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Research Article

Carbon Emission and Footprints of Hospitality Industries in Akure Metropolis, South Western Nigeria

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Abstract

Climate change and global warming have been identified as major threats to the development of existing ecosystem services and local livelihoods. Mitigating greenhouse gas (GHGs) emissions has become an urgent global policy trajectory with countries acceding to related Treaties and setting national targets. This forms the basis for undertaken this study with a view to assess and report on the Green House Gas (GHG) emission of some hospitality industries in Akure, Nigeria. Using qualitative methodology, the carbon footprint of thirty hotels was assessed. The hotels were selected based on star ratings and categories. Purposive sampling was used to select the respondents based on management heads of the hotels while the result was presented qualitatively using thematic analysis. Results revealed that the sources of GHGs emissions are constituted by human activities including consumption of electricity, fuel combustion, waste generation and laundry services, of which waste and fuel combustion are the highest factor. Reports also showed that the bigger the hotel in term of star rating and category the higher the carbon and GHG emissions. The evaluated hotels emit significant amount of greenhouse gases each year which is detrimental to environment health, The study recommended further research to assess the applicability of the identified strategies for enhancing environmental performance of hospitality industry and to quantify GHGs emissions from cooling appliance within the hospitality industry in the study area.

Keywords

Climate Change, Consumption, Carbon Footprint, Environmental Health, Greenhouse Gas Emissions, Hospitality Industry, Local Livelihoods, Management

1. Introduction

According to United Nations World Tourism Organization [UNWTO] reports [33] there was 4% rise in international tourist arrival in 2021. Despite the % increase recorded, year 2021 was still regarded as challenging year since arrivals still 72% down on pre-pandemic levels [24]. Hence stronger co-ordination and increased vaccination rates is recommended

for improved performance. Many factors are adjudged as factors militating against the development of tourism. For instance, [13] opined that although tourism has a positive economic impact however the negative environmental and social –cultural impacts from noise pollution and crime are enormous. [35] earlier identified several economic costs such as inflation. Global climate change is observed to have negative impacts on ecosystems and human communities all over the world including tourism industry.

In the upcoming years, it's anticipated that in the tourism industry, transportation-related carbon emissions are anticipated to rise by 25% between 2018 and 2030 [8]. About 20% of the global CO_2 emission is contributed by surface transport [4]. The hotel industry contributes significantly to greenhouse gas emissions, owing mainly to the energy used for lighting, air conditioning, heating, and other related services [9]. The actual impact of the hotel business on carbon emissions, however, could be greater than this estimate. A large portion of the waste produced by the hotel business goes toward carbon emissions and environmental damage. Approximately 289,700 tons of waste are generated annually by hotels, according to a study by the International Tourism Partnership, with food waste accounting for the majority of this waste [14]. A significant amount of carbon emissions are linked to plastic waste in the hotel business, according to a study by [16].

Therefore, it is evident that the hotel industry needs a proper GHG emission reporting mechanism that can be used universally. The hotel business produces a significant amount of carbon emissions that must be mitigated in order to reduce the carbon footprint, according to a study by [37]. Recent developments in the tourism industry have brought forth novel and emerging trends in travel, including but not limited to ecologically aware tourism, golf-based travel, medical vacations, pilgrimage-based journeys, and wildlife expeditions. Public awareness and growing conscience about sustainability have also put pressure on hoteliers to change their practices. The AISE study provides data on the likelihood of employing different temperature settings, namely, '30 ℃ or lower', '40 ℃', '50 ℃', and '60 ℃ or higher', across different countries [11]. It was observed that during 1990s, the hospitality industry transitioned towards adopting sustainable and environmentally-conscious practices [30]. The hotel sector must therefore continue to give priority to efforts to lower carbon emissions linked to transportation. The authors [6, 7, 34] suggested that hotels should adopt sustainable practices such as using energy-efficient equipment and eco-friendly detergents to reduce their carbon footprint [29].

According to [23], the travel priorities of millennial differ from those of other demographics, which results in a positive economic and social impact for local residents. Hospitality industries support their communities through tourism related development and promotion, catering for customers who require accommodations. Hotel is an integral aspect of sustainability because by supporting local businesses and initiatives, hotels contribute to the development of the community, which results in a positive economic and social impact. It is closely associated with the travel industry and the hospitality industry.

