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AN ANALYTICAL REVIEW ON INITIATIVES FOR A SUSTAINABLE CAMPUS OPERATION IN MALAYSIAN PUBLIC HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

Sustainability in higher education has become a global imperative. Understanding the successful implementation of campus operation initiatives is pivotal to the transition to sustainable practices. Sustainability becomes a critical priority for higher education institutions as they strive to align their operations with environmentally friendly practices. This research aims to review the current sustainable initiatives implemented in Malaysian public Higher Education Institutions (HEIs), specifically focusing on their campus operations. Thus, the research methodology employed in this paper utilised the bibliometrics approach, involving retrieving written publications from the Scopus database and document analyses from each institution. An exhaustive literature review facilitated the identification of eight key areas encompassing the sustainable campus operation initiatives. The findings unveiled that buildings, air & climate, energy, food, grounds, transportation, waste management, and water management were pivotal components driving the attainment of a sustainable campus operation. Nevertheless, in pursuing sustainability, it is noteworthy that only a few public HEIs in Malaysia have embraced these initiatives. The progress towards sustainable development in Malaysian higher education institutions still needs to meet the target outlined in the 2030 Agenda for Sustainable Development. Hence, it is recommended that the adoption of sustainable practices across all HEIs in Malaysia be increased by enhancing the level of awareness, allocating resources, and consistently monitoring to bridge the current gaps.

Keywords: Campus Operation, Higher Education Institutions, Sustainable Campus, Sustainable Development.

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1. INTRODUCTION

Sustainable initiatives are essential in resolving environmental challenges and promoting sustainable development. Sustainable initiatives have become a key focus in educational institutions worldwide. Higher education institutions (HEIs) now consider sustainability crucial as they strive to align their operations with environmentally friendly practices. The contemporary era, marked by increasing environmental concerns, has led to a surge in sustainable practices across various sectors (Filho et al., 2019). As key societal actors, HEIs are vital in advancing sustainability (Goni et al., 2017). The concept of a sustainable campus has emerged as a new priority for these institutions. Numerous initiatives and awareness programs have been launched to actively promote sustainability practices and outcomes (Yusoff et al., 2021). However, a significant gap remains in the comprehensive analysis of campus operations to assess the effectiveness of sustainable initiatives implemented by HEIs in Malaysia (Zhao & Cheah, 2023). Existing literature often highlights global and generalised practices without providing an in-depth examination of sustainability implementation within Malaysian campuses, where efforts are still in the early stages. It has yet to be fully integrated comprehensively. Limited research exists on the extent to which Malaysian HEIs have comprehensively integrated sustainability practices within their campus operations or on the specific areas that require improvement to align with national and global sustainability targets, such as the 2030 Agenda for Sustainable Development. This lack of targeted research impedes HEIs' ability to strategically plan, implement, and assess the efficacy of their sustainability initiatives. (Nawanira et al., 2018). This gap creates a lack of clarity on which specific campus operations initiatives are most impactful and the challenges and facilitators unique to the Malaysian context.

In the past few years, HEIs' role in promoting sustainable development has become more widely recognised (Ghojogh Najad, et al., 2018). Ensuring that campus sustainability initiatives positively impact the economic, social, and environmental spheres is crucial (Abad-Segura & González-Zamar, 2021). HEIs have evolved from being mere centres of knowledge to becoming pivotal agents in promoting and achieving sustainability. This shift is particularly evident in their implementation of sustainability initiatives within campus operations, demonstrating their commitment to environmental stewardship. As key societal actors and platforms for knowledge creation and dissemination, HEIs are vital in advancing sustainable practices. The integration of sustainability efforts in campus operations underscores their dedication to environmental responsibility and provides an educational model for both students and the wider community (Dawodu et al., 2022). The evaluation of the Universiti Sains Malaysia (USM) community reveals a significant perception of sustainability as highly important, with active involvement in sustainable initiatives and practices on campus, as Bakar and Kadir (2021) emphasised. However, according to Nawanira et al. (2018), adopting sustainable initiatives in campus operations within Malaysian HEIs is still early. It has yet to be fully integrated comprehensively. This underscores the imperative for additional research endeavours to explore and understand the trend of campus operation on sustainability implementation in Malaysian HEIs. Hence, this research paper will review the current sustainable initiatives in Malaysian public HEIs, explicitly focusing on their campus operations.

