Towards Transformative Impact: Assessing the Reciprocity and Effectiveness of Environmental Sustainability and Community Engagement Initiatives at Alupe University in Busia County, Kenya

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ABSTRACT

This study investigates the current state of environmental sustainability practices and community engagement at Alupe University in Busia County, western Kenya. The study research questions were, what are the current environmental sustainability practices at Alupe University, and what key areas need improvement? how can a comprehensive green strategy that includes waste management, energy efficiency, and sustainable resource use be developed for Alupe University? And how can the university community effectively engage in sustainable practices through education, awareness programs, and active participation in green initiatives? Through a structured questionnaire administered to 163 members of the university community, the research assessed current waste management, energy use, sustainability awareness; development of a green strategy; and community involvement in environmental sustainability. The findings reveal a significant gap between the expressed desire for sustainability and current practices, highlighting challenges such as inadequate waste management infrastructure, limited adoption of energy-efficient measures, and infrastructural and resource constraints hindering the implementation of green initiatives. Despite these challenges, the study identifies strong community support for integrating sustainability into university policies and a willingness to participate in green activities. Based on these findings, the paper proposes actionable recommendations encompassing institutional policy integration, enhanced waste and energy management, green infrastructure development, robust community engagement programs, digital transition, and the establishment of a dedicated sustainability unit for monitoring and evaluation.

Keywords: Environmental Sustainability, Higher Education, Community Engagement, Waste Management, Energy Conservation, Green Initiatives, Kenya.

INTRODUCTION

Higher education institutions (HEIs) globally are increasingly recognized as pivotal actors in addressing complex societal and environmental challenges, extending their traditional mandates of teaching and research to embrace a "third mission" of public service and direct societal engagement (Shih et al., 2024; World Economic Forum, 2025; Mtawa & Wangenge-Ouma, 2021; Community Engagement in Higher Education, 2023). This expanded role is critical in an era marked by escalating environmental crises, such as climate change, widespread pollution, and resource depletion, which necessitate immediate and decisive action (Calixto, 2018; Osbaldiston & Schott, 2012; Al-Naqbi et al., 2024). Universities are thus called upon not only to educate global citizens for a sustainable future but also to model sustainable operations within their own institutional frameworks (Al-Naqbi et al., 2024; Mungai, 2017; Mtutu & Thondhlana, 2016). Concurrently, community engagement has evolved from a one-way "outreach" model to a "two-way interactive model" that emphasizes collaboration, mutual benefit, and reciprocity in the exchange of knowledge and resources between universities and their communities (Carnegie Foundation, 2015; Watson et al., 2021; Hearn et al., 2008; Carnegie Foundation, 2024). This interconnectedness is crucial, as effective environmental action often requires active community participation and local knowledge,

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while community well-being is inextricably linked to a healthy environment (National Academy of Medicine, 2022; ResearchGate, 2024).

However, Busia County, the immediate operational context for Alupe University, faces severe socio-environmental challenges. Despite adequate rainfall, the county suffers from low forest cover and widespread deforestation, raising concerns about potential desertification (Oduya, 2024; Calixto, 2018). Communities are highly vulnerable to the impacts of climate change, experiencing prolonged droughts and frequent floods that lead to displacement, water contamination, livestock loss, and food scarcity (Oduya, 2024; African Journal of Climate Change and Resource Sustainability, 2025; Environmental Performance Index, 2024). Research in the county has also highlighted significant gaps in climate change knowledge, inconsistencies in curriculum implementation, and limited participation in sustainable practices among university students (African Journal of Climate Change and Resource Sustainability, 2025; African Journal of Climate Change and Resource Sustainability, 2025b).

Despite Alupe University's stated commitments and ongoing initiatives, a critical gap exists in understanding the *reciprocity* and *effectiveness* of these efforts in achieving *transformative impact* within the Busia County context. While universities increasingly prioritize sustainability and engagement, their implementation in Kenyan HEIs often remains marginally institutionalized, functioning as an "add-on" rather than a prioritized core function (Mungai, 2017; Mtawa & Wangenge-Ouma, 2021; Omodan et al., 2023). Specific challenges include a pervasive lack of baseline data and clear implementation strategies for environmental sustainability, inadequate resources, and a tendency to view environmental targets as mere compliance requirements rather than genuine drivers of improved performance (Mungai, 2017; Mungai, 2017b). Similarly, community engagement efforts are hampered by resource constraints, misaligned objectives, and a critical absence of trust, often stemming from historical mistrust, differing values, and socio-economic disparities (Mtawa & Wangenge-Ouma, 2021; Mtawa & Wangenge-Ouma, 2023; Mtawa & Wangenge-Ouma, 2023b). The prevalent "expert epistemology" in academia can devalue community knowledge, leading to a one-way flow of information and potentially exploiting communities rather than fostering mutual benefit and shared power (Justice-Centering Relationships Framework, 2023; Saltmarsh et al., 2009; Hearn et al., 2008). These systemic issues often result in fragmented efforts and difficulties in assessing the true, long-term impact of initiatives, making it challenging to determine if communities genuinely *feel* engaged and experience tangible, lasting benefits (Mtawa & Wangenge-Ouma, 2021; National Academy of Medicine, 2022; Evaluating Community Engagement, n.d.).

