



# Strategy for the Development of Waste Management at Padang State University

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**Abstract:** As centers of academic activity, universities generate significant waste volumes requiring systematic and sustainable management. This research aims to analyze the current state of waste management at Universitas Negeri Padang (UNP) across technical-operational, socio-institutional, economic, and regulatory dimensions; assess the participation level of the academic community; and formulate an efficient, sustainable development strategy. This study employed a qualitative descriptive method with a case study approach. Data were gathered through observation, interviews, questionnaires, and documentation studies. The strategic framework was developed using SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, supported by Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS) matrices. The findings reveal that UNP's current waste management remains conventional (collect-transport-dispose), handling 1.5 to 2 tons daily without integrated source-sorting. SWOT analysis identified strong internal legal foundations and a large human resource pool as primary strengths, while the conventional system and low community participation constitute main weaknesses. Although external threats include public apathy and landfill dependency, significant opportunities exist through governmental regulatory support and potential collaborations. With an IFAS score of 1.1 and an EFAS score of 0.29, UNP is positioned in the aggressive strategy (SO) quadrant. Furthermore, economic valuation indicates a potential daily revenue of IDR 1,545,100 from recyclable waste, highlighting the viability of an integrated system. To achieve sustainable management, UNP must leverage its internal strengths to seize external opportunities. The study recommends a transition from conventional methods to an integrated model by strengthening internal regulations, optimizing 3R (Reduce, Reuse, Recycle) infrastructure, implementing sustainable education programs, and fostering multi-stakeholder partnerships.

**Keywords:** Development strategy; Green campus; SWOT analysis; Waste management

## Introduction

Human life cannot be separated from the pace of urbanization and consumption related to waste production, which causes environmental problems (Arumsari et al., 2025; Farhah et al., 2025; Furqoni, 2024). Environmental issues are now increasingly becoming global concerns (Apriana et al., 2025), one of them is the issue of waste. The waste problem is a strategic issue that must be resolved immediately because the impacts are very complex, waste is a very crucial environmental

problem for Indonesian society (Khairunnisa et al., 2023; Tamba et al., 2024; Rahmadani et al., 2025; Septianingrum et al., 2023). Waste problems are closely related to daily life starting from population growth, economic growth, education, and changes in people's consumption patterns (Fariani et al., 2025). The escalating crisis of municipal solid waste management represents a formidable barrier to achieving sustainable urban development, particularly in emerging economies like Indonesia (Wattimena, 2025). Data from the Ministry of Environment and

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Forestry and the Environment for 2021 shows that Indonesia produces 67.8 million tons of, this makes Indonesia the 5th largest contributor of waste in the world. waste (Gozali, 2025; Ummamah et al., 2024; Widiyanti et al., 2024). National data reveals a significant gap in effective waste handling, with only 59.84% of waste being properly managed, comprising 46.62% handling and a mere 13.22% reduction. In regions such as West Sumatra, the reliance on conventional methods is stark, with over half of the waste being diverted to landfills, an approach increasingly recognized as unsustainable due to environmental degradation and finite land availability. This challenge is compounded by low public engagement, where a significant portion of the population exhibits indifference towards responsible waste practices, thereby undermining reduction and recycling initiatives at their source.

Higher education institutions (HEIs), functioning as high-density micro-cities, are significant contributors to the urban waste stream. With their large populations and diverse range of academic, research, and commercial activities, universities generate substantial and complex waste profiles. Therefore, there is need for higher education institutions (HEI) to implement Green initiatives in supporting sustainability attainment for waste decrease, energy efficiency, water utilization reduction, healthy working surroundings as well as clean indoor air (Anthony, 2021). Universitas Negeri Padang (UNP), a prominent state university in Indonesia with a population exceeding 45,000 individuals, exemplifies this challenge, producing an estimated 1.5 to 2 tons of waste daily. The waste composition is dominated by organic materials (food scraps, yard waste), plastics, and paper, reflecting the intensive daily activities on campus. Foodwaste is becoming a problem in a number of countries as a result of its numerous consequences (Khosravani et al., 2025; Muliarta et al., 2023) particularly in small island developing nations where fragmented in stitutions, financial constraints, and inadequate technology exacerbate pollution problems (Matagi et al., 2024).