In Nigeria, road transport is predominant sector and this entails an excessive consumption of internal combustion engine vehicles (ICEs), hence, an immense contribution to CO_2 emission In addition, due to usage of relatively small number of mobile air conditioners and refrigerators in transportation sector in Nigeria, small amount of hydro fluorocarbon (HFC) is being emitted. Nigeria was the world's 17th biggest emitter of greenhouse gases in 2015, the Nigerian transport sector contributed an annual average of 48% to her total CO_2 emission from fuel combustion.

Several studies have emphasized the significance of measuring and reporting carbon emissions in the hospitality business [17]. This not only helps hotels comprehend their carbon footprint, but it also allows them to pinpoint areas where emissions can be reduced. Adoption of energy-efficient techniques can considerably reduce energy consumption. Additionally, policies, regulations, and incentives at the societal level play an essential role in promoting energy sustainability and demand reduction. Therefore, the purpose of this study is to explore the carbon emissions of hotels and thereby develop an outline to prepare a standard emission reporting guideline.

If we want to fulfill SDG 13 and the Paris Agreement's objectives, there is an urgent need to cut carbon emissions and it demands everyone's participation. Practitioners, politicians, researchers, and government authorities must committed to spending a lot of time, resources and effort to achieving national emission targets. A focus on identifying reporting mechanisms and mitigation tactics [26, 36]. Research on the potential carbon emissions of hotels has recently caught the attention of academics and governments all around the world. However, even at the policy level, the carbon emissions from hotels in developing nations in general, and Sub-Saharan Africa in particular, remain ignored. Due to this restriction, Hotel managers and national authorities are unable to pinpoint their contribution to GHG emissions.

INDC identified power generation, LULUCEF, agriculture, and transportation as the primary sources of GHGs, while waste and industry-related activities are regarded as negligible, and no mention is made towards mitigating potential emissions emanating from the rapidly expanding hospitality sector running on self-generated electricity using onsite diesel generators [18]. Therefore, an understanding of management processes is essential for managers and leaders in any organizational setting. It is on this note that these hypotheses are formulated.

H1:-are there any significant relationship between sources of carbon emission and the means of reduction of emission.
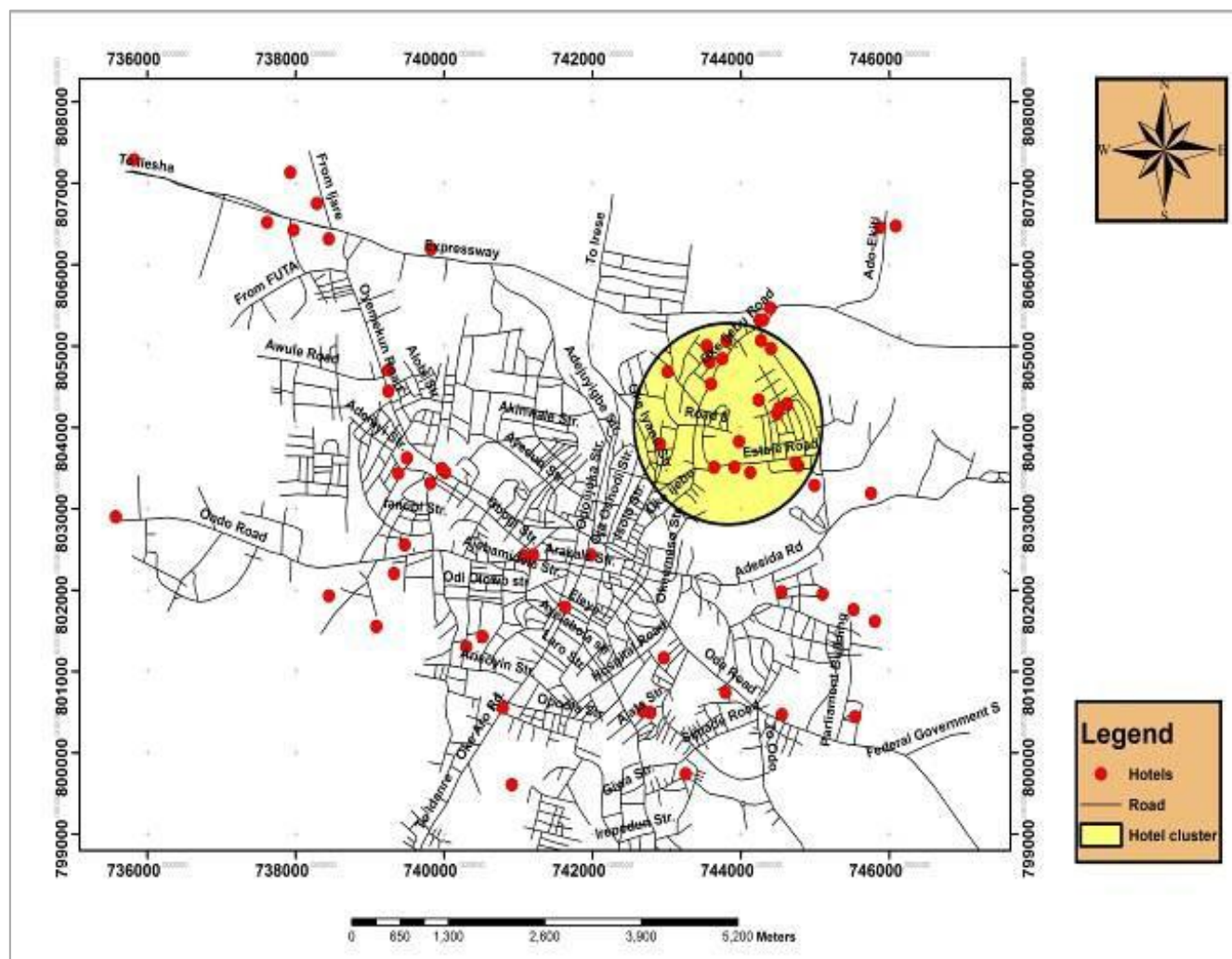
H2: are there any significant relationship between the rate