2. LITERATURE REVIEW

2.1 Sustainable Higher Education Institutions (HEIs)

HEIs are significant contributors to and drivers of sustainable development, with their efforts initially rooted in the concept of Environmental Education, which was biased on environmental issues; hence, it was later revised to Education for Sustainable Development, which integrates the three pillars of social, economic, and ecological sustainability (Osman et al.; Osman et al., 2009). By incorporating sustainable development as the means and purpose of teaching, learning, research, and community engagement, all of these ideas required the participation of HEIs (Abdul Gapor et al., 2014). In recent years, there has been a growing emphasis on conducting campus sustainability research, with a specific focus on assessing the environmental impact of universities. Various methodologies have been implemented to evaluate and rank HEIs globally based on the performance of institutions towards sustainability. According to Beynaghi et al. (2016), HEIs are embarking on a new phase termed "Universities and Sustainable Development." Three prospective university models are envisioned, characterised by an institution guided by social, environmental, and economic considerations. This perspective is reinforced by Aleixo et al. (2018), who emphasise that the economic, ecological, and social aspects of sustainable campus activities are incorporated into the fundamental activities of HEIs, encompassing teaching, research, operations, societal engagement, and cultural obligations. Notably, global rankings like the Green Metric World University Ranking and STARS (Sustainability Tracking, Assessment, and Rating System) have gained traction as

benchmarking systems that allow HEIs to assess their sustainability performance based on a broad array of operational and educational criteria (Duarte et al., 2023; Moggi, 2023).

In this context, HEIs contribute to sustainable development through a dual approach. Firstly, by reducing the negative impacts of their activities on the economy, society, and environment. Secondly, by amplifying the positive effects of their efforts across these three dimensions (Filho et al., 2019). This entails incorporating sustainable practices into curricula and research programs and promoting sustainability (Stough et al., 2018). From a theoretical standpoint, Dagiliute et al. (2018) argue that a university can be deemed "sustainable" or "green" when it consistently integrates sustainability principles across all relevant areas. Research on sustainability has primarily focused on global aspects, including studies conducted by Filho et al. (2019) on the examination of green projects on campuses, Bradley's (2019) work on integrating environmental concepts into educational curricula, along with the widespread adoption of sustainability reporting and self-assessment as highlighted by Cavicchi & Vagnoni (2018), Duarte et al. (2023) and Moggi (2023).

In Malaysia, HEIs are gradually aligning with these global trends, albeit slower. Unlike their counterparts in Europe and North America, Malaysian HEIs face unique challenges, such as limited funding, regulatory restrictions, and a lack of cohesive sustainability policies. This has resulted in a fragmented approach to sustainable development, with varying levels of commitment and success across institutions. Although Malaysian HEIs recognise the importance of sustainability, a notable gap exists in implementing comprehensive, campus-wide sustainability frameworks that integrate social, economic, and environmental dimensions as seen globally (Foo, 2013; Goni et al., 2017). Hence, this study addresses the need to contextualise global sustainable practices within Malaysian HEIs to identify areas for improvement and suggest targeted interventions. However, aligning Malaysian HEIs with global models remains an active research and development area, as HEIs strive to meet sustainability targets by integrating international best practices. By examining sustainable operations through Amaral et al.'s (2020) model, this study comprehensively analyses how Malaysian HEIs can adopt best practices to improve their sustainability performance across various campus dimensions, including air, climate, food, and energy.

2.2 Sustainable Initiatives

Sustainable initiatives can be implemented within and without the campus. Initiatives that do not involve changes to external parties beyond the campus, as commonly observed in community engagement and outreach programs (Abdul Gapor et al., 2014; Groulx et al., 2021). Conversely, sustainable initiatives on campus foster lasting efforts and transformations within the campus environment. The campus itself serves as a living laboratory to achieve sustainability objectives, as demonstrated by projects such as the "bike hub" initiative promoting cycling (Pedersen et al., 2017), the promotion of social entrepreneurship (Daub et al., 2020), and the provision of sustainable food options (Merino, 2022). The most common examples of campus sustainability initiatives involve the operations of HEIs, particularly those related to the physical built environment of the campus (Amaral et al., 2020).

