 2022, 65% of WUR's waste was being separately collected, CO_2 emissions had already fallen 50% since 2010, and 67% of the university's energy came from sustainable sources. From 2017 to 2025, WUR has been ranked the world's most sustainable university by UI GreenMetric for nine consecutive years (Wageningen & Research, 2024, 2025a, 2025b).

University College Cork (UCC) — Global Rank #2

The lack of adequate facilities for recycling on campus stimulated the establishment of a Green Campus Program at UCC. The initiative's success has not only significantly improved facilities for recycling waste but also implemented an ambitious and globally leading waste reduction program.

UCC combines both short-term practical actions with long-term strategic planning, supported by both bottom-up participation from students and staff and top-down commitment from university leadership. Long-term direction comes from the dedicated Office of Sustainability and Climate Action and the Sustainability and Climate Action Plan (2023–2028), while bottom-up input is embedded through the Green Campus Committee (in operation since 2007) and Green Forum (established in 2013), both enabling students and staff to shape the university's sustainability direction. Top-down commitment is holding "overall responsibility" for implementing the plan across the institution and has contributed to embedding sustainability across operations, teaching, research, and outreach. UCC's Green Campus Program is student-led, research-informed, and practice-focused and combines practical sustainability measures with institutional support. This combination of grassroots participation and executive-level ownership has helped UCC achieve recognised external validation of its practical performance, including being the first university outside North America to receive a STARS Gold rating from AASHE in 2018, renewed in 2022, and consistent recognition by Times Higher Education as a global sustainability leader.

UCC has reduced waste tonnage by 40%. Its waste reduction includes several notable milestones, including reducing energy use through the “Saver Saves” Scheme (2016), in which Green Teams keep energy savings to fund further environmental projects; a 2017 ban on disposable cups in the Boole Library of UCC with a campus-wide ban on disposable cups and plastic bottles removing all single-use cups and plastic bottles from campus in 2023, diverting more than 1 million disposable cups from landfills in the first year; Boole Library also introduced a binless waste system (2017) by removing individual bins and establishing centralised recycling stations, reportedly diverting up to 10,000 plastic bags from landfill annually, followed in 2018 by the launch of the Bio Green Café, Ireland's first single-use-plastic-free café, developed in partnership with its catering provider and demonstrating how green initiatives along with stakeholder engagement and environmental awareness and education can work together to transform how a service is delivered, achieving an 18% reduction in food waste through AI-based monitoring of kitchen bins. The Sustainable Print Management Policy of UCC in 2019 had reduced paper waste and historically accounted for a significant share of overall waste tonnage. Environmental sustainability is considered alongside the price and quality while buying something or selecting a supplier (Irish, 2023; STARS, 2022; University College Cork, 2025, n.d.-a, n.d.-b, n.d.-c).

Nottingham Trent University (NTU) — Global Rank #3

Multi-category waste segregation at NTU covers dry mixed recycling, glass, general, and food, alongside specialist categories including clinical, laboratory, hazardous, batteries, and electronics. Each of these wastes is routed to designated contractors or collection points, and safe disposal is the responsibility of the departments that produce it. Catering outlets and staff kitchens collect food waste separately. The detailed segregation structure of NTU fits within a broader circular system, ensuring that resources are reused and repurposed rather than wasted, with disposal used only as a last resort and unavoidable general waste processed via Energy from Waste in place of landfill (Nottingham Trent, n.d.-b; Nottingham Trent University (NTU), n.d.).

A top reuse initiative is “Warp It," launched in 2018, which helps staff to redistribute unwanted furniture and equipment across campuses or to local partners. The Warp It initiative has generated savings of £378,717 and helped avoid 46 tonnes of waste and 181 tonnes of CO_2 to date. This is complemented by British Heart Foundation donation banks for clothing, books, shoes, and accessories, located across all three of NTU's campuses. A partnership with Green Scheme enables the resale of surplus laboratory and scientific equipment. NTU is a founding member of the Pack for Good partnership with the British Heart Foundation, Nottingham City Council and the University of Nottingham, through which the NTU community repurposed over 10 tonnes of donated items in 2025 (Nottingham Trent, n.d.-a, n.d.-b).