The zero waste concept is an application of a complex concept that must be owned by all life support institutions in urban areas (Zamzam et al., 2023). Despite institutional commitments to sustainability, including the establishment of a "Green Campus" vision and formal regulations such as Rector's Decree No. 10 on Waste Management, a significant "policy-implementation gap" persists at UNP. A green campus is a concept that emphasizes steps in protecting, managing, and preserving the environment on campus. The current operational reality is a conventional "collect-transport-dispose" system, where integrated waste sorting at the source is largely non-existent, and potentially valuable materials are co-mingled and

ultimately landfilled. While existing literature has focused on specific aspects of campus waste, such as waste characterization, the environmental impact of current practices, or the potential of isolated initiatives like community-based models, a critical research gap remains. There is a lack of studies that formulate a comprehensive, data-driven, and holistic strategic framework for waste management development within a large Indonesian public university. Most prior research has been descriptive or technical, rather than developing a structured, long-term strategic plan that integrates technical, institutional, social, and economic dimensions.

To address this gap, this study aims to develop a robust waste management development strategy for Universitas Negeri Padang. The specific objectives are: (1) to comprehensively analyze the existing waste management system at UNP, evaluating its technical-operational, socio-institutional, economic, and regulatory facets; (2) to assess the level of awareness and participation among the academic community ; and (3) to formulate and prioritize an effective, participatory, and sustainable development strategy using a systematic SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This research contributes a replicable, evidence-based strategic model that bridges the gap between policy aspiration and operational reality, offering valuable insights for UNP and other universities in Indonesia and similar developing countries striving to transition towards sustainable campus environments.

## Method

### Research Design and Approach

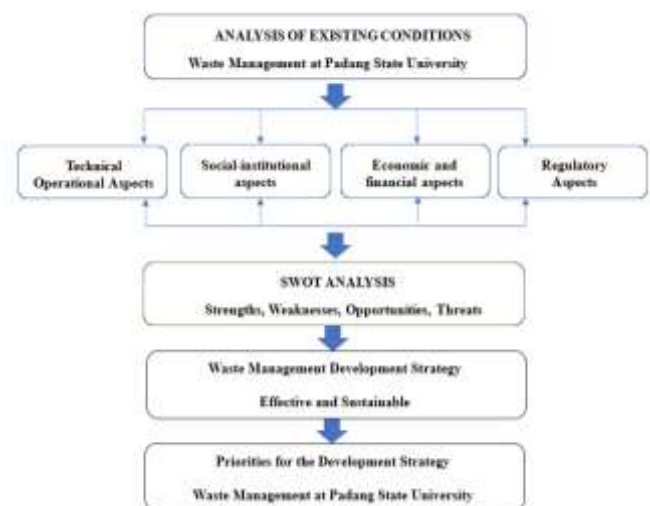


Figure 1. Research framework

This study employed a qualitative descriptive research design utilizing a single-case study approach.

This methodology was selected for its strength in providing a holistic and in-depth understanding of a complex, real-world phenomenon—in this case, the waste management system within Universitas Negeri Padang (UNP). The descriptive approach allowed for a detailed illustration of the existing conditions, influencing factors, and the dynamics of stakeholder participation, while the case study framework enabled a concentrated and comprehensive investigation within a specific, bounded context.

#### *Study Site and Participants*

The research was conducted at Universitas Negeri Padang (UNP), a prominent and large public university in West Sumatra, Indonesia. UNP was chosen as an ideal case study due to its large population (over 45,000 students, faculty, and staff), significant daily waste generation (approximately 1.5–2 tons), and its formal institutional commitment to sustainability through a "Green Campus" vision, creating a clear context to study the gap between policy and practice. A purposive sampling technique was used to select 40 key informants who could provide rich, relevant, and diverse perspectives on the research topic. This multi-stakeholder approach was critical to capturing a comprehensive view of the system. The participants were drawn from four distinct groups:

- University Management (n=2): Key personnel from the university's general administration and facilities management (bagian rumah tangga) were selected to provide insights into policy, budgeting, and institutional oversight.
- Faculty (n=8): Lecturers with a demonstrated involvement and expertise in the university's "Green Campus" programs and environmental issues were included to offer an academic and expert perspective.
- Students (n=20): Student leaders (e.g., heads of faculty student executive boards) were chosen to represent the perspectives and behaviors of the largest campus population group.
- Operational Staff (n=10): Cleaning service personnel directly involved in the daily collection and transport of waste were included to provide critical on-the-ground, operational insights.

#### *Data Collection*

To ensure a robust and triangulated dataset, data were collected from May to June 2025 using multiple methods:

- In-depth Interviews: Semi-structured interviews were conducted with university management, expert faculty, and operational staff to explore institutional

policies, operational challenges, and strategic priorities in detail.

