

Greening the Savannah: Environmental Pathways to Zero GHG Emissions in Kenya's Game Lodges and Tented Camps

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ABSTRACT

This study examined the relationship between environmental sustainability practices and the adoption of zero greenhouse gas (GHG) emission practices among lodges and tented camps in Kenya's Southern Tourism Circuit. Grounded in the Triple Bottom Line Framework (People, Planet, and Profit) and Stakeholder Theory, the study employed a quantitative research design and used multiple linear regression to assess the impact of six environmental sustainability components: Community and Stakeholder Engagement, Operational Resource Efficiency, Environmental Policies and Purchasing Practices, Sustainable Infrastructure, Renewable Energy and Composting, And External Institutional Partnerships. Findings revealed that the regression model was statistically significant ($R^2 = 0.465$, $F(6,66) = 9.545$, $p < 0.001$), indicating that environmental sustainability practices collectively explain 46.5% of the variance in the adoption of zero GHG emission practices. Five components were found to significantly influence adoption: Renewable Energy and Composting ($\beta = 0.522$), Operational Resource Efficiency ($\beta = 0.506$), Community and Stakeholder Engagement ($\beta = 0.312$), Environmental Policies and Purchasing ($\beta = 0.265$), and External Institutional Partnerships ($\beta = 0.242$). However, Sustainable Infrastructure ($\beta = 0.009$, $p = 0.424$) did not show a significant impact. These results suggest that strategic operational, policy, and community-driven initiatives are more impactful than infrastructure development alone in promoting zero GHG emissions. The study underscores the need for integrated sustainability efforts, particularly those emphasizing renewable energy use, efficient resource management, stakeholder involvement, and institutional collaboration. The findings provide valuable insights for tourism operators, policymakers, and sustainability advocates targeting an advancement of climate-resilient practices within the hotel sector.

Keywords: *Environmental Sustainability, Zero GHG Emissions, Renewable Energy, Operational Efficiency, Tourism Lodges, Kenya, Sustainable Tourism.*

Introduction

The importance of tourism is globally and locally recognised. In Kenya, tourism is among the sectors that contribute immensely to the Gross Domestic Product of the country. The sector contributes in terms of foreign exchange, job opportunities, and regional development (Kenya National Bureau of Statistics [KNBS], 2025). The tourism sector in Kenya cuts across various regions, but some regions, such as Nairobi, South Rift, and the Southern tourism circuit, are known to be more important than others in terms of tourist levels. The Southern tourism circuit is one of the prime tourism destinations in Kenya, being home to three branded parks, including Tsavo West, Tsavo East, and Amboseli. Therefore, this region has been known to provide incomparable wildlife and safari experiences, making it crucial to tourism in Kenya (Okumu et al., 2023). Besides, this region has game lodges and tented camps that provide excellent hospitality experiences to both domestic and international visitors. Given that these establishments are situated within an environmentally fragile ecosystem, their role in conserving this ecosystem cannot be overlooked. However, the same establishments are highly susceptible to the effects of climate change. The sustainability of the operations of the game lodges and tented camps in this region is prone to climatic conditions such as long periods of drought, unreliable rainfall patterns, and increased temperatures (Okumu et al., 2023). These issues strengthen the importance of environmental sustainability initiatives in dealing with the effects of climate change. This, in turn, guarantees sustainable business operations while enhancing competitiveness.

Scholars have asserted that sustainability initiatives in the hospitality sector are crucial in reducing the harmful greenhouse gas (GHG) emissions (Cardenas et al., 2024; Velaoras et al., 2025). Hospitality establishments such as the game lodges and tented camps in this study are widely leveraging renewable energy sources. The main aim is usually to reduce costs at the same time increasing profits. However, such measures are known to contribute positively to environmental outcomes such as the reduction of GHG emissions. In the hotel sector, there is a consensus on the importance of environmental sustainability initiatives in the fight against escalating GHG emissions (Makoondlall-Chadee & Bokhoree, 2024). The initiatives help organizations and surrounding communities to adopt environmentally friendly behaviours, which are capable of making them resilient to conditions of climate change. However, despite the aforementioned realization, there exists an empirical gap on the relationships between environmental sustainability initiatives and the adoption of zero GHG emission practices, especially in game lodges and tented camps in developing nations such as Kenya. The aim of this study is premised on this background.