Comparison: Top Three International Universities

Table 1 compares the core waste management strategies of the three globally top-ranked universities, highlighting that while all three follow the same waste hierarchy, each underscores a different stage of it—WUR on circularity, UCC on institutional ambition, and NTU on reuse.

The same underlying waste hierarchy logic is applied in all three universities: refuse/reduce, reuse, recycle, and recover, but they differ in where they place their emphasis and how they structure their governance. WUR leads on circularity, material-input reduction, and measured progress; reports indicate that 65% of its waste was separately collected by 2022. A hybrid governance model that pairs bottom-up staff and student committees with top-down executive ownership, facilitating UCC to lead on institutional ambition and long-running public recognition. Structured reuse, cross-sector redistribution partnerships, and the sheer granularity of its waste segregation system are the main approaches of the NTU, though its own guidance reveals that several common waste items remain outside current recycling infrastructure.

Pakistani Case Studies

The University of Lahore (National Rank #1, World Rank 141), Khwaja Fareed University of Engineering and Information Technology (National Rank #2, World Rank 144), and Muhammad Nawaz Shareef University of Agriculture, Multan (National Rank #3, World Rank 145) are the top three Pakistani universities in the 2025 UI GreenMetric rankings (UI GreenMetric, 2025).

It is worth mentioning here that baseline conditions in Pakistani HEIs differ substantially from those at the international case-study universities discussed above. A study on Pakistani public universities identifies limited stakeholder awareness of sustainability issues, economic constraints such as high costs and budget limitations, and governance-related barriers as the central obstacles, with poor authority control and limited resources being the most frequently cited by academic literature as the biggest obstacles to embedding sustainability (Shah Bukhari, Said, Gul, & Ibna Seraj, 2022). The same study concluded that there is a strong association of sustainability issues with lack of institutional change and training.

Table 1

Comparative Overview of Waste Management Practices at WUR, UCC, and NTU

Criterion	Wageningen (WUR)	UCC	NTU
Core strategy	Circular Economy Policy (2019–2030): 50%+ reduction in resource use/waste by 2030 vs. 2014 baseline	Zero Waste certification target (2030), backed by hybrid governance model	Multi-stream segregation (20+ categories) + reuse partnerships
Guiding framework	Circularity hierarchy (refuse → reduce → reuse) + Material Flow Management	Waste hierarchy + binless office model	Five-stage waste hierarchy (avoid–reduce–reuse–recycle–dispose)
Governance model	Executive Board–approved policy (2019), operationalised via Facility Services	Hybrid: bottom-up (Green Campus Committee since 2007; Green Forum since 2013) + top-down (Office of Sustainability, in the President's Office, since 2022)	Devolved departmental ownership (e.g., Digital Technologies for e-waste) + central Sustainability team
Source segregation	3 main waste streams (industrial, paper, hazardous); 65% of waste separately collected (2022)	Not publicly quantified as a segregation rate; qualitative commitment to a "binless office" model to improve segregation	20+ specific waste categories (A-Z waste guide), including recyclable, organic, hazardous, and specialist streams
Flagship action	Material Flow Management; category-based (not items-by-item) reduction targets	Bio Green Café (2018). Plastic Free UCC (2023)	'Warp It' reuse platform (2018); Pack for Good donations (10+ tonnes, 2025)
Documented outcome	65% of waste separately collected (2022); 50% CO2 reduction since 2010 (by 2019); 67% sustainable energy (2022)	STARS Gold rating (2018, renewed 2022); ranked #1 globally for SDG 12 (THE Impact Rankings, 2019)	Warp It: £378,717 saved, 46 tonnes of waste avoided (cumulative)
UI GreenMetric standing (2025)	World's most sustainable university, 2017–2025 (9 consecutive years)	2nd globally; 1st for Energy and Climate Action	3rd globally

The University of Lahore (UOL) — Rank #1, Pakistan

UOL has sustained its position as Pakistan's top-ranked university for sustainability, rising from 3rd place nationally in the 2017 UI GreenMetric ranking to 1st place nationally by 2025, reaching 141st globally with an overall score of 84.10% — up from 82.35% in 2024. The water recycling project, developed in partnership

with the Worldwide Fund for Nature (WWF), is a concrete example of its sustainability work, addressing water conservation on campus. UOL has also integrated sustainability into its curriculum through an "Introduction to SDGs" course, offered to undergraduate students across all departments (GoToUniversity; TopUniversities).