- Questionnaires: A structured questionnaire, utilizing Likert scales, was administered to the 40 participants to quantitatively assess their perceptions, awareness levels, attitudes, and behaviors regarding waste management practices at UNP.
- Direct Observation: Non-participant observation was carried out across the campus to document the actual waste management process, including waste generation points, the functionality of sorting bins, collection procedures, and the state of temporary storage sites. This method was crucial for identifying discrepancies between stated policies and actual practices.
- Documentary Analysis: Official documents, including university regulations (e.g., Rector's Decree on Waste Management), "Green Campus" program guidelines, internal reports, and campus population statistics, were systematically reviewed to understand the formal institutional framework and context.

#### *Data Analysis*

Data analysis was conducted in two sequential phases. First, qualitative data from interviews and observations were analyzed using thematic analysis, involving data reduction, coding, theme identification, and interpretation to understand the core issues and patterns. Quantitative data from questionnaires were analyzed using descriptive statistics (frequencies and percentages) to summarize stakeholder perceptions and behaviors. The core of the analysis was a systematic SWOT analysis to formulate a development strategy. This process involved four key steps:

- Factor Identification: Internal factors (Strengths, Weaknesses) and external factors (Opportunities, Threats) influencing UNP's waste management were identified by synthesizing findings from all data sources.
- Matrix Development and Scoring: The identified factors were organized into an Internal Factor Analysis Summary (IFAS) and an External Factor Analysis Summary (EFAS). Each factor was assigned a weight based on its relative importance and a rating (on a scale of 1-4) based on UNP's current response to that factor, resulting in a weighted score.
- Strategic Positioning: The total weighted scores for the IFAS (Strength - Weakness) and EFAS (Opportunity - Threat) were calculated and plotted on a two-dimensional matrix to determine UNP's strategic position. The final coordinates (X=1.1; Y=0.29) placed UNP in the "Aggressive" (SO)

quadrant, indicating that the optimal approach is to leverage internal strengths to capitalize on external opportunities.

- Strategy Formulation: Finally, a TOWS matrix was used to systematically generate specific and actionable strategies by combining the identified factors: SO (Strength-Opportunity), WO (Weakness-Opportunity), ST (Strength-Threat), and WT (Weakness-Threat) strategies. The credibility of the SWOT analysis and the resulting strategies was ensured through data triangulation and expert judgment.

## Result and Discussion

### Results

#### Existing State of Waste Management at UNP

The investigation revealed that UNP's waste management system is in a transitional phase, characterized by a significant gap between policy aspirations and operational realities.

**Technical-Operational Aspects:** The prevailing system is conventional, adhering to a "collect-transport-dispose" model where nearly all waste is ultimately sent to a regional landfill. The university generates approximately 1.5 to 2 tons of waste daily, dominated by organic materials (40%), plastics (30%), and paper (20%). The management of multilayer plastic waste in Indonesia presents significant challenges, primarily due to the absence of a systematic strategy for its handling (Anwar et al., 2025). Although the university has provided three-color sorting bins (organic, inorganic, hazardous) in several locations, their distribution is uneven and their capacity is often insufficient, particularly in high-traffic areas like canteens. Critically, direct observation confirmed a fundamental systemic failure: waste that has been separated by users at the source is frequently remixed by cleaning staff into a single container during the collection process. This practice nullifies the purpose of the sorting infrastructure and is a primary barrier to effective recycling and composting.

**Institutional and Regulatory Aspects:** Structurally, waste management responsibility falls under the General Administration and Finance Bureau (BUK), integrated with general cleaning and facility maintenance tasks. The university currently lacks a dedicated, specialized unit for integrated waste management. While high-level policies like Rector's Decree No. 10 and the "Green Campus" vision exist as a strong legal basis, there is an absence of detailed, binding Standard Operating Procedures (SOPs) for waste sorting and collection that are enforced campus-wide. This results in a significant policy-implementation gap. This statement is supported by research which

states that to effectively address the projected increase in waste production, it is essential to implement a comprehensive waste reduction and recycling policy framework (Lakhout, 2024).

**Socio-Economic and Participation Aspects:** The study identified a low level of awareness and active participation in proper waste management among a large portion of the academic community. Questionnaire results indicated a paradox: while a majority of respondents agreed with the need for waste management policies, this did not translate into consistent sorting behavior. The economic valuation of recyclable materials revealed significant untapped potential. Analysis showed a potential daily revenue of IDR 1,545,100 from selling sorted waste, which translates to over IDR 46 million per month. Plastic bottles were the largest contributor, accounting for IDR 1,164,000 of the daily potential value.