Review of Literature

Theoretical frameworks

Two theories are used to underpin the current study: the triple-bottom-line (TBL) and stakeholder theory. The two models offer a multifaceted understanding of how the hotel sector adopts sustainability initiatives. TBL originated from the work of Elkington in 1997 and brings together three interrelated sustainability pillars: environmental, social, and economic. With respect to these pillars, TBL provides a holistic approach to examining how organizations perform. It argues that organizations should not only strive to be economically viable, but also endeavour to conserve the environment in which they operate. The economic pillar focuses on the profitability of business operations for viability (Nazir, 2024). While the social pillar focuses on matters such as equitable labour, community engagement, and

corporate social responsibility, the focus of the environmental pillar is on reducing the impacts of enterprise operations to the immediate environment. The environmental pillar is crucial as it helps in addressing the issues of carbon emissions through practices such as eco-labelling, energy efficiency, and sustainable waste management. TBL is relevant in this study as it underpins the rationale behind the adoption of sustainability initiatives by game lodges and tented camps. The model highlights the need for businesses to balance profitability goals and ecological preservation in response to climate change (Lovisceck, 2021).

Stakeholder theory is another model with roots dating back to 1984 from Freeman's work. This model gels well with TBL because it projects sustainability as a function of dealing with relationships among stakeholders (customers, employees, investors, communities, and the natural environment). As per the tenets of stakeholder theory, long-term business success hinges on the capability of organizations to effectively deal with stakeholders' relationships (D'Souza et al., 2024). It has been shown that, adoption of sustainability initiatives is a product of mounting pressures from eco-conscious guests, regulators, and local communities (Tyler et al., 2024). This theory shows how stakeholders' expectations motivate the adoption of sustainability initiatives. Thus, the adoption of zero GHG emissions can be seen as a response to stakeholders' expectations. Both models provide a strong theoretical perspective for evaluating the influence of environmental sustainability initiatives on the adoption of zero GHG emission practices.

Adoption of Zero GHG Emissions Practices Within the Hotel Sector

Policymakers, scholars, and business executives globally have been quite worried about sustainability in the last few years. Many see it as a strategic solution to the urgent social, economic, and environmental problems that today's nations face (Rame et al., 2024). There is no one definition of the term that everyone agrees on. But it mostly means adding economic viability, environmental preservation, and social equality to how businesses work (Correia, 2019). In the hospitality industry, sustainability is becoming more and more understood as a constant endeavor to include three areas—people, planet, and profit—in corporate plans and everyday operations (Correia, 2019).

The hotel industry has started to include sustainability efforts in its long-term business plans to help the environment, build better relationships with the community, and make more money (Purnama, 2024). In this context, environmental sustainability techniques include using environmental management systems, getting materials from responsible sources, and saving water and energy (Makoondlall-Chadee & Bokhoree, 2024). These practices are essential for achieving zero GHG emission targets, as they specifically focus on reducing waste and making better use of resources. On the other hand, social sustainability is all about making relationships with employees, consumers, and the local community stronger. This means making sure that tourism's benefits are shared fairly, encouraging local growth, and making sure that workers have fair working conditions (Wijesundara, 2023). Economic sustainability, on the other hand, means keeping profits high while lowering negative effects on the environment and society. This may be done by creating jobs, coming up with new ideas, and adding value (Eslami et al., 2019).

Even though people are becoming more aware, the hotel industry has been hesitant to implement comprehensive sustainability measures compared to other industries like manufacturing or transportation (Alonso-Almeida et al., 2017; Makoondlall-Chadee & Bokhoree, 2024). Some businesses have put in place formal sustainability plans, while others

have only adopted random environmental practices (Abdou et al., 2020). Still, many of the reasons people do things have been to make money, not because they care about the environment or society (López-Gamero et al., 2024). Because hotel operations are affected by many different factors in the environment and society, research suggests that hotels should take a strategic and integrated approach to sustainability. This includes taking the initiative to adopt methods that do not release any GHG in response to pressure from regulators, changing stakeholder expectations, and the global need to do something about climate change. This study concentrates on identifying the environmental sustainability strategies implemented by lodges and camps in Kenya's Southern Tourism Circuit, emphasizing their contribution to the overarching transition towards zero greenhouse gas emissions.