The Waste-specific data (such as segregation rates, composting volumes, or diversion percentages) is not provided by the publicly available institutional material comparable to what is published by MNS-UAM. This is most probably due to a general reporting gap common across Pakistani HEIs (Shah Bukhari et al., 2022) instead of an absence of practice, but it limits how precisely UOL's waste-specific performance can be assessed from public sources alone.

Khwaja Fareed University of Engineering and Information Technology (KFUEIT) — Rank #2 Pakistan
KFUEIT, established in 2014, is a public-sector university that frames its sustainability efforts around alignment with the UN Sustainable Development Goals, describing itself as integrating quality education with social and environmental responsibility. The university's engagement with the UI GreenMetric framework is active and visible at an institutional level: KFUEIT rose to a top-three position in Pakistan in the 2022 UI GreenMetric rankings, and in October 2023 it hosted, in partnership with UI GreenMetric itself, a National Workshop on UI GreenMetric World University Rankings for universities across Pakistan—with KFUEIT's Vice Chancellor and UI GreenMetric's Chairperson both presenting on the framework's six evaluative criteria, including Waste (Educatly, n.d.; TopUniversities, n.d.; Wikipedia, 2026) (U. I. GreenMetric, 2023).

Publicly available documentation specific to KFUEIT's waste segregation, diversion, or recycling infrastructure is limited. This is reasonably a genuine data-availability gap rather than an absence of practice, but it means, as the university was established only in 2014, KFUEIT's waste-specific performance cannot currently be assessed in the same depth as MNS-UAM's (Educatly, n.d.).

Muhammad Nawaz Shareef University of Agriculture, Multan (MNS-UAM) — Rank #3, Pakistan
A dedicated operational Solid Waste Management (SWM) site on campus, being used both operationally and as an active research facility, makes MNS-UAM stand apart among the three Pakistani case studies. Researchers at the university have piloted mechanised windrow composting as a core organic-waste treatment method, converting agricultural and campus waste, including cotton stalk, rice and wheat straw, maize stalk, fresh grass clippings, and tree pruning from university farms, into compost, using nitrogen- and carbon-rich organic matter combined with animal manure. Differences in yield and compost maturity were examined in 2024 by comparing the mechanised against manual (conventional) compost-turning methods using a windrow turner machine (Hashim et al., 2024; Hashim et al., 2022).

This on-campus research work gives MNS-UAM the most structured, publicly verifiable waste management evidence base of the three Pakistani case studies, which distinguishes it from UOL's institution-level reporting and KFUEIT's more general sustainability framing.

Comparison: Top Three Pakistani Universities
Table 2 summarises how UOL, KFUEIT, and MNS-UAM compare across governance structures, waste strategies, and evidence transparency.

Among Pakistan’s top universities, MNS-UAM is the clearest outlier of the three; its agricultural specialisation supports it in handling waste management as an active research and demonstration activity, producing peer-reviewed, measurable output that is rare among general-purpose Pakistani universities. Credible institutional engagement with sustainability and the UI GreenMetric framework is exhibited by the UOL and KFUEIT, but neither currently publishes waste-specific operational data at a point that could be used for direct comparison with MNS-UAM or with the international case studies.

International versus Pakistani Top Three - Combined Comparison

Table 3 compares the international and Pakistani top-three universities across four dimensions of waste management practice, synthesising the individual case-study findings from Sections 3.1 and 3.2.