Studies on sustainable initiatives in Malaysia have been conducted. Still, they tend to be scattered and lack a connection to a coherent theoretical framework, often focusing on evaluating existing practices and activities. These include assessments of greenway development, sustainability-related research, and the involvement of NGOs in campus activities (Foo, 2013). However, the research on green office initiatives at Universiti Teknologi Malaysia in Johor was notably comprehensive (Zen et al., 2016) and the evaluation of utilising information systems for sustainability initiatives benchmark database, monitoring, and evaluation process by Goni et al. (2017). Hence, this research focuses on the operational aspect of sustainable initiatives related to the physical aspects of the campuses. Operation dimensions include eight aspects, which follow Amaral et al. (2020) model framework. These include buildings, air & climate, energy, food, grounds, transportation, waste management, and water management.

3. METHODOLOGY

This research analyzes the current sustainable initiatives implemented in Malaysian public Higher Education Institutions (HEIs), specifically focusing on their campus operations. The research methodology employed in this study adopts a bibliometric approach, utilising the Scopus database to retrieve written publications and document analyses from each institution's website. A search query has been employed to pinpoint pertinent written

publications concerning sustainable initiatives for campus operations, such as the title, abstract, and keywords. Scopus and Web of Science are the most frequently utilised databases for bibliometric analyses (Trevisan et al. (2023). In recent years, this approach has played a significant role in reviewing scientific knowledge (Abad-Segura, et al., 2020). According to Abad-Segura & González-Zamar (2021), bibliometrics is extensively applied in the study and analysis of various aspects of written publications, particularly in science and academia. It involves the quantitative examination of bibliographic information. This encompasses critical elements such as the number of publications, citation patterns, authorship, and the distribution of publications across different journals or disciplines. The specific dimensions of bibliometrics integrated into this research methodology are as follows:

1. Citation analysis: involves scrutinising the frequency with which other publications cite a particular work to provide insights into its impact and influence.
2. Authorship patterns: entailing the study of patterns in authorship within the scientific literature, encompassing the number of authors per paper and collaborative research trends.
3. Journal impact factor calculation: This measures the typical number of citations that a journal's published articles receive from 2010 to 2024, often used to indicate the journal's prestige and influence.
4. Co-citation analysis: identifying documents frequently cited together, signifying a thematic relationship or shared influence.
5. Keyword analysis assesses the frequency of specific keywords or terms in literature. It is also used to understand trends, topics, and emerging research areas.

The detailed process of selecting articles is shown in Figure 1.

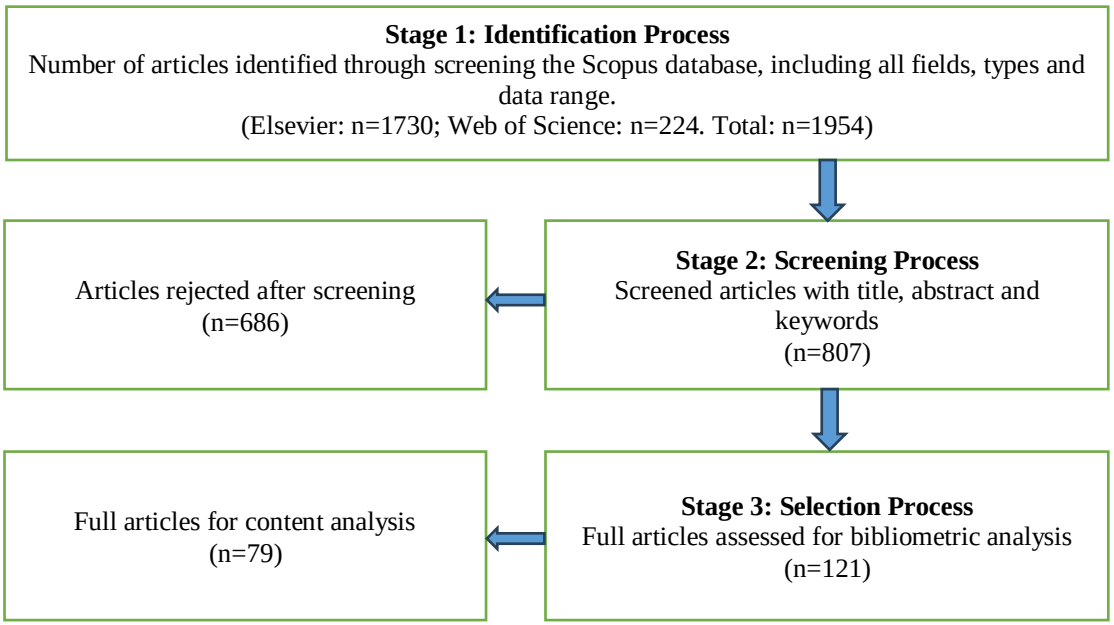

Figure 1: Process Selection of Articles for Bibliometric and Content Analysis.