Link Between Environmental Sustainability Initiatives and Adoption of Zero GHG Emission Practices

There has been a lot of writing about how environmental sustainability and the hotel industry's use of zero GHG emissions techniques are related. It is not uncommon for studies to show both the benefits and drawbacks of sustainability initiatives in the fight against climate change. Previous study indicates that the majority of stakeholders in the hotel sector are cognizant of the environmental consequences of their operations. But not all businesses in the hotel industry are fully committed to sustainability efforts to reduce greenhouse gas emissions. For many businesses in the hospitality industry, the major reason for their sustainability efforts is to save money, not because they care about the environment.

Hornig et al. (2017) examined Taiwanese hotels and found that environmental initiatives like eco-room development, energy and waste conservation, and environmental policy formulation were mostly adopted because of regulatory pressures and competitive advantages, not because of long-term climate goals. Likewise, Mir (2020) discovered that hotels in North India adopted moderate sustainability practices, such as utilizing energy-efficient equipment and renewable energy sources, while neglecting more comprehensive strategies, including environmental certification and extensive supply chain sustainability codes.

In Australia, Khatter (2020) showed that pressure from stakeholders was a major reason for adopting green activities like teaching employees about the environment, managing trash, and saving water and energy. People thought that these efforts would help lower carbon footprints and make better use of resources. Acampora (2020) also said that Italy was moving towards "green hotels" by using methods like treating wastewater and reusing towels. These practices not only saved environmental resources, but they also made guests happier and cut down on emissions.

Research conducted in Africa, such as Kassim (2018) in Ethiopia and Wario (2020) in Kenya, corroborated these trends, highlighting the adoption of energy-efficient technologies, afforestation, and water conservation as prevalent practices, though with minimal focus on raising awareness or formal certification. These studies indicate that although initiatives are present, they frequently lack the necessary integration and strategic alignment to attain zero GHG emissions.

Gössling and Lund-Durlacher (2021) and other researchers stressed the need for systemic changes, such as low-carbon building designs and getting local, low-emission foods, to fully address climate change. Youssef and Zeqiri (2022) pointed out that technological progress is another factor. They talked about how Industry 4.0 technology, including smart lighting and water-saving systems, might help hotels lower their emissions. Even though these different settings gave us useful information, most of the research we looked at was only done in places like metropolitan hotels or industrialized countries. This means that their findings cannot be used in places like Kenya's Southern Tourism Circuit, which is focused on ecotourism and is

in a rural area. Conversely, the present study aimed to offer context-specific insights into the impact of environmental sustainability programs on the adoption of zero GHG emission techniques in lodges and tented camps, thereby addressing a notable deficiency in the previous literature. A summary of literature review and implications for this study are provided in Table 1.

Table 1: Summary of Literature Review and Research Gaps

#	Area of Focus	Identified Gap	Supporting Evidence	Implication for Current Study
1	Geographic Context	Lack of empirical studies in rural, ecotourism-based settings like Kenya's Southern Tourism Circuit	Most studies focus on urban/metropolitan hotels in industrialized countries (e.g., Taiwan, Australia, Italy, North India)	The current study provides context-specific evidence from a rural African ecotourism circuit
2	Motivation for Sustainability Initiatives	Sustainability efforts in prior studies were primarily driven by cost-saving and compliance motives, not environmental concern or climate change commitment	Horng et al. (2017), Khatter (2020), Mir (2020)	This study explores intrinsic vs extrinsic motivations for zero GHG adoption in a conservation-oriented tourism context
3	Comprehensiveness of Initiatives	Existing practices often exclude advanced or holistic strategies such as supply chain sustainability, formal certification, or systemic change	Mir (2020), Wario (2020), Kassim (2018), Gössling & Lund-Durlacher (2021)	The study investigates whether lodges/camps adopt integrated, strategic, or systemic approaches
4	Technology and Innovation	Limited examination of how emerging green technologies (e.g., Industry 4.0 tools) are deployed in low-resource, nature-based hospitality settings	Youssef & Zeqiri (2022)	The study assesses practical adoption of low-emission technologies in remote Kenyan lodges/camps
5	Guest and Stakeholder Engagement	Minimal focus on raising awareness among guests/staff or stakeholder co-involvement in environmental sustainability in African contexts	Kassim (2018), Khatter (2020) note stakeholder pressure, but few address proactive engagement or education	The study includes how lodges engage guests, staff, and local communities in zero GHG efforts
6	Outcome Orientation	Many initiatives are not explicitly linked to measurable zero GHG emission outcomes or long-term carbon neutrality	Kassim (2018), Mir (2020), Gössling & Lund-Durlacher (2021)	This study links initiatives directly to zero GHG adoption outcomes
7	Strategic Integration	Fragmentation and lack of integration in existing environmental practices limit systemic progress	Wario (2020), Kassim (2018) report piecemeal adoption	The study examines how initiatives are aligned with strategic sustainability planning
8	Policy and Certification	Lack of attention to formal environmental certification and regulatory frameworks in African hospitality settings	Mir (2020), Kassim (2018)	The study evaluates the extent of formal recognition and compliance frameworks guiding zero GHG transitions