The mature, named waste programs are run by the selected international universities having histories stretching back a decade or more. Selected Pakistani universities' strongest evidence currently lies in a single research-based case (MNS-UAM), while the other two cases indicate strong institutional commitment but a limited public record on waste, and that may be due to the broader administrative and resourcing barriers documented in Pakistani HEIs generally (Shah Bukhari et al., 2022).

Applicability of the International Waste Models to Pakistani Universities: A Proposed Framework

A single international university model can not be used as a direct transplant for Pakistani universities because of differing development levels examined across the six case studies. Lessons from the three international cases that are relevant to the Pakistani context can be implemented through a staged sequence. UCC's program initiated from a basic lack of recycling infrastructure, a starting point closer to where several Pakistani institutions appear to stand currently, before growing into a Zero Waste-targeted program over roughly two decades. NTU's structured reuse and redistribution systems (Warp It, Pack for Good) can be implemented as a separate, resource-efficient layer once basic waste segregation is in place. Mature data systems support institution-wide circularity targets in WUR, and that advanced stage can come next (Nottingham Trent, n.d.-a; Shah Bukhari et al., 2022; University College Cork, n.d.-a; Wageningen University & Research, n.d.).

Table 2

Comparative Overview of Waste Management Practices at UOL, KFUEIT, and MNS-UAM

Criterion	UOL (Rank #1)	KFUEIT (Rank #2)	MNS-UAM (Rank #3)
Core strategy	Not publicly documented as a named waste strategy	Not publicly documented as a named waste strategy	Mechanised windrow composting of organic/agricultural waste
Guiding framework	Not publicly documented	Not publicly documented	Research-driven composting protocol (mechanised vs. manual turning)
Governance model	Sustained institutional engagement with UI GreenMetric since 2017; curriculum integration via "Introduction to SDGs" course	Active institutional engagement; hosted national UI GreenMetric workshop (2023)	Operational, research-embedded Solid Waste Management site
Source segregation	Not publicly documented	Not publicly documented	Not publicly documented at the segregation-rate level; composting process itself is documented in detail
Documented outcome	Ranking score improvement, 82.35% (2024) → 84.10% (2025); WWF-partnered water recycling project	Rose to top-3 national ranking position (2022)	Quantified compost yield gains: 13,768 kg (mechanised) vs. 11,512 kg (manual) — a 19.5% improvement
Known limitation	No public waste-specific operational data (segregation, diversion, composting volumes)	Newer institution (est. 2014); limited published sustainability documentation overall	Findings specific to organic/agricultural waste stream only; no equivalent data for general campus waste
Flagship action	WWF-partnered water recycling project; SDG curriculum integration	National UI GreenMetric workshop host (2023)	Windrow-turner composting research program
UI GreenMetric standing (2025)	National Rank #1; World Rank 141	National Rank #2; World Rank 144	National Rank #3; World Rank 145

Table 3

Combined *Comparison*: International versus Pakistani Top Three Universities

Dimension	International Top 3 (WUR / UCC / NTU)	Pakistani Top 3 (UOL / KFUEIT / MNS-UAM)
Strategic vision	Named institutional frameworks (circularity policy, waste hierarchy, Zero Waste target) applied campus-wide	Mostly institution- or discipline-specific engagement (ranking performance, curriculum integration, research) rather than a unified, publicly documented waste framework
Administrative model	Explicit, documented structures — executive-approved policy (WUR), hybrid bottom-up/top-down committees (UCC), devolved departmental ownership (NTU)	Institutional-level engagement with UI GreenMetric is evident, but no dedicated, publicly named waste-specific governance body identified at any of the three
Source segregation	Documented in varying detail — from a quantified rate (WUR: 65%) to a granular category system (NTU: 20+ streams) to a stated but unquantified commitment (UCC)	Not publicly documented at any of the three institutions, at the segregation-rate level
Key strength	Systemic, campus-wide waste-hierarchy integration with sustained multi-year UI GreenMetric recognition	Specialised, research-driven innovation (MNS-UAM's agricultural composting research) and consistent participation in the UI GreenMetric rankings over multiple years (UOL, KFUEIT)
Reporting practices	Institutionally published sustainability pages with named initiatives and some quantified outcomes	Uneven — ranges from research-based data (MNS-UAM) to general institutional/ranking-level reporting (UOL, KFUEIT)

Proposed Three-Phase Framework

The study proposes the following phased framework.

