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Innovative strategies for sustainable campus management: Insights from "Karya Hijauku untuk Kampus Biruku”

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Introduction

Sustainable campus management has become an increasingly important issue in higher education. A campus is not only a center for education and research but also serves as a miniature model of environmental governance that can set an example for the broader society (Sugiarto et al., 2022). Amid growing concerns about climate change, environmental degradation, and urgent demands for efficient use of natural resources, the application of sustainability principles has become an urgent need. Therefore, sustainable campus management is not merely about meeting environmental standards but also represents the educational institution’s responsibility toward the future of the environment (Durão et al., 2025; Oliveira & Proença, 2025).

Conservation of natural resources (NR) is an integral part of environmental conservation efforts, especially in the higher education sector (Simpao & Yabut, 2022; Vidal-Cornelio et al., 2025). Campuses have great potential to become models in implementing the concept of sustainability (Montgomery et al., 2022). The book " Karya Hijauku untuk Kampus Biruku" documents the experience of Universitas Gadjah Mada (UGM) as a pioneer in sustainable management of NR in the campus environment. This article aims to review the contents of the book and relate them to NR conservation steps that can be applied in other educational institutions. "Karya Hijauku untuk Kampus Biruku" by Utami et al. (2021) provides a comprehensive guide on sustainable campus management through the efforts of the Integrated Smart and Green Building (INSGREEB) research group at Universitas Gadjah Mada (UGM). This review examines each chapter, highlighting key points and contributions towards achieving a green and sustainable campus.

The scope of this book covers four critical pillars of green campus development: (1) Introduction to green campus philosophy and policy direction, (2) Sustainable land and infrastructure management, (3) Efficient and adaptive water resource management strategies, and (4) Innovative, integrated, and eco-friendly waste management systems. These themes make the book highly relevant as a reference for developing sustainable practices and policies in other higher education institutions.

The primary objective of this review article is to systematically examine the contents of “Karya Hijauku untuk Kampus Biruku”, assess its contribution to natural resource conservation, and evaluate the extent to which its approaches can be replicated or adapted by other campuses in Indonesia or internationally. Through this review, it is expected that a deeper understanding will emerge regarding green campus practices and their implications for environmental sustainability in the academic sector.

Chapter 1: Introduction to Green Campus Initiatives

This chapter introduces the importance of sustainable practices in academic institutions, outlining environmental challenges and the need for integrated approaches. This chapter discusses the green campus philosophy implemented at UGM as an initial step in creating a sustainable campus environment. The author highlights various initiatives, such as greening the campus area, energy efficiency, and involving students in environmental conservation activities.

Greening initiatives on campuses often include sustainable waste management, green transportation, and the creation of eco-friendly spaces like gardens and green roofs. These efforts are aimed at enhancing environmental sustainability and are supported by both faculty and student involvement (Geok et al., 2024). Energy conservation is a key focus in green campus initiatives. This includes using alternative energy sources, energy-efficient building designs, and promoting energy-saving behaviors among students and staff. Such practices are crucial for reducing energy consumption and greenhouse gas emissions (Fachrudin & Fachrudin, 2021). Student engagement is a critical factor in the success of green campus initiatives. Students participate in sustainability activities (Dadi et al., 2024), enhancing their environmental awareness and improving the university's corporate image and reputation (Al-Dmour, 2023). Their involvement can include participating in eco-friendly practices and other supporting green campus policies (Sarkawi et al., 2024). The green campus initiatives outlined are highly relevant in reducing carbon footprints, increasing environmental awareness, and encouraging campus community participation in environmental conservation.

The first chapter of Karya Hijauku untuk Kampus Biruku provides a philosophical foundation regarding the importance of green approaches in campus management. The authors emphasize the integration of sustainable practices and the involvement of the campus community in addressing global environmental challenges. While the chapter effectively conveys the urgency and foundational principles, the authors' arguments tend to be narrative and lack measurable evaluations of implemented initiatives. In light of existing literature, green campus initiatives should be viewed as adaptive systems (Fachrudin & Fachrudin, 2021), and the absence of specific success indicators weakens the chapter’s analytical strength. Student engagement, mentioned as a critical element, is not systematically discussed in terms of measurable involvement as emphasized by Al-Dmour (2023). For example, in the book "Handbook Hibber UNIGAL" by Parjaman et al. (2022) practical programs that have been implemented are explicitly described, such as the Clean Friday Movement, Tree Planting, and Green Class, without reviewing the theoretical or ideological framework of the green campus conceptually in too much depth (Mauladi & Rachmah, 2023). Therefore, although this chapter is inspirational, it requires strengthening through data and impact indicators.