Methodology

Research Design and Target Population

This study adopted a quantitative approach with an explanatory research design. Utilising this design helps in determining the relationships between the constructs under investigation (Saunders et al., 2012). This design fit well in this study because it allowed the exploration of how environmental sustainability initiatives impact the adoption of zero GHG emission practices. The target population for this study comprised 110 managers drawn from a census of 22 lodges and tented camps within the Southern Tourism Circuit of Kenya. The consideration of all the 22 establishments allowed for comprehensive coverage without the need for sampling. Moreover, these establishments represent the entire population of interest within the area of study; thus, it enabled the study to provide holistic and context-specific insights regarding the impact of environmental sustainability initiatives on the adoption of zero GHG emission practices. This approach is important because it promotes the validity and generalizability of the findings. Specifically, this region comprises three branded national parks: Amboseli, Tsavo East, and Tsavo West. The three parks are pivotal to ecotourism efforts in Kenya and are crucial areas for the adoption of sustainability initiatives. Participants were drawn from five departments: front office, housekeeping, kitchen, food and beverage service, and maintenance. These are units that play a vital role in the daily operationalization of sustainability practices. Their daily roles and responsibilities, including waste management, energy efficiency, procurement and staff training, make them suitable as key informants on both policy implementation and operational challenges.

Data Collection

Quantitative data were collected using questionnaires. The questionnaires were distributed through a dual-mode approach comprising online and paper formats. The mode of data collection was based on the accessibility and preferences of the participants. The online data collection was accomplished through emails and Google Forms®. This strategy ensured wider participation and inclusivity across the diverse operational contexts of the lodges and camps. Where paper-based questionnaires were required, three trained research assistants familiar with the study region assisted in data collection. Data was collected from mid-February to mid-March 2025. The reliance on self-reported data from managerial-level respondents introduced the possibility of self-reported bias. However, assurances of anonymity and confidentiality were provided to encourage honest disclosure of the required information.

Data Analysis

The quantitative data analysis in this study utilized the Statistical Package for Social Sciences, SPSS® version 30.0. The analysis incorporated both descriptive and inferential statistical techniques to address the research objective and test the proposed hypothesis. Initially, the data obtained from survey questionnaires underwent a thorough cleaning and preparation process to eliminate errors, handle missing values, and ensure consistency. Descriptive statistics were employed to summarize key attributes of the sample population, using measures such as frequencies, percentages, means, and standard deviations. These statistics provided insights into the demographic characteristics of the respondents. They also offered a general overview of the respondents' perceptions and practices related to environmental sustainability initiatives. These results also revealed the extent to which lodges and tented camps within the Southern Tourism Circuit of Kenya have adopted zero GHG emission practices.

The constructs in this study were measured using items drawn from various sources. Thus, an exploratory factor analysis (EFA) with Varimax Rotation was conducted to establish the underlying factors. EFA merges various measurement items into interpretable components based on shared variance. This facilitates a clearer understanding of the latent constructs underpinning participants' responses. Factors were grouped based on their loadings, which were typically above 0.5. Each established component was named according to the thematic alignment of its items. To assess the suitability of data for factor analysis, Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity were used. These findings are elaborated upon in the results section of this manuscript. To assess the influence of environmental sustainability initiatives (independent variables) on the adoption of zero GHG emission practices (dependent variable), a multiple linear regression analysis was conducted to test the hypothesis. This analysis allowed the researcher to establish the relative contribution of each established factor in predicting the adoption of zero GHG emission practices. Results are considered significant when their associated p-values are equal to or less than the 5% level of significance.