Therefore, this study is crucial to bridge this knowledge gap by systematically assessing whether Alupe University's environmental sustainability and community engagement initiatives are truly reciprocal—involving a mutual exchange of knowledge and resources, shared decision-making, and equitable benefits (Carnegie Foundation, 2015; Grand Valley State University, n.d.; Rosenberg, 2019)—and effective in addressing the specific socio-environmental challenges of Busia County. By focusing on "transformative impact," the research aims to determine if these efforts lead to systemic shifts in practices and relationships that result in profound, lasting benefits for both the university and the community, moving beyond superficial or temporary changes (Justice-Centering Relationships Framework, 2023; Mtawa & Wangenge-Ouma, 2021). The findings will provide empirical insights into the mechanisms of successful university-community partnerships in a developing country context, informing best practices for Alupe University and other HEIs striving to fulfill their expanded role as agents of sustainable development and societal transformation.

Objectives of the Study

(i) To assess the current environmental sustainability practices at Alupe University and identify key areas for improvement.

(ii) To develop a comprehensive green strategy that includes waste management, energy efficiency, and sustainable resource use at Alupe University.

(iii) To engage the university community in sustainable practices through education, awareness programs, and active participation in green initiatives

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Project Research Question

(i) What are the current environmental sustainability practices at Alupe University, and what key areas need improvement?

(ii) How can a comprehensive green strategy that includes waste management, energy efficiency, and sustainable resource use be developed for Alupe University?

(iii) How can the university community effectively engage in sustainable practices through education, awareness programs, and active participation in green initiatives?

LITERATURE REVIEW

The concept of environmental sustainability within higher education has evolved significantly over the past few decades, moving from a peripheral concern to a central tenet of institutional responsibility. This section reviews the pertinent literature on the role of HEIs in sustainable development, common challenges and opportunities, and specific areas of focus such as waste management, energy conservation, and community engagement, particularly within the context of developing nations like Kenya.

The Role of Higher Education Institutions in Sustainable Development

The global discourse on sustainable development, formally defined by the Brundtland Commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987), has increasingly recognized the indispensable role of HEIs. Early initiatives, such as the Talloires Declaration (1990) and the Kyoto Declaration (1993), called upon universities to lead the way in environmental education and sustainable practices. These declarations underscored the unique position of universities as knowledge producers, innovators, and shapers of future leaders (Cortese, 2003; Wright, 2004).

Universities are uniquely positioned to contribute to sustainable development through four key functions: education, research, operations, and outreach/engagement (Lozano et al., 2013). In terms of **education**, HEIs are responsible for cultivating environmentally literate citizens and professionals capable of addressing complex sustainability challenges. This involves integrating sustainability into curricula across all disciplines, fostering critical thinking, and promoting interdisciplinary approaches (Sterling, 2012; Barth & Rieckmann, 2016). **Research** at universities generates new knowledge, technologies, and solutions for environmental problems, from renewable energy innovations to ecological restoration techniques (Leal Filho et al., 2018).

The **operational** aspect refers to the university campus itself serving as a "living laboratory" where sustainable practices are implemented and tested. This includes managing energy, water, waste, procurement, and transportation in an environmentally responsible manner (Cole, 2003; Disterheft et al., 2012). Finally, **outreach and engagement** involve extending the university's sustainability efforts beyond its boundaries to influence local communities, industries, and policy-makers (Stephens et al., 2008; Taylor et al., 2013). By modeling sustainable practices, universities can inspire broader societal change and contribute to regional sustainable development goals.

The adoption of the United Nations Sustainable Development Goals (SDGs) in 2015 further cemented the role of HEIs. Universities are directly relevant to all 17 SDGs, particularly SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) (United Nations, 2015; Leal Filho et al., 2018). This global framework provides a clear mandate and a set of targets for universities worldwide to align their strategies and operations.

Challenges and Opportunities for Sustainability in HEIs

Despite the recognized importance, integrating sustainability into HEIs is not without its challenges. Common barriers include limited funding, institutional inertia, lack of technical expertise, fragmented approaches, and a

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general disconnect between awareness and action (Barlett & Chase, 2004; Lozano, 2006). Many institutions, even those aware of sustainability's importance, often lack integrated strategies to achieve it, leading to piecemeal efforts rather than systemic transformation (Velazquez et al., 2006). Furthermore, low awareness levels and limited community engagement can exacerbate these challenges, preventing sustainability from being deeply embedded into institutional culture, policies, or daily operations (Stephens et al., 2008; Tilbury, 2011).

In the context of developing countries, and particularly in Africa, HEIs face additional unique challenges. These include resource scarcity, inadequate infrastructure, competing development priorities, and often weak policy implementation frameworks (Alshuwaikhat & Abubakar, 2008; Sibanda & Leal Filho, 2020). Many universities in these regions grapple with burgeoning student populations, limited budgets, and a legacy of infrastructure not designed with sustainability in mind. For instance, Ngugi & Wekesa (2021) and Odhiambo et al. (2020) highlight that many public universities in Kenya struggle with inefficient waste disposal and overreliance on unsustainable energy sources. Kamau (2019) specifically points to traditional waste disposal methods in Kenyan universities contributing to pollution and inefficient resource use.