Chapter 2: Land and Infrastructure Management

Focuses on sustainable campus land and infrastructure management, providing detailed strategies for optimizing land use and designing eco-friendly buildings. UGM's case studies demonstrate practical applications, making the chapter informative and actionable for other institutions. Land use and infrastructure management carried out include green open areas, UGM Local Wisdom Park, Wanagama Educational Forest, Pagilaran Tea Plantation, Getas-Ngandong Forest, PIAT UGM, Green infrastructure development, BEEMS development, Analysis of subjective responses of residents, building system simulation, management actions, and building utilities.

Infrastructure management is directed at benefits that can be felt by all parties, not only the campus environment but also the environment around the campus. An integrated land use management approach can promote sustainable development of educational campuses, promoting a symbiotic relationship with nature and promoting pedestrian-friendly transportation networks (Thilagam, 2015). in other studies, Suburban parks in southwest Madrid provide high environmental and social services, making them ideal for implementing a supra-municipal strategy for green infrastructures and improving biodiversity (Verdú-Vázquez et al., 2021). Exposure to outdoor and

indoor green spaces improves mental health, physical health, and cognitive abilities, while also reducing stress, anxiety, and depression (Paniccià et al., 2024). Sustainable land and infrastructure management efforts are not only friendly to the natural environment but also friendly to the social environment.

The second chapter explores how Universitas Gadjah Mada (UGM) manages campus land use and infrastructure to support sustainability. The authors present concrete case studies such as the Wanagama Educational Forest and the Pagilaran Tea Plantation. This aligns with Thilagam (2015) perspective on the importance of integrating green open spaces into campus development. However, the chapter lacks critical analysis of the challenges encountered in these projects, such as spatial planning conflicts or funding constraints. Moreover, the social benefits of green infrastructure, although implied, are not thoroughly explored. As Paniccià et al. (2024) argue, green spaces play a crucial role in mental health and social cohesion.

Chapter 3: Water Resource Management

Discusses water conservation and management on campus, presenting techniques and technologies implemented at UGM to reduce water consumption and promote recycling. Efficient campus water governance systems are crucial for both clean water consumption and conservation efforts. Universitas Gadjah Mada (UGM) aims to conserve water by utilizing rainwater runoff and recycled water as alternative sources, alongside ensuring efficient consumption based on campus occupants' needs and activities. To implement an alternative clean water supply system effectively, the campus must gather detailed data on the ideal water distribution system (Edwin N. Pagayona, 2024; Sankar et al., 2015). This includes understanding existing systems, ensuring water quality and regulatory compliance due to the importance of adhering to water management rules (Mulyanti et al., 2023), and integrating advanced technologies like IoT for efficient monitoring and management (Verma et al., 2015). Clean water is a vital resource for the sustainability of campuses and their surrounding communities (EL-Nwsany et al., 2019). Management of water resources includes water governance, water balance calculation, water metering system, drinking water supply system (SPAM-Toyagama), rainwater harvesting, rainwater infiltration areas, grey water usage, and water conservation programs.