Results

Response Rate and Reliability Statistics

This study invited 110 managers drawn from the 22 lodges and tented camps to participate in the online survey. Of these participants, 73 completed the questionnaire, for a response rate of approximately 66.4%. With respect to the reliability analysis, environmental sustainability initiatives revealed a Cronbach's alpha of 0.913, depicting a high internal consistency of measurement items. Likewise, adoption of zero GHG emission practices construct recorded a Cronbach's alpha of 0.927, demonstrating acceptable reliability. Both constructs showed strong reliability with values well above the threshold of 0.70 (Hair et al., 2010).

Respondents' Demographic Profile

The survey comprised 73 participants. Of these, 63.01% identified as male and 36.99% as female. With regard to age, most respondents (71.23%) were aged 30 years and below. With respect to educational qualifications, 68.49% held undergraduate degrees. Regarding work experience, 69.86% had five years or less in their current roles, while 52.05% worked in chain-affiliated establishments. 63.01% were drawn from lodges.

Perceptions of Adoption of Zero GHG Emission Practices

Table 2 presents the descriptive statistics on the extent to which lodges and camps in the Southern Tourism Circuit have adopted zero GHG emission practices. All mean responses fell within the "Agree" range (3.40–4.19), indicating a generally positive adoption across practices. The highest-rated practices included waste management ($M = 4.16$, $SD = 0.746$), water conservation initiatives ($M = 4.11$, $SD = 0.951$), and adoption of renewable energy sources ($M = 4.00$, $SD = 1.054$). Other practices, such as staff training ($M = 3.97$, $SD = 0.942$), use of energy-efficient technologies ($M = 3.92$, $SD = 0.812$), and management support ($M = 3.93$, $SD = 0.948$), also scored highly. Comparatively lower ratings were observed for monitoring and tracking GHG emissions ($M = 3.52$, $SD = 1.082$) and the setting of clear GHG emissions reduction targets ($M = 3.71$, $SD = 1.172$). The standard deviations ranged from 0.746 to 1.172, suggesting moderate variability in adoption levels across the surveyed establishments.

Table 2: Descriptive Results of Adoption of Zero GHG Emission Practices

Statement	Mean	Std. Dev
My organization has implemented GHG reduction measures.	3.93	0.991
We monitor and track GHG emissions regularly.	3.52	1.082
The organization uses energy-efficient technologies to reduce GHG emissions.	3.92	.812
The organization has adopted renewable energy sources.	4.00	1.054
We have water conservation initiatives that reduce GHG emissions.	4.11	0.951
Waste management at the organization contributes to reducing GHG emissions.	4.16	0.746
The organization has set clear GHG emissions reduction targets.	3.71	1.172
Management actively supports GHG emissions reduction initiatives.	3.93	0.948
Staff are trained in GHG emissions reduction practices.	3.97	0.942
The organization collaborates with suppliers focused on reducing GHG emissions.	3.93	0.839

Notes: N = 73. Scale (*Range of Means Interpretation*): 1 = *Strongly Disagree* (SD) (1.00 – 1.79) - 5 = *Strongly Agree* (4.20 – 5.00)

Environmental Sustainability Initiatives and the Adoption of Zero GHG Emission Practices

Factor analysis was employed to identify the key dimensions of environmental sustainability initiatives based on 20 Likert-scale items. The data were deemed suitable for factor analysis as evidenced by a Kaiser-Meyer-Olkin (KMO) value of 0.703 and a statistically significant Bartlett's Test of Sphericity ($\chi^2 = 1012.521$, $p < 0.001$). Principal Component Analysis (PCA) with Varimax rotation extracted six distinct components explaining a cumulative variance of 75.42%, surpassing the recommended 60% threshold for social science research. These components were interpreted and labelled based on factor loadings and thematic consistency, as follows:

1. Community and Stakeholder Engagement

This factor explained 21.71% of the variance and included actions such as educating guests on eco-friendly behaviour, collaborating with conservation groups, and involving local communities. Mean scores for this factor ranged from 3.58 to 4.05. The highest-rated item was engagement in biodiversity protection ($M = 4.05$, $SD = 0.80$), while regular environmental assessments scored lowest ($M = 3.58$, $SD = 0.89$), suggesting a gap in monitoring practices.