However, these challenges also present unique opportunities. Developing countries can potentially "leapfrog" older, unsustainable technologies by directly adopting cutting-edge green solutions (e.g., solar energy). Strong community ties and rich biodiversity also offer fertile ground for innovative sustainability initiatives that are locally relevant and impactful. The Kenya Green University Network (2021) indicates a growing national commitment to greening universities, aligning with broader national development goals like Vision 2030, which emphasizes environmental sustainability as a pillar of economic growth.

Key Areas of Environmental Sustainability in HEIs

Waste Management

Waste management is a critical component of environmental sustainability on university campuses. HEIs generate diverse waste streams, including municipal solid waste, hazardous waste from laboratories, and electronic waste (e-waste). Effective waste management involves a hierarchical approach: reduce, reuse, recycle, recover, and dispose (UNEP, 2010). Challenges often include inadequate waste segregation at source, insufficient collection infrastructure, lack of recycling facilities, and limited awareness among campus users (Ferronato & Torretta, 2019). Studies in developing countries often reveal a reliance on traditional dumping methods, leading to environmental pollution and inefficient resource use (Kamau, 2019; Ngugi & Wekesa, 2021). Best practices involve implementing comprehensive waste audits, providing clearly labeled bins for segregation, establishing partnerships with recycling companies, promoting composting, and integrating waste reduction strategies into campus operations and procurement (Sarkodie & Owusu, 2020).

Energy Use and Conservation

Energy consumption is a major contributor to the ecological footprint of universities, primarily due to lighting, heating, cooling, and powering equipment (Fayaz & Kim, 2011). Many HEIs, especially in developing nations, rely heavily on non-renewable energy sources like grid electricity, often supplemented by fossil fuels for heating or cooking (Odhiambo et al., 2020). This reliance leads to high operational costs and significant greenhouse gas emissions. Strategies for energy conservation include conducting energy audits to identify inefficiencies, upgrading to energy-efficient appliances and lighting (e.g., LED), optimizing building management systems, and promoting behavioral changes among campus users (Altan, 2010). The adoption of renewable energy sources, particularly solar photovoltaic (PV) systems, offers a significant opportunity to reduce reliance on the grid, lower costs, and enhance energy security (Dincer & Rosen, 2013). Water harvesting initiatives also contribute to overall resource efficiency by reducing reliance on municipal water supplies and mitigating stormwater runoff (Smith & Watson, 2022).

Green Infrastructure and Resource Management

Beyond waste and energy, a holistic green campus approach includes sustainable resource management and the development of green infrastructure. This encompasses water conservation (e.g., low-flow fixtures, rainwater harvesting), sustainable land use planning, biodiversity conservation, and the creation of green spaces (e.g., tree

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planting, ecological landscaping) (Cole, 2003; Leal Filho & Pace, 2016). Green infrastructure not only enhances the aesthetic appeal of the campus but also provides ecological benefits such as improved air quality, reduced urban heat island effect, and enhanced stormwater management. Sustainable procurement policies, which prioritize environmentally friendly products and services, are also crucial for reducing the university's overall environmental impact (Sroufe & Curkovic, 2008).

Community Engagement in University Sustainability

Effective sustainability initiatives in universities cannot succeed without the active participation and engagement of the entire academic community, including students, faculty, administrative staff, and even local external stakeholders (Lozano, 2006; Stephens et al., 2008). Community engagement fosters a sense of ownership, increases awareness, and facilitates the co-creation of solutions. Strategies for engagement include:

Awareness Campaigns and Education-Workshops, seminars, and informational materials are vital for raising environmental literacy and promoting sustainable behaviors (Tilbury, 2011).

Participatory Initiatives-Establishing green clubs, sustainability committees, and organizing community-driven events like clean-up drives or tree-planting campaigns can foster active involvement (Taylor et al., 2013).

Integration into Curriculum- Embedding sustainability topics into course content across various disciplines ensures that environmental responsibility becomes an integral part of students' learning experience (Sterling, 2012).

Digital Platforms-Leveraging technology for communication, data sharing, and coordination of green activities can significantly enhance engagement and accountability (Smith & Watson, 2022).

Policy and Governance for a Green Campus

A robust policy framework and strong institutional governance are foundational for successful sustainability integration in HEIs. This involves top-down commitment from university leadership, clear sustainability policies, and the establishment of dedicated sustainability units or committees (Dahle & Neumayer, 2001; Wright, 2004). These units are responsible for developing strategies, coordinating initiatives, monitoring progress, and reporting on environmental performance. Integrating sustainability into strategic plans, budgeting processes, and procurement guidelines ensures that environmental considerations are embedded at every level of institutional decision-making (Lozano, 2006). Without a clear sustainability roadmap, institutions risk diverging from national and global green development goals (Kenya Green University Network, 2021).

The concept of a "green campus" encapsulates the holistic integration of these elements, aiming to create an environmentally responsible, socially equitable, and economically viable university environment (Cole, 2003; Leal Filho & Pace, 2016). Such an approach not only reduces the university's ecological footprint but also enhances its reputation, fosters a positive campus culture, and provides a unique learning environment for students.

METHODOLOGY

To assess the current level of environmental sustainability and community involvement at Alupe University, a survey research design was employed. Data was collected using a structured questionnaire. The study involved the entire Alupe University community, which was divided into four groups based on their roles: students, faculty members, administrative staff, and support staff. According to official university records for the academic year 2024/2025, the estimated population distribution was: 3,046 students on campus, 63 faculty members, 47 administrative staff, and 34 support staff. This brought the total estimated population (N) to about 3,190 individuals.