The article selection process unfolded through a systematic three-stage approach. Initially, in Stage 1, a comprehensive screening of the Scopus database was conducted, taking into account all fields, types, and the specified data range. Elsevier and Web of Science were chosen to carry out this methodology on sustainable initiatives focusing on campus operation in Malaysian HEIs as it is among the most extensive repositories that have undergone peer review. The selection of articles found by utilising the search term [TITLE-ABS-KEY (sustainable campus operation) AND TITLE-ABS-KEY (sustainable initiatives) AND TITLE-ABS-KEY (Malaysia university OR Malaysian higher education institutions) from the year 2010 to 2024. This rigorous examination identified 1954 articles for Elsevier and Web of Science. Subsequently, in Stage 2, a meticulous screening process ensued, focusing on evaluating articles based on their title, abstracts, and keywords. This screening process led to the identification of 807 articles for further consideration. Notably, a specific number of articles (n=686) were excluded during this stage as they failed to meet the predetermined criteria or needed more

relevance to the study. Finally, in Stage 3, the selection process reached its culmination. After successfully passing the initial screening phases, full articles underwent a thorough assessment to determine their suitability for bibliometric analysis (n=121) and content analysis (n=79). This final stage ensured a refined and well-considered compilation of articles that would contribute effectively to the intended research objectives. Multiple measures were conducted to minimise selection bias by clearing the inclusion and excluding some of the criteria. This step is to minimise arbitrary decisions in article selection. The systematic screening process is structured to ensure the most relevant articles are included by defining specific criteria to minimise subjective bias. In addition, citation frequency data was also analysed while selecting articles to ensure each publication's influence was balanced on each article's impact based on the year of publication. This step mitigates the risk of older articles due to accumulated citations over time. Citation frequencies in this research were analysed by including the year of publication, journal impact factors, and pattern of co-citations. Articles with high citations were counted for thematic analysis, revealing the current insights trend of sustainable campus initiatives.

They are widely utilised in evaluating research performance, academic institutions, and individual researchers; bibliometrics aids in identifying research trends, assessing the impact of research output, and making informed decisions about resource allocation and research priorities. It is essential to acknowledge that while bibliometrics is a valuable tool, it has limitations and should be used with other qualitative measures to offer a more comprehensive understanding of research impact and quality (Abad-Segura et al., 2020). Hence, web document analysis is also adopted in this research to support the data. Web document analysis evaluates and interprets information from the internet or other web-based sources. The methodology involves systematically examining digital documents retrieved from the official websites of 20 public HEIs in Malaysia, as listed in Table 1.

Table 1: Official Website of Public Higher Education Institutions in Malaysia.

Malaysian Public Higher Education Institutions (HEIs)	Official Website
Universiti Malaya (UM)	http://www.um.edu.my
Universiti Sains Malaysia (USM)	http://www.usm.my
Universiti Kebangsaan Malaysia (UKM)	http://www.ukm.my
Universiti Putra Malaysia (UPM)	http://www.upm.edu.my
Universiti Teknologi Malaysia (UTM)	http://www.utm.my
Universiti Islam Anatarabangsa Malaysia (UIAM)	http://www.iiu.edu.my
Universiti Utara Malaysia (UUM)	http://www.uum.edu.my
Universiti Malaysia Sarawak (UNIMAS)	http://www.unimas.my
Universiti Malaysia Sabah (UMS)	http://www.ums.edu.my
Universiti Pendidikan Sultan Idris UPSI	http://www.upsi.edu.my
Universiti Sains Islam Malaysia (USIM)	http://www.usim.edu.my
Universiti Teknologi MARA (UiTM)	http://www.uitm.edu.my
Universiti Malaysia Terengganu (UMT)	http://www.umt.edu.my
Universiti Tun Hussein Onn Malaysia (UTHM)	http://www.uthm.edu.my
Universiti Teknikal Malaysia Melaka (UTeM)	http://www.utem.edu.my
Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA)	http://www.ump.edu.my
Universiti Malaysia Perlis (UniMAP)	http://www.unimap.edu.my
Universiti Sultan Zainal Abidin (UniSZA)	http://www.unisza.edu.my
Universiti Malaysia Kelantan (UMK)	http://www.umk.edu.my
Universiti Pertahanan Nasional Malaysia (UPNM)	http://www.upnm.edu.my/