2. Operational Resource Efficiency

Accounting for 18.93% of the variance, this component focused on energy and water-saving infrastructure. Participants reported moderate to high agreement ($M = 3.59$ – 3.95). Water-efficient fixtures ($M = 3.85$, $SD = 0.68$) and energy-efficient appliances ($M = 3.84$, $SD = 1.01$) were prevalent, while water recycling lagged slightly ($M = 3.59$, $SD = 1.04$).

3. Environmental Policy and Purchasing Practices

This dimension explained 13.38% of the variance and captured the presence of formal environmental policies, waste management, and eco-procurement. It recorded relatively high mean values ($M = 3.78$ – 4.05). The highest-rated item was the presence of an environmental policy ($M = 4.05$, $SD = 0.94$). Recycling programs had the widest variability ($SD = 1.13$), indicating inconsistent implementation.

4. Sustainable Infrastructure

This factor (8.06% of variance) reflected the use of sustainable construction materials. It had a high mean ($M = 3.92$, $SD = 0.49$), suggesting widespread and consistent adoption across the establishments surveyed.

5. Renewable Energy and Composting

Contributing 7.12% of the variance, this factor included renewable energy use and organic waste management. The use of renewable energy sources was the highest-rated initiative across all components ($M = 4.26$, $SD = 0.67$), illustrating a strong commitment to low-emission technologies. In contrast, composting had a lower average ($M = 3.68$, $SD = 1.09$), reflecting variability in practice.

6. External Institutional Partnerships

This final component (6.22% of variance) reflected collaborations with NGOs and government agencies. Respondents moderately agreed with the presence of such partnerships ($M = 3.74$, $SD = 0.80$), suggesting potential for enhanced institutional collaboration to strengthen sustainability outcomes.

Overall, the findings demonstrate a strong presence and institutionalisation of environmental sustainability initiatives across the studied organizations. While most initiatives are broadly adopted, certain areas—such as composting, environmental impact assessments, and water recycling—highlight opportunities for further strengthening to advance zero GHG emission practices. The results are summarised in Table 3.

Table 3: Descriptive Results of Environmental Sustainability Initiatives

Factor and Measurement Items	Mean	Std. Dev
<i>1st Factor: Community and Stakeholder Engagement</i>		
The organization educates guests on eco-friendly behaviours.	3.71	0.84
The organization engages in initiatives to protect local biodiversity.	4.05	0.80
Collaborate with local conservation organizations.	3.82	0.77
Conduct regular assessments of the environmental impact.	3.58	0.89
The organization involves local communities in sustainability initiatives.	4.03	0.79
<i>2nd Factor: Operational Resource Efficiency</i>		
Energy-efficient appliances are installed throughout the organization.	3.84	1.01
Water-efficient fixtures (e.g., low-flow taps) are used.	3.95	0.96
Have a water recycling program in place.	3.59	1.04
The organization is pursuing green building certifications.	3.85	0.68
Document and track sustainability progress.	3.66	0.97
<i>3rd Factor: Environmental Policy and Purchasing Practices</i>		
The organization has an environmental policy.	4.05	0.94
The organization has a waste reduction and recycling program.	3.78	1.13
The organization follows eco-friendly disposal practices for hazardous waste.	4.03	0.71
Prioritize purchasing eco-friendly products.	3.81	0.72
<i>4th Factor: Sustainable Infrastructure</i>		
Sustainable materials are used in hotel construction.	3.92	0.49
<i>5th Factor: Renewable Energy and Composting</i>		
Renewable energy sources (solar, wind) are used in the organization.	4.26	0.67
Organization composts organic waste.	3.68	1.09
<i>6th Factor: External Institutional Partnership</i>		
The hotel collaborates with NGOs and the government on environmental projects.	3.74	0.80

Notes: N = 73. Scale (*Range of Means Interpretation*): 1 = *Strongly Disagree* (SD) (1.00 – 1.79) - 5 = *Strongly Agree* (4.20 – 5.00)

The hypothesis (H₀) of this study posited that *environmental sustainability practices have no significant effect on the adoption of zero GHG emission practices among lodges and camps in the Southern Tourism Circuit*. To examine this, a multiple linear regression analysis was performed to determine whether six components of environmental sustainability practices significantly predict the adoption of zero GHG emission practices (Table 4).