UGM's comprehensive water management strategy integrates governance across all levels, from individual faculties to top management. The Directorate of Planning plays a central role in overseeing campus water management, utilizing detailed engineering design (DED) data to assess potential rainwater infiltration areas and optimize roof potential. Recommendations from these assessments inform gulaUGM's Green Campus Team and research centers, guiding implementation strategies managed by the Asset Directorate and faculties. Water balance calculations for new buildings are crucial, addressing UGM's daily demand of 1,570,000 liters for academic and irrigation needs. Efficient water use strategies consider building occupancy and operational hours, ensuring sustainability through measures like rainwater harvesting from rooftops and biopores. These initiatives, along with green roofs and detention basin systems linked to the Belik River, manage campus water flows and support environmental quality. UGM's water metering system tracks consumption across campus, identifying savings and leak detection opportunities, crucial for maintaining green building standards. Water systems can make it easier to identify water flow and possible leaks (Edwin N. Pagayona, 2024). Additionally, the SPAM Toyagama provides sustainable drinking water sourced from groundwater, reducing reliance on bottled water. Greywater recycling systems at Bulaksumur Residence further enhance water quality before discharge, complementing UGM's broader conservation efforts encompassing groundwater tanks, rainwater catchments, and biopores distributed throughout campus to enhance environmental resilience and quality .

This chapter outlines various technologies and water conservation practices implemented at UGM, including SPAM Toyagama, rainwater harvesting, and greywater recycling. These initiatives contribute significantly to the discourse on water conservation in academic settings (Yuniawan Isyanto et al., 2023). However, the presentation is overly descriptive and lacks comparative analysis with

similar practices at other institutions. As Verma et al. (2015) highlight, integrating Internet of Things (IoT) technologies into campus water systems should be quantitatively evaluated for efficiency and cost-effectiveness. The chapter also falls short in explicitly discussing the impact of water resource management on campus environmental and operational outcomes. The strength of this chapter lies in showcasing a data-driven governance model led by UGM's Planning Directorate, but this would benefit from statistical evidence and benchmarking against international standards (EL-Nwsany et al., 2019).

Chapter 4: Waste Management

This chapter addresses waste management as a critical aspect of campus sustainability. UGM's programs include recycling, composting, and waste reduction campaigns. Provides a clear roadmap for implementing similar programs in other universities, supported by success stories and statistical evidence. The waste management practices described demonstrate a real contribution to waste reduction, sustainable waste management, and increased awareness among the campus community of the importance of waste management.

Waste management at UGM is grouped into organic, inorganic, and waste management to become biogas. Organic waste management is carried out by accommodating organic waste to be processed into compost through a composting tank. In addition to composting, organic waste is also processed using maggots or larvae from the Black Fly Soldier (BSF). Additional benefits of BSF larvae, apart from being an effective decomposing agent, can also be used as feed or biodiesel fuel. BSF larvae contain high enough fat to be processed into biodiesel (Grossule & Lavagnolo, 2020). In another study it was found that BSF larvae can efficiently convert food waste into biodiesel through non-catalytic transesterification, meeting both Korea and EU biodiesel fuel standards (Jung et al., 2022).

The final chapter discusses organic and inorganic waste management practices at UGM, including composting and the innovative use of Black Soldier Fly (BSF) larvae. These practices are aligned with global waste reduction trends and show innovative potential. The arguments are strong in terms of technological novelty (maggot-based biodiesel), but lack evaluative depth. The chapter does not compare the efficiency of BSF-based decomposition with other methods like thermophilic composting or anaerobic digestion. Furthermore, while environmental awareness is mentioned, there is no survey or metric to measure behavioral change among the academic community. Jung et al. (2022) emphasize the importance of technical and social acceptance of insect-based waste technologies. The authors also fail to address how these systems contribute to emission reductions or cost savings, which would be critical for long-term sustainability assessments.

Conclusion

"Karya Hijauku untuk Kampus Biruku" is an invaluable resource for universities seeking to implement sustainable practices. Each chapter provides detailed strategies, real-world examples, and practical guidance, making it a comprehensive guide to green campus initiatives. Its structured approach and emphasis on stakeholder engagement and ongoing evaluation make it a must-read for academic institutions committed to sustainability. "Karya Hijauku untuk Kampus Biruku" is a valuable contribution to the literature on sustainable campus management in Indonesia. The strength of the book lies in its practical narrative drawn from UGM's real-world experiences and its rich case studies. However, its major weaknesses are its overly descriptive approach and lack of critical evaluation of the impacts of these implementations. To strengthen its position as an academic reference, the book should include quantitative analysis, cross-institutional comparisons, and a more systematic evaluation framework. Greater integration with international literature would also enhance its relevance in the global discourse on green campuses.

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