of carbon and carbon footprint generated in a hospitality industry.

2. Materials and Method

The study area (Akure Metropolis) lies within Latitudes 07° 09' and 07° 19'N and Longitudes 05° 07' and 05° 17'E (Northings 790820 – 809277 mN and Eastings 733726 – 752139mE, UTM Minna Zone 31). It covers an area extent of about 340 km^2. The metropolis is located on a gently undulating terrain surrounded by isolated hills and inselbergs. Topographic elevations vary between 260 and 470 m above sea level [25]. The metropolis is drained by several streams and rivers. Akure is a city in south-western Nigeria. It is the capital and largest city of Ondo State. The city had a population of 403,000 as at the 2006 population census (figure 1).
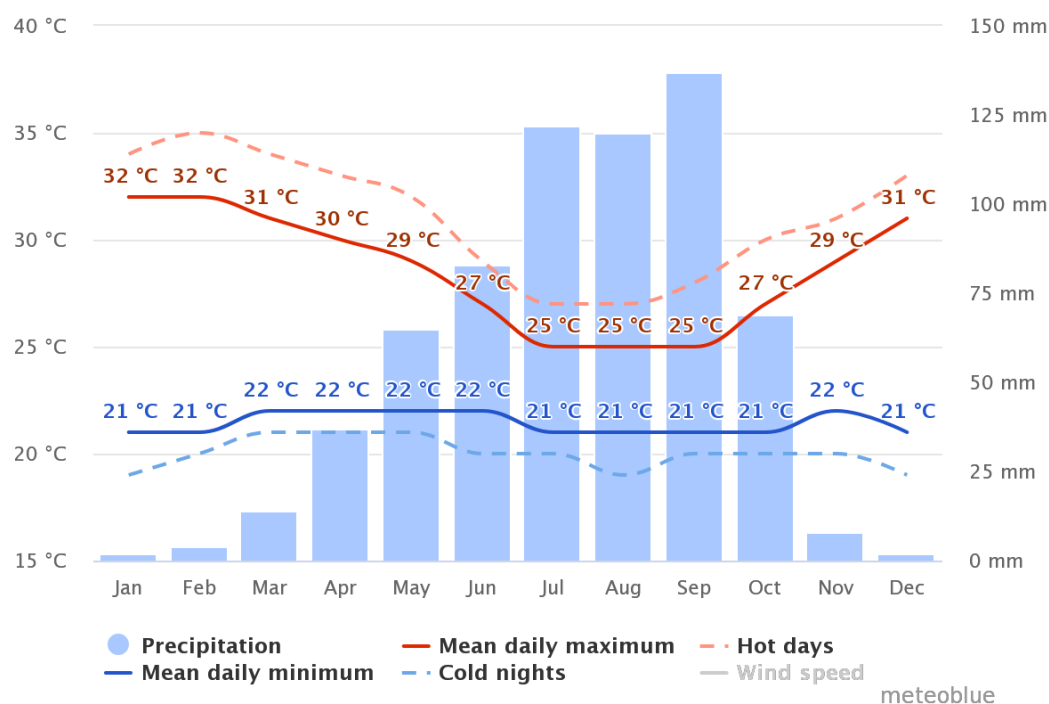