Table 4: Multiple Regression Analysis – Effect of Environmental Sustainability Practices on Adoption of Zero GHG Emission Practices

Predictor	B	SE	β	t	Sig.
(Constant)	0.281	0.194	—	1.448	0.153
Community and Stakeholder Engagement	0.309	0.136	0.312	2.272	< 0.001
Operational Resource Efficiency	0.532	0.131	0.506	4.062	< 0.001
Environmental Policies & Purchasing	0.289	0.116	0.265	2.491	0.002
Sustainable Infrastructure	0.014	0.145	0.009	0.095	0.424
Renewable Energy and Composting	0.598	0.118	0.522	5.068	< 0.001
External Institutional Partnerships	0.231	0.099	0.242	2.333	0.005

Notes: a. Dependent Variable: Adoption of Zero GHG Emission Practices. $R = 0.682$. $R^2 = 0.465$. Adj. $R^2 = 0.416$. S.E. = 0.571. F (df = 6, 66) = 9.545. $p < 0.001$. Significance: ** $p < 0.05$. *** $p < 0.001$. n.s. – not significant.

The regression model was statistically significant, $F(6, 66) = 9.545$, $p < 0.001$, explaining approximately 46.5% of the variance in the adoption of zero GHG emission practices ($R^2 = 0.465$). The findings led to the rejection of the null hypothesis H₀₁, indicating that environmental sustainability practices have a significant effect on the adoption of zero GHG emission practices.

Five out of six components were significant predictors: Renewable Energy and Compositing ($\beta = 0.522$, $p < 0.001$) had the strongest influence, followed by Operational Resource Efficiency ($\beta = 0.506$, $p < 0.001$), Community and Stakeholder Engagement ($\beta = 0.312$, $p < 0.001$), Environmental Policies and Purchasing Practices ($\beta = 0.265$, $p = 0.002$), and External Institutional Partnerships ($\beta = 0.242$, $p = 0.005$). However, Sustainable Infrastructure was not a significant predictor ($\beta = 0.009$, $p = 0.424$). The regression equation derived from the model is as follows:

$$\begin{aligned} \hat{Y}(\text{Zero GHG Emission Adoption}) &= 0.281 + 0.309(\text{Community and Stakeholder Engagement}) \\ &+ 0.532(\text{Operational Resource Efficiency}) \\ &+ 0.289(\text{Environmental Policies and Purchasing Practices}) \\ &+ 0.014(\text{Sustainable Infrastructure}) + 0.598(\text{Renewable Energy and Compositing}) \\ &+ 0.231(\text{External Institutions Partnerships}) \end{aligned}$$

These findings suggest that tangible, immediate-impact interventions such as renewable energy deployment and composting, alongside operational resource efficiency, are critical enablers of zero GHG emission adoption. These practices are more directly linked to measurable emission reductions than infrastructural investments alone. The non-significance of sustainable infrastructure may be attributed to the relatively lower prevalence of green building materials or their limited immediate effect on GHG emissions. Conversely, active operational strategies—like energy and water conservation—and stakeholder engagement are more actionable and impactful. In alignment with the Triple Bottom Line theory and extant literature (Gössling & Lund-Durlacher, 2021; Khatter, 2020; Mir, 2020), the results

underscore the importance for lodges and camps to prioritise renewable energy integration, operational resource efficiency, community engagement, and structured environmental policies. However, the influence of sustainable infrastructure, though weak positive, was not statistically significant. This finding suggests that, unlike other initiatives such as renewable energy, operational efficiency, or stakeholder engagement, investments in sustainable infrastructure is not currently playing a role in impacting the transition toward the adoption of zero GHG emissions among the investigated game lodges and tented camps. Investing solely in physical infrastructure, without concurrent behavioural and systemic sustainability practices, may be insufficient to achieve meaningful emission reductions.

Conclusions

Renewable Energy and Composting emerged as the strongest predictor, suggesting that investment in renewable energy sources and composting systems yields substantial reductions in GHG emissions. Besides, Operational Resource Efficiency also had a strong effect, underscoring the importance of optimizing water, energy, and material use within operations. Community and Stakeholder Engagement, Environmental Policies and Purchasing Practices, and External Institutional Partnerships all showed meaningful positive relationships with zero GHG emission adoption. This highlighted the role of inclusive governance, green procurement, and external collaboration. On the other hand, Sustainable Infrastructure was not a significant predictor. This finding suggests that, while theoretically important, infrastructure investments alone may not lead to immediate or measurable reductions in emissions without accompanying behavioural and operational strategies. Overall, the results indicate that a multi-dimensional approach—one that emphasizes renewable energy integration, efficient resource use, stakeholder engagement, policy enforcement, and partnership development—is essential for achieving meaningful progress toward zero GHG emissions in tourism establishments. Infrastructure development, while foundational, must be coupled with strategic, operational, and collaborative efforts to realize environmental sustainability goals. These insights offer practical implications for policy, planning, and management in sustainable tourism transitions.