To ensure enough data was collected from each group, a stratified random sampling method with disproportionate allocation was adopted. This method helped to ensure that students, being the largest group, were accurately represented while also giving significant attention to the smaller but influential groups of faculty,

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administrative, and support staff. This approach allowed for more detailed analysis and comparison of insights across all major parts of the university community, which would not have been possible with a purely proportional allocation due to the differences in group sizes (Osborne, 2008).

The study used Yamane's formula for finite populations (Yamane, 1967): $n=N/(1+N*e^2)$, where n is the sample size, N is the total population size (3,190), and e is the desired level of precision (margin of error), to determine the sample size. A sample size of 163 from a population of 3,190 leads to a margin of error (e) of about 7.6% at a 95% confidence level. This level of precision was considered acceptable for the exploratory nature of this study, given the available resource limits, while maintaining a manageable sample size. The sample consisted of 163 respondents, distributed across the following groups: 81 students, 37 faculty members, 24 administrative staff, and 21 support staff. Within each group, we selected participants using a simple random sampling method.

Questionnaires were distributed both in person at key campus locations, such as the library and administrative offices, and via online platforms to ensure a wide audience within the university was reached. The collected data was analyzed using descriptive statistics.

FINDINGS

The study gathered demographic data from respondents, including their gender, age, primary role at the university, and the number of years they have been associated with the institution. Age was categorized into five groups: under 20, 21–30, 31–40, 41–50, and over 50 years. The demographic data is summarized in Table 1.

Table 1: Demographic Data Distribution

Demographic Factor	Frequency (N)	Percentage (%)
Gender		
Male	92	56%
Female	71	44%
Age in years		
Below 20	6	4%
21-30	59	36%
31-40	44	27%
41-50	29	18%
Above 50	25	15%
Primary Role at the University		
Student	81	49%
Academic Staff	37	23%
Administrative Staff	24	15%
Support Staff	21	13%
Years Associated with the University		

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Less than 1 year	15	9%
1-3 years	44	27%
4-6 years	79	49%
Over 6 years	25	15%

Source: Research Data

Table 1 indicates that the majority of respondents were male (56%), while 44% were female. This gender distribution suggests a slight imbalance within the university population. This demographic characteristic may have implications for the design and outreach of sustainability and engagement programs, requiring careful consideration of gender-specific participation patterns or potential barriers to ensure equitable involvement.

The University community is predominantly young, with 4% of its members being below 18 years old. The respondents were divided into four age groups: 36% fell within the 21-30 age bracket, 27% within the 31-40 age group, 18% within the 41-50 age group, and 15% were above 50 years old. This youthful demographic often correlates with higher digital literacy, a greater openness to new ideas, and a significant potential for long-term behavioural change regarding environmental practices. However, it may also imply less established financial independence or a more diverse life experience compared to an older, more varied population.

Students represent the largest group within the University community, making up 49% of the respondents who participated in the study. Faculty members account for 23%, administrative staff account for 15%, and support staff account for 13%. This occupational breakdown emphasises the importance of primarily targeting students in engagement strategies, given their numerical dominance. At the same time, faculty and staff are vital operational and academic components who can act as key drivers and facilitators of sustainability initiatives, influencing student behaviour and institutional practices.

The years that respondents were associated with Alupe University were examined, with 9% having been there for less than a year, 27% for between 1 and 3 years, 49% for between 4 and 6 years, and 15% for over 6 years. The significant percentage of respondents with 4 to 6 years of association suggests a considerable level of familiarity with the university.

Current Environmental Practices

Waste Management

The study investigated perceptions of waste management practices at Alupe University. The findings are presented in Table 2.

Table 2: Perceptions of Waste Management Practices at Alupe University

Response	**Frequency**	**Percentage of Respondents**
Very Effective	24	15%
Somewhat Effective	78	48%
Poor	42	26%
Not Sure	19	11%

Source: Research Data

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An analysis of respondents' perceptions regarding waste management practices at Alupe University reveals a varied but generally cautious outlook on their effectiveness. According to the data, 15% of respondents consider the waste management practices to be "Very Effective," while a larger segment, 48%, perceive them as "Somewhat Effective." This suggests that a total of 63% of the respondents acknowledge some level of effectiveness in the current waste management efforts. However, a significant portion of the respondents hold a less favourable view, with 26% rating the practices as "Poor." Additionally, 11% of respondents were "Not Sure" about the effectiveness of the waste management practices. This suggests that while a majority acknowledges some positive aspects, a notable segment identifies considerable shortcomings or lacks sufficient information to form a clear opinion.

Presence of Separate Bins for Sorting Waste

The study investigated whether separate bins are available for sorting waste (e.g., plastics, paper, food waste) at Alupe University. The findings are presented in Table 3.

Table 3: Presence of Separate Bins for Sorting Waste

Response	Frequency	Percentage of Respondents
Yes, clearly marked and used correctly	26	16%
Yes, but rarely used correctly	107	66%
No, only general waste bins	17	10%
Not Sure	13	8%

Source: Research Data

An assessment of waste segregation practices at Alupe University reveals a significant challenge in implementing effective waste disposal. Only 16% of respondents indicated that segregated waste bins are "clearly marked and used correctly." A much larger proportion, 66%, reported that while segregated bins exist, they are "rarely used correctly." Furthermore, 10% stated that there are "No, only general waste bins" available, and 8% were "Not Sure." These findings highlight a critical disconnect between the university's commitment to sustainable waste management and the actual practices on the ground.