Source: [23]

Figure 1. The study area showing the locations of Akure hotels.

In Akure, the wet season is warm, oppressive, and overcast and the dry season is hot, muggy, and partly cloudy. Over the course of the year, the temperature typically varies from 65 ℉ to 88 ℉ and is rarely below 58 ℉ or above 93 ℉. The hot season lasts for 2.0 months, from January 22 to March 23, with an average daily high temperature above 86 ℉. The hottest month of the year in Akure is March, with an average high of 87 ℉ and low of 72 ℉. The cool season lasts for 3.8 months, from June 14 to October 9, with an average daily high temperature below 82 ℉. The coldest month of the year in Akure is August, with an average low of 69 ℉ and high of 80 ℉.

Source: AccuWeather

Figure 2. Climate chat.

This study was conducted to solve a contemporary issue, reduction of GHG emissions through proper reporting mechanisms to assess the carbon emissions of the hotel in Akure, Ondo State. Numbers of hotels was selected as the case study to explore the carbon emissions. In order to identify the areas of concern in the hotels, a preliminary walk through study was conducted in the selected hotels. Thirty hotels were selected from four categories of hotel star rating, which are category 1 to 4. Each hotel was categorized based on the similarities of services, amenities and facilities they offer. Consequently, the selection of 12 hotels from 1star rating, 8 hotels from 2 star rating, 6 hotels from three star rating, and 3 hotels from four star rating were selected respectively. Hotels selected from each category serves as a representative of each star rating. Seven different facilities were identified as basis for categorizing the hotels as shown in table 1. While P represents the facilities are present, A represents where the facilities are absent,

Table 1. Different Facilities present in the hotel.

S/N	Different facilities present in the hotel category (between 1 and 4 star)	1	2	3	4
I	Spa	A	A	P	P
2	Laundry services	P	P	P	P
3	Maintenance department	A	P	P	P
4	Kitchen dept.	P	P	P	P
5	Bar	A	P	P	P
6	Guest rooms	P	P	P	P
7	Gym	A	A	P	P

P- Represents present A- represent absent
Source: Field survey 2023

2.1. Research Design

In this study, interview guide was adopted for collecting information that determine/demonstrate situations as they exist. It was done without influence or interference on a variable studied. This is adopted in view of its ability to answer questions such as what is and what was. It also provide the opportunity to use qualitative data in order to find the information and characteristics about the research being carried out. A major advantage is that information can be collected from individuals, personal accounts and from written data.

2.2. Instruments for Data Collection

Interview guide was administered in data collection for this research. The structural interview guide was used as a data collection instrument which contains standard questions or items meant to collect data that can be subjected to statistical analysis. Materials used include:

1) A recorder: used as making an audio Information
2) A pen and a book: it was used for writing down points from the interviewer
3) A printed interview question guide: which is given to the respondent before going through (Key Informant Interview)

The respondents were approached, their consent were sought and were briefed about the purpose of the study and its educational implications and impact, and they were also given opportunity to raise questions about the areas they could not understand. The interview was conducted after the discussion.

2.3. Data Analysis

The analytical and statistical tools used for this study are qualitative using thematic analysis. Important interview questions were poised to the respondents, in which the respondent gives specific and accurate answer to the questions. Interview guide was used to know the facilities and services offered in the hotels which are factors of carbon emission, and management of these sources.

2.4. Key Informant Interview

Staff from the hotels, the head manager, the receptionist and the kitchen staffs including the maintenance officers were the 4 types of Key Informants that were interviewed. Purposeful sampling was used to choose the employees of each hotel location using selection criteria and rationale (Tables 2, 3, 4 and 5). The variables measured through the Key Informant Interview were used to determine the rate of activities and services that are prone to emission. The selection criterion and interview variables were developed from knowledgeable source and findings from literature on similar studies that have been conducted. Thematic analysis was used to analyze the data acquired during the Key Informant Interview.