4. RESULTS AND DISCUSSION

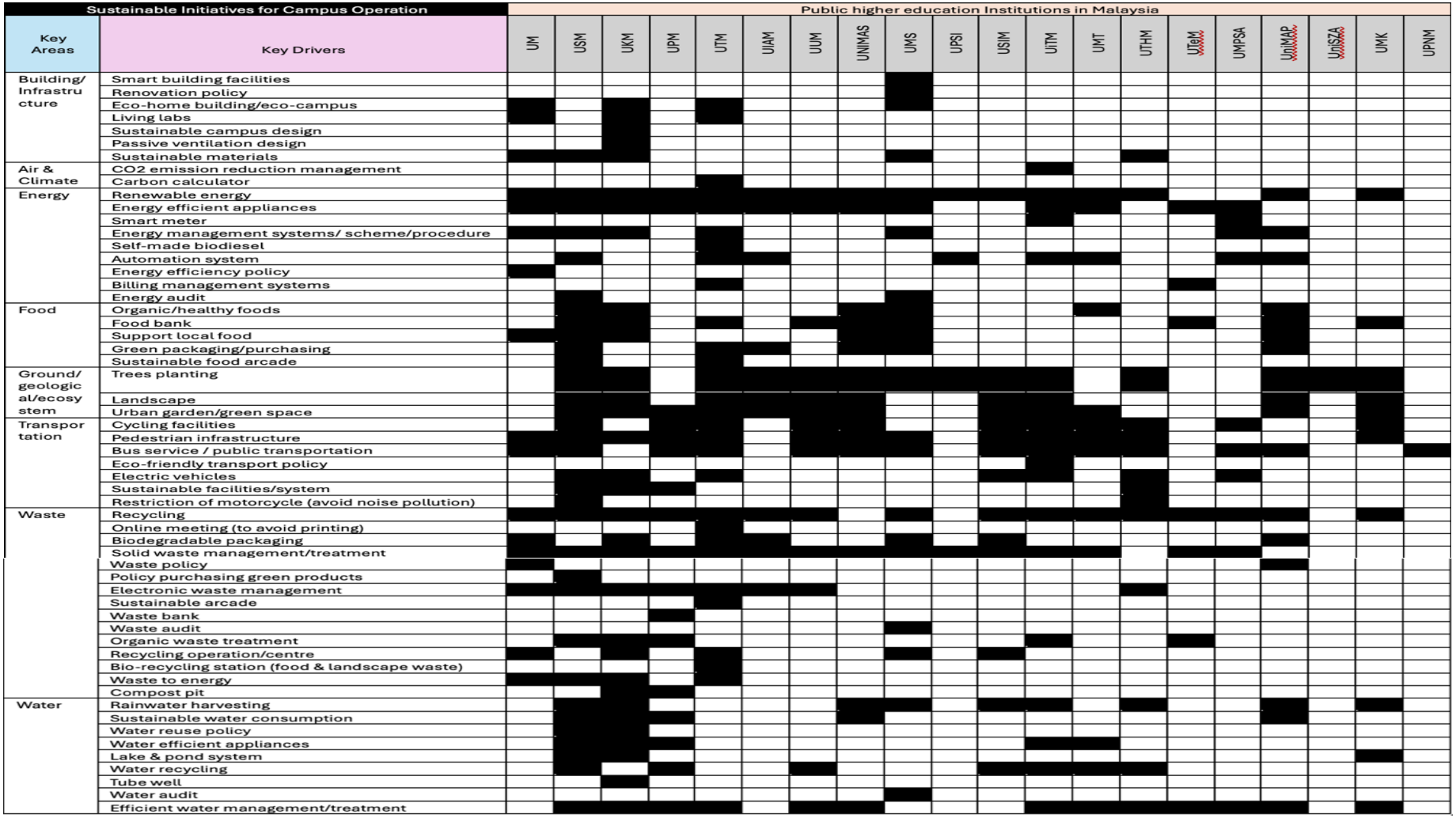

Figure 2: Sustainable Initiatives on Campus Operations Implemented by Public HEIs in Malaysia.