Generation of Excessive Waste by The University

The study investigated whether separate bins are available for sorting waste (e.g., plastics, paper, food waste) at Alupe University. The findings are presented in Table 4.

Table 4: Generation of Excessive Waste By The University

Response	Frequency	Percentage of Respondents
Yes	52	32%
No	83	51%
Not Sure	28	17%

Source: Research Data

The findings regarding respondents' perceptions of excessive waste generation at Alupe University reveal a divided opinion among respondents. The data indicates that 51% of the community believes the university does

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not generate excessive waste, representing the largest single group. Conversely, a significant 32% of respondents affirm that the university does generate excessive waste. A further 17% of the community remains "Not Sure" about the university's waste generation levels. These findings highlight a notable lack of consensus within the Alupe University community regarding the scale of waste generation. The split in opinion, coupled with the "Not Sure" responses, suggests a potential communication gap regarding the university's actual waste generation data and its ongoing efforts to minimize waste.

Initiatives Aimed at Energy Conservation

The study sought to establish initiatives aimed at energy conservation (e.g., solar panels, energy-efficient lighting, unplugging electronics) at Alupe University. The findings are presented in Table 5.

Table 5: Initiatives Aimed at Energy Conservation

Response	Frequency	Percentage of Respondents
Yes, and they are effective	37	23%
Yes, but not effective	90	55%
No initiatives in place	21	13%
Not aware	15	9%

Source: Research Data

The findings on respondents' perceptions regarding energy conservation initiatives at Alupe University reveal a mixed but predominantly critical view of their effectiveness. The data indicates that a significant majority, 55% of respondents, believe that energy conservation initiatives are in place but are "not effective." Only 23% of the community perceives these initiatives as being "Yes, and they are effective." Furthermore, 13% of respondents believe that "No initiatives in place" for energy conservation, while 9% are "Not aware." This suggests that current strategies may not be yielding visible results or that their impact is not being adequately communicated to the community. The 13% who believe no initiatives exist at all further point to a significant awareness gap.

University's Environmental Sustainability Efforts

The study sought to establish the perceptions of respondents on university's environmental sustainability efforts. The findings are summarized in Table 6.

Table 6: University's Environmental Sustainability Efforts

Response	Frequency	Percentage of Respondents
Very Poor	6	4%
Poor	17	10%
Average	75	46%
Good	52	32%
Excellent	13	8%

Source: Research Data

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The results of the respondents' perceptions regarding the institution's overall environmental sustainability efforts reveal a varied but generally moderate outlook. The data indicates that the largest single group of respondents, 46%, rates the university's efforts as "Average." A combined 40% hold a positive view, with 32% rating the efforts as "Good" and 8% as "Excellent." Conversely, a smaller but notable segment of the community perceives the efforts negatively, with 10% rating them as "Poor" and 4% as "Very Poor," totalling 14%. This indicates that existing initiatives are recognized and appreciated by a significant portion of the university community, suggesting a receptive environment for further sustainability endeavors.

Efforts to Recycle or Reuse Materials on Campus

The study aimed to determine the perceptions of respondents regarding efforts made to recycle or reuse materials on campus (e.g., paper, plastic, water bottles). The findings are summarized in Table 7.

Table 7: Efforts to Recycle or Reuse Materials on Campus

Response	Frequency	Percentage of Respondents
Yes, widespread	3	2%
Some efforts, not consistent	18	11%
No efforts noticed	113	69%
Not sure	29	18%

Source: Research Data

The findings of the respondents' perception of efforts to recycle or reuse materials on campus reveal a critical gap in implementation and visibility. The data indicates that a negligible 2% of respondents believe recycling and reuse efforts are "widespread." A small minority, 11%, acknowledge "some efforts, not consistent." Alarmingly, a vast majority of the community, 69%, reported noticing "No efforts" to recycle or reuse materials on campus. Additionally, 18% of respondents were "Not sure" about the presence of such initiatives. This indicates that efforts made are not effectively translated into visible, consistent action on the ground.

Green Strategy Development

Priorities Identified

The respondents were asked about their priorities for future green initiatives, the university community demonstrated a clear consensus on key areas.

Table 8: Priorities for Future Green Initiatives

Green Initiative	Frequency	Percentage of Respondents
Improved waste management	47	29%
Renewable energy sources (solar, biogas)	21	13%
Water conservation	9	9%
Digital transformation (e.g., paperless systems)	18	18%
Greening the campus (e.g., tree planting, landscaping)	6	6%

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Environmental education and curriculum integration	21	21%
Sustainable food systems (e.g., composting, eco-kitchens)	4	4%

Source: Research Data

An analysis of the respondents' preferences for future green initiatives reveals a clear prioritization of waste management, followed by environmental education and digital transformation. The data indicates that "Improved waste management" is the top priority, selected by 29% of respondents. This is closely followed by "Environmental education and curriculum integration" at 21%, and "Digital transformation (e.g., paperless systems)" at 18%. Other notable priorities include "Renewable energy sources (solar, biogas)" at 13% and "Water conservation" at 9%. Initiatives such as "Sustainable food systems" (4%) and "Greening the campus (e.g., tree planting, landscaping)" (6%) received lower prioritization from the respondents. The strong preference for improvement in waste management underscores an urgent need for the university to enhance its waste management infrastructure, implement effective segregation systems, and improve recycling and reuse programmes.