Implications for Practice

Based on the results of objective one, this study recommends owners/operators of lodges and tented camps together with the government (the Ministry of Tourism and Wildlife, Tourism Regulatory Authorities) and the private sector to encourage lodges to adopt renewable energy (such as solar, biogas) through government subsidies and partnerships with clean energy providers. In addition, the study recommends the National Environment Management Authority (NEMA) and respective County Governments to make Environmental Impact Assessments (EIAs) and follow-up environmental audits a compulsory licencing and compliance requirement for lodges to ensure sustainability is integrated into their daily practices. Moreover, this study recommends that tourism facilities and environmental NGOs work together to establish guidelines for greywater recycling and provide technical support or grants to hospitality establishments such as those studied to implement water reuse technologies. Besides, the study recommends hospitality developers, especially those handling lodge constructions, update the building codes to include green architecture and energy-efficient design requirements for all constructions in sensitive ecosystems. Another recommendation is that managers of lodges need to implement mandatory procurement policies that prioritises local, biodegradable, and low-carbon products supported by certifications and supplier audits. Kenya Wildlife Service, NEMA and hospitality business

associations are also recommended to increase enforcement of environmental laws like the plastic ban and reward businesses that comply with green certifications or financial incentives. Table 5 presents a summary of prioritised recommendations based on feasibility and impact and suggested metrics for ensuring compliance by the studied game lodges and tented camps.

Table 5: Ranked Recommendations Based on Feasibility and Impact and Proposed Compliance Metrics

Priority	Recommendation	Feasibility	Impact	Justification	Proposed Metrics
1	Adoption of renewable energy	High (feasible via policy and existing energy providers)	High	- Directly reduces reliance on fossil fuels - Visible and measurable GHG reductions	- Percentage of establishments using solar energy - Annual reduction in the use of gasoline consumption
2	Environmental Audits and Environmental Impact Assessments (EIAs)	Medium	High	- Ensures long-term sustainability and regulatory compliance across all facilities	- Percentage of establishments with latest environmental audit reports - Number of establishments corrected via compliance audits
3	Establishment of water recycling and reuse systems	Medium	Medium–High	- Supports efficient water use; grants improve feasibility in resource-constrained lodges	- Percentage of establishments with greywater reuse - Number of liters of water recycled per month
4	Adoption of green architecture	Low–Medium	High (long-term impact)	- Difficult in retrofit projects but crucial for sustainable development in new lodges	- Percentage of new lodge buildings consistent with green practices - Certified lodges under green construction standards
5	Sustainable procurement	Medium–High	Medium	- Supports circular economy and reduces supply chain emissions	- Percentage of local items in procurement schedules - Number of suppliers evaluated for sustainability
6	Environmental law enforcement and provision of incentives	High	Medium–High	- Builds a culture of compliance; rewards accelerate voluntary adoption of best practices	- Number of inspections conducted on the environment - Number of establishments either sanctioned or rewarded for compliance

Limitations and Suggestions for Future Research

This study was conducted among game lodges and tented camps within the Southern Tourism Circuit of Kenya. While this study generated valuable insights from data collected, the regional focus fundamentally limits results' generalizability. This is because practices, policies, and resource availability in the area of study may not reflect those in other circuits in Kenya

or across tourist destinations. Thus, future research should explore the adoption of zero GHG emission practices in a broader perspective beyond this scope to assess the generalizability of the findings. Future studies can also explore cross-country comparisons in East Africa to understand regional best practices and challenges in adopting zero GHG emissions in nature-based tourism. In addition, future studies can adopt a longitudinal approach to observe how the adoption of zero GHG emission practices evolves in lodges and camps, and to assess the long-term impact of environmental, social, and economic sustainability initiatives. Such studies will also help in tracking the progression of sustainability initiatives and measuring their actual reductions in GHG emissions.

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