The provided data thoroughly examines sustainable initiatives undertaken by Malaysian public higher education institutions across various key areas and drivers related to campus operations. In alignment with the findings of Gomez and Yin (2019), the data substantiates the multifaceted drivers behind sustainable campus initiatives. The leading public institutions in Malaysia that adopt sustainable practices are USM, UKM, and UTM, which serve as exemplary models. Specifically, in the area of building and infrastructure, there is a discernible trend in the adoption of intelligent building facilities among numerous institutions, including UM, UPM, UTM, UIAM, and others. Living labs at UM, UKM, and UTM provide a real-world setting for testing innovations and technologies, allowing researchers to gather valuable data and feedback in a more authentic context. These labs are collaborative environments where researchers, businesses, and communities come together to test, prototype, and co-create solutions for various challenges (Mohamad et al., 2022; Yusoff et al., 2021). The prevalence of renovation policies further underscores the widespread commitment to sustainable building practices, with universities like USM, UPM, and UiTM actively embracing such policies. Notably, the data also reveals the promotion of eco-home building and eco-campus development by institutions like UM, UKM, UTM, and USM (Hussin & Kunjuraman, 2015; Zen et al., 2014), underscoring a collective dedication to environmentally friendly construction practices. This comprehensive overview reinforces the notion that sustainable campus initiatives are diverse and deeply rooted in the strategic objectives of Malaysian public HEIs.

UiTM directs its efforts toward CO2 emission reduction management in the context of air and climate initiatives, highlighting a proactive stance in mitigating environmental impact, as indicated by Mustaffa et al. (2022). Concurrently, UPM utilises a carbon calculator, exemplifying a commitment to monitoring and regulating carbon emissions. The energy initiatives within these institutions demonstrate a collective dedication to sustainability through the widespread adoption of renewable energy sources and energy-efficient appliances (Shafie et al., 2023). Noteworthy is the implementation of intelligent meter initiatives by UM, UPM, and UiTM, indicating a shared commitment to enhancing energy efficiency and management practices (Ismail et al., 2016). These initiatives underscore a comprehensive approach by the Malaysian public HEIs to address the environmental challenges associated with air quality and energy consumption.

The commitment to sustainable food practices becomes apparent through various initiatives that advocate for promoting organic and healthy foods, establishing food banks, and supporting locally sourced produce. UPM's Sustainable Food Arcade is a notable example, illustrating the institution's endeavours to seamlessly integrate sustainable food options into the fabric of campus life. In addition, UTM also implements waste management strategies, explicitly addressing the disposal of organic and food waste through the Sustainable Food Arcade (Zen et al., 2016). Beyond food-related initiatives, a broader commitment to environmental conservation is evident through widespread engagement in activities such as tree planting, landscape projects, and the development of urban gardens and green spaces. Institutions like UM, USM, UKM, and others actively contribute to these conservation efforts, reflecting a holistic approach to sustainability that encompasses food choices and the overall ecological well-being of the campus environment. The multifaceted initiatives underscore a collective dedication to fostering a sustainable and environmentally conscious ethos within the Malaysian public HEIs landscape.

The spectrum of transportation initiatives within Malaysian public HEIs encompasses the provision of cycling facilities, the development of pedestrian infrastructure, and the facilitation of public transportation services, indicative of a concerted effort to promote sustainable commuting options. Notably, universities such as UM, UPM, UiTM, and UMK distinguish themselves by their notable adoption of electric vehicles, aligning with the global trend towards embracing eco-friendly transportation alternatives. In research conducted by Kaliani Sundram, et al. (2021), UiTM adopted sustainable campus transportation. This strategic move reflects a commitment to reducing carbon footprints. It underscores the institutions' recognition of electric vehicles' pivotal role in mitigating environmental impact and contributing to a more sustainable and ecologically responsible transportation landscape. By prioritising the integration of electric vehicles into their transportation systems, these institutions exemplify a forward-thinking approach that aligns with the broader global agenda for sustainable and environmentally conscious practices in higher education.