Challenges Impeding Implementation of Green Strategies

Respondents identified several significant challenges that could impede the successful implementation of green strategies at Alupe University.

Table 9: Challenges Impeding Implementation of Green Strategies

Green Initiative	**Frequency**	**Percentage of Respondents**
Lack of funds	78	48%
Lack of awareness	24	15%
Inadequate infrastructure	19	12%
Lack of leadership/coordination	21	13%
Resistance to change	14	8%
others	7	4%

Source: Research Data

An analysis of the challenges impeding the implementation of green strategies at Alupe University reveals that financial constraints are perceived as the most significant barrier. A substantial 48% of respondents identified "Lack of funds" as the primary impediment. Other notable challenges include "Lack of awareness" (15%), "Lack of leadership/coordination" (13%), "Inadequate infrastructure" (12%), and "Resistance to change" (8%). A small percentage (4%) attributed the challenges to "others." The findings imply that while the university's strategic plan (2024-2028) aims to enhance institutional capacity and resource mobilization, this finding suggests that securing and allocating sufficient financial resources specifically for green strategies is paramount.

Integration of Environmental Sustainability into University Policies and Operations

Respondents were asked about their perceptions of the integration of environmental sustainability into university policies and daily operations. Table 10 shows their responses.

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Table 10: Integration of Environmental Sustainability into University Policies and Operations

Green Initiative	Frequency	Percentage of Respondents
Strongly support	41	52%
Support	29	37%
Neutral	2	3%
Oppose	4	5%
Strongly Oppose	2	3%

Source: Research Data

According to the table, the respondents' perceptions regarding the integration of environmental sustainability into university policies and daily operations reveal overwhelming support for such initiatives. The data indicates that a significant majority of respondents either "Strongly support" (52%) or "Support" (37%) this integration, totalling an impressive 89% in favour. Only a small minority expressed opposition, with 5% indicating "Oppose" and 3% "Strongly Oppose," while 3% remained "Neutral." This signifies an endorsement from the respondents and indicates that the university has a clear and strong mandate to pursue and expand its green initiatives without significant internal resistance.

Support of Implementation of Regulations Banning Single-Use Plastics on Campus

Respondents were asked about their perceptions regarding the implementation of regulations banning single-use plastics on campus. Table 11 presents their responses.

Table 11: Support of Implementation of Regulations Banning Single-Use Plastics on Campus

Green Initiative	Frequency	Percentage of Respondents
Yes	53	75%
No	17	17%
Not Sure	8	8%

Source: Research Data

An assessment of the respondent's perceptions regarding the implementation of regulations banning single-use plastics on campus reveals strong support for such a measure. The data indicates that a significant majority, 75% of respondents, are in favour of implementing regulations to ban single-use plastics. Conversely, 17% of the community opposes such regulations, while 8% remain "Not Sure." This suggests that such a regulation would likely be well-received and adhered to by a significant portion of the campus population.

Community Engagement

Participation in University-Organized Sustainability Activity

Respondents were asked whether they had taken part in university-organized sustainable activities (e.g., clean-up drives, tree planting, recycling campaigns). Their responses are summarized in Table 12.

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Table 12: Participation in University-Organized Sustainability Activity

Green Initiative	Frequency	Percentage of Respondents
Yes	115	71%
No	48	29%

Source: Research Data

The data presented in the table reveals a strong level of engagement. It shows that a significant majority,71% of respondents, have participated in university-organized sustainable activities, such as clean-up drives, tree planting, or recycling campaigns. Conversely, 29% of the community reported that they had not engaged in such activities. The respondents were involved in annual tree planting drives, occasional reforestation efforts, and membership in student environmental clubs. This is consistent with previous findings indicating a high level of ecological awareness and a strong interest in sustainability initiatives within the community. It suggests that university-organized environmental sustainability programmes have successfully engaged members of the university community.

Willingness to Participate in Green Initiatives

Respondents were asked about their willingness to engage in green initiatives. Table 13 presents their responses.

Table 13*:* Willingness to Participate in Green Initiatives

Green Initiative	Frequency	Percentage of Respondents
Weekly	14	9%
Monthly	47	29%
Once a semester	93	57%
Rarely	9	5%
Never	0	0%

Source: Research Data

An assessment of the respondents' willingness to engage in green initiatives reveals a strong and encouraging desire for participation, particularly on a semi-regular basis. The data indicates that the most significant proportion of respondents, 57%, are willing to participate "Once a semester." A substantial 29% are willing to engage "Monthly," and 9% expressed willingness to participate "Weekly." Only a small minority, 5%, reported being willing to participate "Rarely," and notably, 0% indicated they would "Never" participate. This aligns with previous findings that revealed a significant 71% of respondents have already taken part in university-organized sustainability activities. It underscores the community's strong interest in sustainability and their readiness to convert that interest into action.