Phase 1: Basic (Informed by UCC's Institutional Trajectory)

- Establishing or strengthening dedicated sustainability/green campus governance structures, -UCC's program from a starting point of minimal recycling infrastructure.
- Reduction measures of symbolic, low-cost single-use items, e.g., single-use cup or bottle bans, following UCC's Plastic Free UCC initiative and Bio Green Café model, which are inexpensive to implement and create visible early institutional drive.
- Development toward centralised or 'binless' waste collection points, which UCC recognises as best practice for improving recycling participation.
- Sustainability awareness sessions, waste-sorting signs, and waste segregation campaigns, - structured awareness-building activities - directly address the awareness gap identified as a root cause in Pakistani HEIs (Shah Bukhari et al., 2022) and have been shown to have positive effects on student attitudes toward environmental concern and willingness to participate in green activities (Tariq et al., 2021).

Phase 2: Organised Reuse and Redistribution (Informed by NTU's Model)

- Furniture and equipment reuse/redistribution platforms, modelled on NTU's 'Warp It' scheme, which reduces procurement costs promptly - provided the budget constraints are identified as a major barrier in the Pakistani context.
- Partnerships with community or charitable organisations for donation-based redistribution, following NTU's Pack for Good model, which requires minimal capital investment while extending the useful life of campus materials.

Phase 3: Research-Rooted and Circular Systems Practice (Long-Term Target, Informed by WUR and MNS-UAM)

- Once basic data-tracking capacity exists, next come the long-term, institution-wide waste-reduction targets and structured source segregation, following WUR's Vision on Circularity.
- Scaling research-rooted, discipline-specific waste solutions, following MNS-UAM's own windrow composting research program as a proof-of-concept model that other Pakistani HEIs, particularly those with relevant science faculties, could follow.

Direct replication of any single international model is not supported by sections 3 and 4 above; hence, the phased pathway offers a realistic, evidence-based roadmap consistent with the governance and resourcing limitations documented in the Pakistani sustainability literature. This framework indulges governance strengthening, behaviour change, organised reuse, and long-term circular targets as step-by-step rather than simultaneous goals that allow institutions to build capacity and stakeholder confidence at each stage before progressing to the next.

Conclusion

This study examines and compares the waste management practices of the three globally top-ranked universities and the three top-ranked Pakistani universities in the 2025 UI GreenMetric World University Rankings, with the goal of outlining practical, evidence-based lessons for HEIs in Pakistan. The comparative case studies show that Wageningen University & Research, University College Cork, and Nottingham Trent University each use a distinct but complementary approach to campus waste management, circularity-focused material flow management, institutionally driven Zero Waste ambition, and structured reuse and redistribution, respectively, aided by sustained, publicly documented institutional programs that in several cases trace back a decade or more. Engagement with the UI GreenMetric framework is clearly present at all three Pakistani institutions, but the extent of publicly available waste-specific confirmation varies considerably: Muhammad Nawaz Shareef University of Agriculture, Multan, is distinguished for making quantitative research on composting practices available, while The University of Lahore and Khwaja Fareed University of Engineering and Information Technology exhibit strong institutional and educational commitment to sustainability without an equivalent level of publicly documented, waste-specific working data.

Limited institutional resources, gaps in training and awareness, and governance-related constraints in the Pakistani HEIs are consistent with this asymmetry and strengthen the main conclusion of this study that replication of any single international model is unlikely to be a practical strategy for Pakistani HEIs. Hence, this study concludes a phased framework in Section 5, which is more justified in the Pakistani context, beginning with low-cost, governance-building measures, progressing to structured reuse and redistribution practices, and developing mature circular-economy systems as a long-term aspirational target rather than an immediate benchmark. Further, MNS-UAM's windrow composting research demonstrates that locally developed, discipline-specific innovation can itself function as a credible, exportable model for other Pakistani universities.