Table 2. Interview selection process, variable and rationale for the key informant interview in selected 1 star hotels in, Akure, Ondo state.

Table methods	Participants	Selection criteria and rationale
Key informant interview	12 hotels/guest houses managers	Employed by the owner of the hotel as the management service
	22 receptionist	Employed by the manager as attendant to guests
	8 maintainers officers	Assessing the energy supply for the hotel
	10 kitchen staffs	Food services management

Source: Field survey 2023

Table 3. Interview selection process, variable and rationale for the key informant interview in selected 2 star hotels in, Akure, Ondo State.

Table methods	Participants	Selection criteria /rationale
Key informant interview	6 hotels managers	Employed by the owner of the hotel as the head of management services
	8 receptionist	Must offer services to the guests
	2 maintenance officers	Must check the overall wellness of equipment, facilities and tools
	2 kitchen officers	Must offer services to the guest

Source: Field Survey 2023

Table 4. Interview selection process, variable and rationale for the key informant interview in selected 3 star hotels in, Akure, Ondo State.

Table methods	Participants	Selection criteria/rationale
Key informant interview	4 head Manager	Employed by the owner of the hotel as the head of management services (purposive sample)
	7 receptionist	Must offer services to the guests (purposive sampling)
	5 maintenance officers	Must check the overall wellness of equipments, facilities and tools (purposive sampling)
	2 kitchen staff	Must offer services to the guest (purposive sampling)

Source: Field survey 2023

Table 5. Interview selection process, variable and rationale for the key informant interview in selected 4star hotels in, Akure, Ondo State.

Table methods	Participant	Criteria and rationale
Key informant interview	3 managers	Employed by the owner of the hotel as the head of management services to oversee everything (purposive sampling)
	6 receptionist	Must offer services to the guests (purposive sampling)
	2 kitchen staff	Must offer services to the guest (purposive sampling)
	1 maintenance staff	Must check the overall wellness of equipment, facilities and tools for effective running (purposive sampling)

Source: Field Survey 2023

3. Results

Based on the findings obtained through an interview with the respondents at the hotels, it was discovered that the hotel services exhibit numerous activities and operations that are directly linked to carbon emissions. Their perception on these activities and operations were assessed based on variables including source of electricity, mode of transportation, volume of fuel consumed, quantity of waste generated, manner of sorting and management of the waste, use of plastic and rate of usage and management practice; and laundry service being offered (Tables 6, 7, 8 and 9). The perceptions were subjected to the researcher based on the information obtained during the field observation (Table 10). There are indications that majority of hotels exhibit lack of environmental consciousness, as their operations fails to accommodate for the crucial reduction of carbon emissions.

For instance, in term of electricity supply greater percentage of the respondents attested to the fact that although, they make use of power both from generator and the National Grid by the Power Holding Company of Nigeria (PHCN), however, they rely on supply from generator than power from PHCN claiming that supply from PHCN is unreliable and inconsistent.

Manner of transportation was observed to vary largely due to

their operation and service delivery. While 1 star hotels offer service in small scale which does not require offering any form of transportation to their guests whereas, the 4 star hotels mostly utilized carpool administrations for bringing their guests especially those in diasporas. Public transport is used to facilitate their operations in term of conveying items purchased to be utilized in the kitchen and bringing the staff to their offices.

Moreover, the study has disclosed the daily volume of fuel procurement, signifying the significant role of fuel consumption rate on carbon emissions and ultimately impacting the climatic conditions. Due to the inconsistent in electricity supply from the PHCN, the 1 star hotel provide their guests with the supply of electricity powered by the generator for a short period of time unlike hotels in other categories that cannot do without electricity to meet the services offered to their guests. The greater the size of services offered the higher the quantity of the diesel or petroleum consumed for powering their generator in meeting the service demand.