**Table 1.** Data on the Type and Weight of UNP Waste per Day for Economic Valuation Calculations

Type of Waste	Weight (kg)
Food Scraps	32
Plant Scraps	1556
Wood	39
Plastic Scraps	963
Paper	354
Wrapping Scraps	203
HVS Paper	133
Cardboard	18
Styrofoam	73
Plastic Bottles	291
Cloth	42
Glass	14
Cans	14
Rubber	14
Total	3351

Economic valuation is also in line with the transition, from this calculation further research is needed to understand the factors that drive the dependence on landfills in the transition towards a circular economy in waste management. In the context of sustainability, the green transition represents a shift from current unsustainable practices towards a future where our activities no longer have a negative impact on environmental well-being (Ibarra Vega & Bautista-Rodriguez, 2024; Pambudi et al., 2025). Furthermore, the green transition is considered a significant shift in the economic system towards the reduction of environmental damage (Hatch et al., 2017).

#### SWOT Analysis and Strategic Positioning

The SWOT analysis synthesized the collected data to identify key internal and external factors.

**Strengths:** The primary strengths identified were a strong internal legal basis for waste management (Rector's Decree), a large and educated human resource pool (over 45,000 individuals), and institutional capacity for academic research on environmental solutions. **Weaknesses:** The most significant weaknesses were the conventional "collect-transport-dispose" operational system, low participation and awareness among the academic community, and inadequate supporting infrastructure. **Opportunities:** Key external opportunities included strong national government regulations supporting 3R principles, the ability to benchmark against successful programs at other universities (e.g., UI, UGM), and a growing global trend towards "Green Campuses" that can enhance institutional reputation. **Threats:** The main threats were a general public culture of apathy towards waste issues, a long-term dependency on a regional landfill with finite capacity, and a prevailing consumptive lifestyle centered on single-use products. The quantitative evaluation of these factors resulted in a total Internal Factor Analysis Summary (IFAS) score of +1.1 and a total External Factor Analysis Summary (EFAS) score of +0.29. As depicted in the SWOT matrix, these coordinates firmly place UNP in Quadrant I, indicating an "Aggressive" or "Growth-Oriented" (SO) strategic position. This signifies that the university is in a strong internal position to leverage external opportunities for strategic development.

activities, such as overexploitation of natural resources and pollution, is a major global issue. The continuous growth of the human population has led to an increase in waste generation, which significantly contributes in the environmental degradation (Hajam et al., 2023). The findings of this study highlight a critical disconnect between policy and practice in UNP's waste management system, a challenge common in many institutions in developing nations. The core issue is not the absence of a vision—UNP has a "Green Campus" agenda and a formal rector's decree—but the failure to translate this high-level commitment into an effective, integrated operational system. The research identified that the single most critical failure point is the remixing of waste during collection, which renders the sorting infrastructure and any user participation efforts futile. This finding aligns with literature emphasizing that without integrated systems, isolated interventions are bound to fail.

The low participation from the academic community, despite a general stated agreement with policy goals, corroborates the "Knowledge-Attitude-Practice (KAP) Gap" documented in environmental behavior literature. As suggested by Sulaeman et al. (2021), knowledge is a key prerequisite, but this study confirms that knowledge and awareness alone are insufficient to drive behavioral change. The findings support the arguments of (Ling et al., 2025), which posit that situational factors—such as clear guidelines, consistent enforcement, and structural interventions—are crucial. The success of a pilot program at UNP that integrated community participation with incentives further underscores this point, demonstrating that active engagement strategies can yield significant improvements in waste reduction and sorting rates.

The result of the SWOT analysis, placing UNP in an "Aggressive" strategic quadrant, is a key finding that should guide future action. It suggests that a passive or defensive stance is inappropriate. The university possesses significant internal strengths—its legal framework, academic expertise, and large population—that it must proactively use to seize external opportunities, such as government support for 3R initiatives and partnerships with the recycling industry. The formulated SO strategies, such as strengthening policy implementation to enhance campus reputation and leveraging academic capacity for technological innovation, provide a clear roadmap for this growth-oriented approach.