Limitations and Future Recommendations

This study encounters several limitations. First, this work relies on publicly available institutional and academic sources rather than direct site visits/audits and interviews, which shows that the apparent data gaps at UOL and KFUEIT may understate practices that exist but are not yet published. Secondly, the six-university sample selected from a single ranking system can not represent the full range of waste management practices across the broad higher education sector.

Future recommendations, based on the limitations of this study, include primary data collection through site visits, waste audits, and/or interviews with sustainability office/office staff at Pakistani HEIs, which could

help to get a more comprehensive understanding of on-ground waste management practices. Expanding the sample beyond the top three nationally ranked institutions and broadening the sample by including universities from other ranking systems could further help validate and refine the proposed phased framework and identify context-specific sub-phases.

Although a substantial gap currently exists between the waste-management maturity of the world's leading green campuses and that of Pakistan's top-ranked universities, this gap is manageable. This study suggests that a phased and locally adapted approach can provide Pakistani HEIs with a practical and achievable pathway towards integrated, campus-wide waste-management systems that strengthen the broader goals of environmental sustainability and green and healthier campus environments.

References

Abakumov, E., & Beresten, S. (2023). Green Campus as a Part of Environmental Management of St. Petersburg State University. *Sustainability, 15*(16), 12515. https://doi.org/10.3390/su151612515

Air University Quality Enhancement, C. (n.d.). UI GreenMetric.

Baty, P. (2025). *Out now: Impact Rankings 2025*. https://www.timeshighereducation.com/press-releases/out-now-impact-rankings-2025

Educatly. (n.d.). *Khwaja Fareed University of Engineering and Information Technology KFUEIT: Rankings, Course Details and Scholarships*.

GreenMetric, U. (2026). M*ethodology and Rankings Framework*. https://uigreenmetric.com/rankings

GreenMetric, U. I. (2023). *National Workshop on UI GreenMetric World University Rankings for Universities in Pakistan*.

Habib University (2025). *A Global Milestone for a Green Campus*. https://habib.edu.pk/HU-news/pakistans-first-edge-advanced-campus-habib-university-leads-the-way-in-sustainable-higher-education/

Hashim, S., Bashir, R., Khan, A. A., Mirani, A. A., Shoaib, M., Razzaq, A., . . . Munir, F. (2024). Performance Evaluation of Compost of Windrow Turner Machine Using Agriculture Waste Materials. *Sustainability, 16*(17), 7779. https://doi.org/10.3390/su16177779

Hashim, S., Waqas, M., Rudra, R. P., Khan, A. A., Mirani, A. A., Sultan, T., . . . Saifullah, M. (2022). On-Farm Composting of Agricultural Waste Materials for Sustainable Agriculture in Pakistan. *Scientifica, 2022*, 5831832. https://doi.org/10.1155/2022/5831832

Higher Education, C. (n.d.). Prime Minister's Youth Programme: Green Youth Movement. https://www.hec.gov.pk/english/services/students/PMYP/Pages/GYM.aspx

International Islamic University, I. (2024). IIUI's Green Youth Movement GYM Club Executive Body Meets British Council, HEC Officials.

International Islamic University Islamabad. (2025). *IIUI Green Youth Movement Organizes Hiking and Cleanliness Campaign at Margalla Trail*. https://www.iiu.edu.pk/iiui-green-youth-movement-organizes-hiking-and-cleanliness-campaign-at-margalla-trail/

Irish, E. (2023). UCC aiming to lead the change by becoming zero-waste campus. https://www.irishexaminer.com/news/munster/arid-41173942.html

Izmir Institute of Technology. (2021). *Sustainability - Policy Text*.

Maters, E., & Luttik, J. (2021). From Waste Management to Circular Resource Management. *Journal of Sustainability Perspectives, 1*(2), 76–85. https://doi.org/10.14710/jsp.2021.11745

My University. (n.d.). Sustainable Development Goals.