The quantity of waste generated are categorized into low, medium and high. The low quantity of waste is observed among the 1 star hotel, the medium quantity was observed in the 2 and 3rd while the hotels in 4 star rating are reported to be generating high quantity of waste. There are instances where individuals operate in the capacity of waste management oversight within the hospitality industry, whereby certain hotels do not adhere to waste segregation practices. This was observed to be common among the hotels in 1 and 2 rating

unlike in the 3 and 4 star rating where relatively few number of the hotels adhere to the practice of sorting of waste in accordance to the regulatory frameworks and policies applicable to their operations. It is worthwhile noting that effective waste segregation practices assist in the comprehension of the means to diminish overall waste production, identifying reusable and disposable items, thereby enhancing life quality and mitigating greenhouse gas emissions. The service of Government Waste Management Authority is acknowledged, although some of the respondents in other category of the hotels expressed delayed in arrival in the evacuation of the waste and unsatisfactory remarks in the service delivery.

The utilization of plastics in the hotels was reported as expressed by the respondents. This is largely due to the notion of modernization and the idea of takeout or takeaway. Reused of the plastic moderately was observed among the hotels in 1, 2 and 3 star hotel while reused, re sales and recycling were observed among the hotels in 4 star rating.

One of the services offered by the hotel includes laundry services, which often extends beyond catering solely to their guests as expressed by majority of the respondents that were interviewed in the hotels in various categories. As a result, this practice is expected to contribute significantly to green gas emission as compared to hotels that exclusively offer dry cleaning services for their patrons.

Transportation services play a significant role in the exacerbation of global greenhouse gas emissions, as the transportation sector constitutes one of the largest contributors to this environmental issue. The symbiotic relationship between hotels and transportation services stems from the need to facilitate tourist mobility between distinct locations. Hotels often provide carpool services and incorporate transportation as a tool for delivery and intra-facility transportation.

The lack of comprehensive documentation and standardized measurement protocols has resulted in a lack of awareness regarding greenhouse gas (GHG) emissions, which unavoidably contribute to climate change. In addition, these emissions pose a hazard to public health and well-being.

Table 6. Perception and assessment of hotel management with respect to carbon emission and carbon footprints in hotels in Akure, Nigeria (One Star Hotel category).

Variables	Themes	Perception
Source of power	Generator and PHCN	100% respondents assert that they utilize both generators and public electricity (PHCN), with the latter being unreliable and inconsistent in terms of its supply of electricity.
Transportation	None	In the context of accommodating guests they do not offer any form of transportation either for purchase or delivery services, 100% of them only wanted to offer services in small scale.
Kitchen services	public transport	The majority of the kitchen services, specifically 95%, utilizes a public transportation to facilitate the transportation of their kitchen staff, while 5% of the use the hotel transportation.
Fuel usage	Diesel & petroleum	The present study has revealed that a majority of the respondents (80%) affirmed that they rely on PHCN for electricity utilization as their limited services only allows them to buy limited fuel to cater for their guest. When the need arises they make use of both diesel and petroleum powered generators.
Waste generated	Quantity of waste generated are very low	The quantity of waste produced is low as expressed by 90% of the respondents while the remaining 10% indicated that the waste is medium range owing to the comparatively limited size and guest of the hotel.
Sorting of waste	The sorting of waste in each hotel is infeasible	A notable proportion of hotels in this rating, specifically 100%, neglect to implement waste sorting practices despite its criticality.
Waste management	Government is in charge of waste disposal	100% of the waste generated by hotels is subjected to management by the government's waste management. However, as part of the challenges encountered in administering waste management, a proportion of 20% of hotels have reported delays in the arrival of waste management services.
Use of plastic	Plastic bottles and takeaways	The utilization of plastics gets concurrence from 90% of the respondents, though 10% show skepticism towards it.
Rate of plastic usage	Rate of plastic usage in the hotel industry is medium	A 50% consensus exists among the population with regards to moderate usage, while the other 50% agree on using small quantities of plastics.
Plastic usage management	Recycling	100% does a recycling process through the government waste management have people designated to deliver it to them.
Laundry service	The hotel makes use of laundry services for both	90% of the participants concur on the utilization of laundry amenities for individuals beyond the confines of the host's residence, as well as for visiting guests. 10% respondents favor

Variables	Themes	Perception
	guest and outsiders	exclusively providing laundry services for guests.

Source: Field Survey 2023

Table 7. Perception and assessment of hotel management on carbon emission and carbon footprints in hotels Alagbaka estate Akure, Nigeria (2 Star category).