Implementing comprehensive recycling programs characterises the waste management landscape within Malaysian public HEIs, rigorous waste audits, and concerted efforts in managing electronic waste (Elfithri et al., 2012). The waste reduction and management approach at UTHM stands out prominently through the institution's well-defined waste policy and the establishment of waste banks, reflecting a proactive commitment to addressing waste-related challenges. UiTM showcased substantial accomplishments in waste management, as supported by Kaliani Sundram et al. (2021). In water management, initiatives such as rainwater harvesting, promoting sustainable water consumption practices, and fostering water recycling endeavours are prevalent. Institutions like

UM, USM, and UPM actively conduct water audits, focusing on efficient water management and treatment strategies.

Given that these institutions operate in diverse environments and serve different communities, an in-depth comparison could provide valuable insights into how universities can adapt their sustainability initiatives to their specific contexts. UPM Bintulu Campus, for example, stands out for its extensive green sustainability efforts, including energy conservation, rainwater harvesting, a push towards electronic document management to reduce printing, and the implementation of various green activities that have earned it the designation of a "green campus" (Universiti Putra Malaysia, 2023).

The analysis shows that initiatives focusing on geological areas are widely implemented, while initiatives focusing on air and climate are less uniformly implemented. A comparative analysis reveals several distinctions, such as the higher commitment between UTM and UiTM to reducing carbon emissions by employing CO2 calculators and smart meters to track energy consumption compared to other institutions that lack monitoring of the carbon emissions. Less proactive institutions can benefit from both institutions, particularly in areas of air and climate. Dedicated sustainability teams focusing on air and climate drivers could mitigate this lack of implementation. The less proactive institutions face a few challenges, such as lack of finances, awareness and engagement, infrastructure limitations, and technical expertise (Kapitulčinová et al., 2018; Mohamad et al., 2021). It can be recommended that these institutions consider other alternative funding sources, such as grants from the government and partnerships with green organisations. To increase awareness and engagement among the campus community, integrating sustainability into their curricula and increasing awareness programs also could be addressed. Collaboration with proactive institutions could also benefit by benchmarking the best sustainable practices to track their progress. By focusing on the low-key areas of implementation as a starting point, the less proactive institutions can elevate their sustainability efforts. By adopting these recommendations, Malaysian HEIs can more effectively practice sustainability in line with national and global agendas. To conclude, this collective commitment underscores the institutions' dedication to responsible environmental stewardship and their active engagement in practices that contribute to the broader goals of waste reduction, sustainable waste management, and sustainable water conservation within the Malaysian higher education landscape in different ways.

5. CONCLUSION

In conclusion, the data reflects a commendable effort by Malaysian public HEIs to implement a wide array of sustainable initiatives across campus operations. These initiatives span building design, energy consumption, food practices, environmental conservation, transportation, waste management, and water usage, reflecting a holistic and comprehensive approach to sustainability. Nevertheless, it is crucial to highlight that adopting sustainable initiatives in campus operations is yet to be widespread across Malaysian public higher education institutions. A limited number of these institutions have actively embraced such initiatives, while others have only recently initiated efforts, often with minimal actions taken thus far. This indicates varying commitment and urgency among these institutions to integrate sustainable practices into their operational frameworks. The current overall progress toward achieving sustainable development goals in Malaysian HEIs may be insufficient to meet the ambitious targets outlined in the 2030 Agenda for Sustainable Development. To bridge this gap, it is recommended to have policies that can accelerate efforts across higher education institutions. Achieving a more widespread adoption of sustainable initiatives will require a collective commitment, increased awareness, and concerted action by all Malaysian public HEIs to contribute significantly to the sustainable development agenda. The collective dedication to sustainable practices aligns with global environmental objectives and positions these institutions as proactive agents in championing eco-conscious strategies and setting a positive example for the wider community. However, there is a limitation to this research where the scope only focuses on public HEIs rather than private HEIs. Expanding this research by including private HEIs as a scope area could offer a more comprehensive understanding of current sustainable practices across the Malaysian HEIs landscape. The different approaches in private institutions may exist in implementing sustainable practices with their own unique challenges and resources. Comparing both public and private institutions in future research could provide insights and recommendations, fostering sustainability within Malaysian HEIs.

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