National University of Medical Sciences (NUMS) Rawalpindi. (n.d.). *Zero waste at NUMS*. https://numspak.edu.pk/eco/Zero-waste-at-NUMS

Nottingham Trent, U. (n.d.-a). Bin It Right.

Nottingham Trent, U. (n.d.-b). Waste and Recycling.

Nottingham Trent University (NTU). (n.d.). A - Z Waste Guide.

Potting, J., Haas, A. d., Benthem, P. v., & Booman, P. (2019). *WUR's circular economy policy - Vision & strategy 2019-2030*. https://backend.wur.nl/sites/default/files/2025-11/2020207-Vision-WUR-circular-economy.pdf

Shah Bukhari, S. K. U., Said, H., Gul, R., & Ibna Seraj, P. M. (2022). Barriers to Sustainability at Pakistan Public Universities and the Way Forward. *International Journal of Sustainability in Higher Education, 23*(4), 865–886. https://doi.org/10.1108/IJSHE-09-2020-0352

STARS. (2022). *University College Cork -National University of Ireland, Cork , STARS REPORT*. https://www.ucc.ie/en/media/support/sustainabilityandclimateaction/university-college-cork-national-university-of-ireland-cork-co-c.pdf?utm_source=chatgpt.com

Tariq, F., Ahmed, M., & Usman, M. (2021). Green Initiatives of Higher Education Institutions and Students' Willingness to Participate in Green Activities: A Study in Pakistan. *International Journal of Business Reflections, 2*(2), 158-180.

The Express, T. (2018). HEC considers green campus framework. https://tribune.com.pk/story/1728670/hec-considers-green-campus-framework

The News, I. (2018). HEC introduces Green Campus in Pakistani universities. https://www.thenews.com.pk/print/326183-hec-introduces-green-campus-in-pakistani-universities

Times Higher Education. (2026a). *Sustainability Impact Ratings 2026 – University Sustainability Rankings*. https://www.timeshighereducation.com/impactrankings

Times Higher Education. (2026b). Sustainability Impact Ratings 2026: methodology.

Tiyarattanachai, R., & Hollmann, N. M. (2016). Green Campus Initiative and Its Impacts on Quality of Life of Stakeholders in Green and Non-Green Campus Universities. *SpringerPlus, 5*, 84. https://doi.org/10.1186/s40064-016-1697-4

TopUniversities. The University of Lahore: Rankings, Fees and Courses Details.

TopUniversities. (n.d.). *Khwaja Fareed University of Engineering and Information Technology: Rankings, Fees and Courses Details.*

UI GreenMetric. (2025). UI GreenMetric World University Rankings 2025: Overall Rankings.

UNESCO. (2025). *Beyond the Green Campus*. from https://www.unesco.org/en/articles/beyond-green-campus

University College Cork. Resources. https://www.ucc.ie/en/greencampus/resources/

University College Cork. (2025). UCC Ranked Second in the World in Global Environmental Ranking.

University College Cork. (n.d.-a). About the Office of Sustainability and Climate Action.

University College Cork. (n.d.-b). Green Campus Recycling and Waste Management.

University College Cork. (n.d.-c). Green Campus Resources.

University of Peshawar. (n.d.). Welcome to the Green Campus. https://greencampus.pk/

Wageningen, U., & Research. (2024). Sustainability at Wageningen University & Research.

Wageningen, U., & Research. (2025a). *Sustainable Business Operations*. https://www.wur.nl/en/about-wur/our-values/sustainable-business-operations.htm

Wageningen, U., & Research. (2025b). Towards a 50% Reduction of Non-Organic Material Use on Campus.

Wageningen University & Research. (n.d.). From Bulging Trash Cans to 50% Less Waste.

Wikipedia. (2026). Khawaja Fareed University of Engineering and Information Technology.

ZWIA. (2024). *Announcing Zero Waste Alliance Pakistan*. https://zwia.org/2024/06/announcing-zero-waste-alliance-pakistan/