Furthermore, the economic valuation serves as a powerful catalyst for institutional change. The potential to generate over IDR 46 million per month from recyclable waste transforms the perception of waste from a liability and cost center into a valuable asset and potential revenue stream. This aligns with studies by

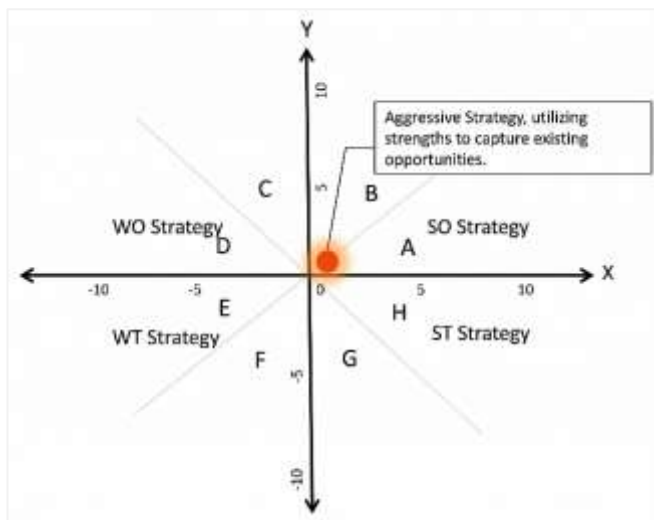


Figure 2. EFAS and IFAS diagrams

*Discussion*

The effective management of waste poses a critical issue in the pursuit of global sustainability. Due to a world population that is expanding, urbanizing, and consuming more, the amount of waste being generated has risen at an alarming rate (Alsabt et al., 2024). Environmental degradation caused by anthropogenic

Dewata et al. (2023) and Wahyuni et al. (2021), which highlight the significant economic efficiencies and income potential of integrated campus waste management. This financial incentive can be instrumental in securing the necessary budgetary allocations and managerial support for investing in the required infrastructure and programs, such as establishing an integrated waste processing unit as recommended.

Overall, this study contributes a comprehensive, evidence-based strategic framework that addresses the identified research gap. By moving beyond a simple description of the problem, the research provides an actionable roadmap that integrates policy enforcement, infrastructure optimization, behavioral change programs, and stakeholder partnerships. The implementation of these interconnected strategies is essential for UNP to bridge its policy-implementation gap and transition into a genuinely sustainable and leading "Green Campus". This is in line with (Dawodu et al., 2022; Dewata et al., 2025; Gholami et al., 2020) research, which states that within the framework of sustainable development, Universities emerge as crucial agents of change.

## Conclusion

This study set out to develop a comprehensive waste management strategy for Universitas Negeri Padang (UNP) to address the significant gap between its "Green Campus" policy aspirations and its operational realities. The research concludes that UNP's current waste management system is fundamentally conventional, characterized by a "collect-transport-dispose" paradigm that fails to capitalize on the potential for resource recovery. Despite the existence of a formal policy framework and basic sorting infrastructure, a lack of detailed and enforced Standard Operating Procedures (SOPs), coupled with low participation from the academic community, renders the system ineffective. The central conclusion, derived from a systematic SWOT analysis, is that UNP is in an "Aggressive" strategic position (Quadrant I). This indicates that the university possesses significant internal strengths—such as a strong legal basis, vast human capital, and academic expertise—which it should proactively leverage to seize pressing external opportunities, including government regulatory support and global sustainability trends. Therefore, transitioning towards an integrated and sustainable waste management system is not merely a corrective measure but a strategic imperative that aligns with the university's strengths and opportunities for growth and reputational enhancement. The primary contribution of this research is the development of a holistic, evidence-based strategic framework that moves

beyond descriptive analysis to provide an actionable roadmap for a large public university in a developing country. By integrating technical, institutional, economic, and social dimensions, this model offers a replicable approach for other higher education institutions facing similar challenges in bridging the policy-implementation divide. It provides a structured pathway to transform waste from an institutional liability into a valuable economic and educational resource. This study is not without limitations. As a single-case study, the specific findings are context-bound to UNP, although the methodological framework is broadly applicable. The analysis is also based on data collected during a specific period and relies on the perceptions of a purposively selected sample. Therefore, future research is recommended to build upon these findings. Specifically, further studies should undertake: (1) detailed quantitative analysis to map waste composition and generation rates across different faculties to enable more precise planning; (2) comprehensive feasibility studies to assess the economic and technical viability of establishing on-campus processing facilities, such as a centralized waste bank or composting unit; and (3) longitudinal research to evaluate the long-term effectiveness of specific educational and behavioral interventions on the campus community.

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## Author Contributions

W. N.: writing – original draft, including methodology, results, discussion, and conclusion; I. D, N. S, and A. A; analysis, review, proofreading and editing.

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