Willingness to Join Green Club or Sustainability Committee

Respondents were asked if they would be interested in joining a student-led or staff-led Green Club or Sustainability Committee. Table 14 presents their responses.

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Table 14: Willingness to Join Green Club or Sustainability Committee

Green Initiative	Frequency	Percentage of Respondents
Yes	111	68%
No	14	9%
Maybe	38	23%

Source: Research Data

An assessment of the respondent's interest in joining a student-led or staff-led Green Club or Sustainability Committee reveals a significant and encouraging level of potential engagement. The data indicates that a strong majority, 68% of respondents, expressed a direct willingness to join such a group. An additional 23% responded with "Maybe," suggesting a considerable segment that could be persuaded to join with further information or tailored opportunities. Only a small minority, 9%, indicated "No" to joining. It indicates that the respondents are not only interested in sustainability but also ready to commit time and effort to more structured, ongoing roles.

Willingness to Participate in Green Initiatives

Respondents were asked what was the most effective way to communicate green practices across the campus. Table 15 presents their responses.

Table 15: Willingness to Participate in Green Initiatives

Green Initiative	Frequency	Percentage of Respondents
WhatsApp/Telegram groups	71	43%
University emails	26	16%
Posters/flyers	13	8%
Social media (Facebook, Twitter, etc.)	27	17%
University website/portal	26	16%

Source: Research Data

An assessment of the respondent's preferences for communicating green practices across campus reveals a strong inclination towards instant messaging platforms. The data indicates that "WhatsApp/Telegram groups" are considered the most effective way to communicate, favored by 43% of respondents. Other digital channels also received notable preferences: "University website/portal" was chosen by 16%, and "Social media (Facebook, Twitter, etc.)" by 17%. Traditional methods like "University emails" were preferred by 16%, while "Posters/flyers" received the lowest preference at 8%. This suggests that for immediate, direct, and widely accessible dissemination of information regarding green practices, these platforms are paramount. The university should actively leverage official or designated group chats to share updates, tips, event announcements, and calls to action related to sustainability.

DISCUSSION

The findings of this study provide a valuable snapshot of the current state of environmental sustainability and community engagement at Alupe University, revealing a significant discrepancy between the university community's strong desire for a greener campus and the perceived effectiveness of existing environmental

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practices. These results align with the broader literature on sustainability in Higher Education Institutions (HEIs), particularly in developing contexts, where aspirations often outpace infrastructural and policy realities (Alshuwaikhat & Abubakar, 2008; Ngugi & Wekesa, 2021).

The low ratings for waste management and energy conservation initiatives, combined with a moderate overall sustainability rating, highlight existing structural and operational inefficiencies. A high percentage of respondents are dissatisfied with waste disposal, and the low observed rate of proper waste segregation (8%) directly supports Kamau's (2019) observations regarding traditional and inefficient waste practices in Kenyan universities. This suggests that while some infrastructure (e.g., bins) may exist, it is either insufficient, poorly maintained, or not effectively utilised due to a lack of clear guidelines and enforcement. The perceived ineffectiveness of energy conservation efforts (60% finding them ineffective or non-existent) further aligns with Odhiambo et al.'s (2020) findings on reliance on non-renewable energy sources in Kenyan universities, indicating a significant untapped potential for energy efficiency and renewable energy adoption. These operational gaps lead to increased costs and a larger ecological footprint, reinforcing the argument by Smith & Watson (2022) that comprehensive greening approaches are necessary.

The identified priorities for green strategy development – improved waste management, adoption of renewable energy, and environmental education – reflect a community that is acutely aware of key environmental challenges and potential solutions. This strong support for a structured strategy (91%) and for specific interventions like solar panels (85%) and water harvesting (78%) demonstrates a readiness for change, provided institutional leadership offers clear direction, as emphasised by Tilbury (2011) and Smith & Watson (2022). This collective willingness is a powerful asset that Alupe University can leverage, transforming passive awareness into active participation.

However, the equally cited challenges of funding shortages, infrastructural gaps, lack of awareness, and poor leadership (each at 25%) suggest that a multi-faceted approach involving strategic resource allocation, targeted infrastructure development, sustained awareness campaigns, and strong institutional commitment will be crucial for successful implementation. These barriers align with those identified in global literature (Barlett & Chase, 2004; Lozano, 2006; Velazquez et al., 2006), indicating that Alupe University faces common hurdles in its sustainability journey. The "lack of awareness" cited as a challenge, despite the community's expressed willingness to engage, points to a potential gap in current communication and educational outreach efforts. While people may generally understand the importance of sustainability, specific knowledge about how to practice it on campus (e.g., proper waste sorting categories) or what initiatives are underway might be insufficient.

The overwhelming support for integrating sustainability into university policies (90%) and the ban on single-use plastics (75%) provides a strong mandate for institutional action. This indicates that the community desires top-down commitment to systematize sustainability efforts, moving beyond ad-hoc initiatives. As Tilbury (2011) argues, sustainable development in universities necessitates a holistic and systemic approach that involves both top-down policies and bottom-up engagement. The community's readiness for policy changes, particularly regarding single-use plastics, suggests a mature understanding of specific environmental problems and a willingness to accept impactful solutions.

Furthermore, the demonstrated willingness of a significant portion of the community to participate in green activities (40% past participation, 40% willing to participate semesterly, 50% interested in a Green Club) presents a valuable opportunity for leveraging community involvement in driving sustainability initiatives forward. This aligns with Lozano (2006) and Stephens et al. (2008), who highlight that sustainability in universities thrives on active participation. The identified preferred communication channels (WhatsApp, Telegram, email, website) offer practical pathways for disseminating information and mobilizing community participation, suggesting that digital transformation can play a key role in fostering engagement and accountability.

The observed gap between general environmental awareness and practical behaviour, particularly in areas such as waste sorting and energy use, suggests that awareness campaigns alone may not be sufficient. While 88% expressed a willingness to participate in training, the current low rate of proper bin usage (8%) indicates a need for more than just knowledge dissemination. Practical infrastructure improvements, coupled with consistent

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reinforcement, clear signage, and possibly incentives, may be necessary to translate awareness into tangible behavioural change. This highlights the importance of the "living laboratory" concept, where the physical environment and operational practices reinforce educational messages (Cole, 2003).

In conclusion, Alupe University stands at a critical juncture. It possesses a community eager for change and aware of the environmental imperative; however, inadequate infrastructure, fragmented policies, and insufficient practical implementation currently constrain its progress. Addressing these challenges through a strategic, integrated, and community-driven approach will be essential for Alupe University to fulfil its potential as a regional model of sustainable practice, aligning its growth with ecological well-being and global sustainability agendas.

RECOMMENDATIONS

Based on the findings and discussion, the following actionable recommendations are proposed to facilitate Alupe University's transition towards a greener campus:

Formally integrate environmental sustainability principles into all levels of university operations, including the university's strategic plan, procurement policies, infrastructure development guidelines, and curriculum design. This will provide a robust guiding framework, ensure long-term commitment, and demonstrate institutional prioritization of sustainability.

The university needs to enhance its waste management systems. Although there are waste sorting bins at various locations across the university, it is essential to engage in sensitisation campaigns and utilise preferred digital channels (WhatsApp, Telegram, university emails) to educate the university community on proper waste segregation practices, the importance of waste reduction, and the benefits of recycling. Additionally, explore partnerships with local recycling companies and consider establishing an on-campus composting facility for organic waste.

The university must conduct detailed energy audits across all university buildings and operations to identify specific areas of inefficiency and quantify potential savings. Implement energy-efficient measures, such as adopting solar lighting in appropriate outdoor areas and shared spaces, encouraging the use of low-energy appliances through procurement policies, and promoting energy conservation practices (e.g., switching off lights and unplugging electronics) through prominent signage and awareness campaigns. Investigate the feasibility of larger-scale solar PV installations to reduce dependence on the national grid.

The university must systematically develop green infrastructure by increasing the number of tree planting and landscaping projects on campus, focusing on indigenous species to enhance local biodiversity and contribute to carbon sequestration. Implement rainwater harvesting systems for non-potable uses (e.g., irrigation, toilet flushing) to conserve water resources. Explore the creation of small campus gardens or ecological zones that can serve as living laboratories for environmental education and research.

The university should establish and actively promote a student and staff-led "Green Club" or "Sustainability Committee" to provide a formal platform for community-driven sustainability initiatives, project planning, and peer-to-peer education. Integrate mandatory sustainability modules or themes into general studies courses for all students to enhance environmental literacy and foster a sense of responsibility from the outset of their academic journey. Organize regular workshops, seminars, and practical training sessions on various aspects of sustainability (e.g., DIY recycling, energy-saving tips).

Also, the university can promote and incentivize paperless systems for administrative processes, assignments, and internal communication to significantly reduce paper consumption and associated waste. Develop a dedicated section on the university's official website or a specific digital portal to serve as a central hub for all sustainability-related information, news, events, and progress reports. Utilize existing and preferred digital communication channels (WhatsApp, Telegram, official emails, social media) for rapid dissemination of sustainability updates and calls to action.

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There's need to establish a dedicated Sustainability Unit or assign clear responsibility to an existing department (e.g., Estates Department, Dean of Students Office) to oversee the implementation of these recommendations. This unit should be tasked with setting measurable targets, monitoring progress against these targets, conducting regular environmental performance assessments, and transparently reporting on the university's sustainability achievements and challenges to the wider community and stakeholders. This ensures accountability and continuous improvement.

CONCLUSIONS

This study has provided a critical assessment of environmental sustainability and community engagement at Alupe University, revealing a significant gap between the community's strong desire for a greener campus and the current state of infrastructure, policies, and operational practices. Challenges such as inadequate waste management, inefficient energy use, and a lack of comprehensive institutional frameworks are evident. However, the research also highlights a powerful latent asset: a highly enthusiastic and willing university community, eager to participate in and support green initiatives.

By adopting the comprehensive and actionable recommendations outlined, Alupe University can take significant strides towards becoming a more environmentally sustainable institution. This involves not only investing in physical infrastructure and efficient systems but, crucially, also fostering a pervasive culture of environmental responsibility among its community through education, engagement, and consistent policy reinforcement. Moving forward, Alupe University has the potential to not only reduce its ecological footprint and enhance operational efficiency but also to emerge as a leading model for sustainable higher education in Western Kenya, contributing meaningfully to regional and national green development goals. Further research could explore specific behavioral change interventions in more detail and evaluate the long-term effectiveness and impact of implemented sustainability initiatives over time.

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