Variables	Themes	Perception
Source of power	Both generator and PHCN	100% respondent claims to run on both generator and PHCN as power supply from PHCN is unreliable, conflicting and questionable
Transportation	None	95% do not offer their guest carpool services instead guest finding their way down to the hotel. Neither do they have any company transportation for any service. 5%have the hotel company service for services like purchase of goods to the hotels.
Fuel usage	Diesel fuel and petroleum usage in average quantity	80% of the respondents concur with the notion that there is a substantial reliance on fuel owing to the inadequate power supply generated by the Power Holding Company of Nigeria (PHCN), resulting in suboptimal power output. In contrast, the remaining 20% of respondents assert that the stability of electricity supply is dependent on the provision of allocated hours from the transformers. The average quantity of diesel and petrol (PMS) consumed whenever they put on the generator cannot be ascertained
Waste generated	Quantity of waste generated in the hotels are medium	The present study indicates that the quantity of waste generated, specifically 90%, is attributed to medium, while the remaining 10% is associated with low range waste, owing to the relatively small size of the hotel under consideration.
Sorting of waste	The sorting of waste in each hotel	According to the findings, a majority, specifically 100% of hotel entities, do not prioritize waste sorting practices.
Waste management	Government is in charge of sorting waste	100%wastes generated by hotels are efficiently managed by the government's waste management system, and there have been no reported instances of delayed arrivals, indicating a satisfactory performance.
Use of plastic	Only Plastic bottles	The employment of plastics finds concurrence among 95% of individuals, whilst a minority of 5% exhibit skepticism towards its utilization.
Rate of plastic usage	Rate of plastic usage in hotel industry is low	A majority comprising 55% of respondents concurs with the notion of moderate usage, while the remaining 45% agrees with the proposition of low usage.
Plastic usage management	Recycling	The utilization of plastic waste follows a distribution whereby 100% of the plastic used are disposed/ disposed.
Laundry service	The hotel makes use of laundry services for guest	77% of the respondents expressed concurrence regarding the employment of laundry facilities for both external parties and visitors, while the remaining 23% indicated agreement exclusively with the provision of laundry services solely for guests.

Source: Field Survey 2023

Table 8. Perception and assessment of hotel management on carbon emission and carbon footprints in hotels in Akure, Nigeria (3 Star category).

Variables	Themes [themes description]	Perception
Source of power	Generator and PHCN	100%respondents prove that they utilize both generators and public electricity (PHCN), with the latter being inconsistent in terms of its supply of electricity.
Transportation	Carpool and designated	In the context of accommodating guests from their diasporas, 40% of respondents expressed a willingness to utilize carpool services, while 60% of respondents do not make use of such

Variables	Themes [themes description]	Perception
services	driver	services.
Kitchen transportation services	Designated driver and public transport	The majority of the kitchen staff, specifically 85%, utilizes a designated for the transportation of their kitchen staff given the frequency of their visits to procure necessary supplies. Conversely, a minority demographic comprising 15% depicts a reliance on public transportation means for this purpose.
Fuel usage	Diesel fuel and petroleum usage in high quantity	The present study has revealed that a predominant majority of 80% populace subscribes to the notion of increased fuel utilization owing to the inadequacy of PHCN-generated power and its subsequently low supply. On the other hand, a mere 20% of the participants affirm a relatively stable provision of electricity, which they attribute to the allocation of transformers. Due to the efficacy of service offered the consumption of diesel and petrol (PMS) used to power their generators whenever there is shortage of electricity supply from the PHCN is considered to be high in quantity
Waste generated	Quantity of waste generated in the hotels are high	The majority of waste produced exhibits high levels, with 90%, with the remaining 20% categorized as medium range owing to the comparatively limited size of the hotel
Sorting of waste	The sorting of waste in each hotels varies	A notable proportion of hotels, specifically 85%, neglect to implement waste sorting practices despite its criticality. Conversely, a minor yet significant fraction, comprising 15%, implement waste sorting practices in response to hotel policies and regulations.
Waste management	Government is in charge of sorting of waste	100% of the waste generated by hotels is subjected to management by the government's waste management. However, as part of the challenges encountered in administering waste management, a proportion of 20% of hotels have reported delays in the arrival of waste management services
Use of plastics	Plastics bottles and takeaways	The utilization of plastics gets concurrence from 90% of the respondents, though 10% show skepticism towards it.
Rate of plastic usage	The rate of plastic usage in the hotel industry	A 50% consensus exists among the population with regards to moderate usage, while the other 50% agree on using small quantities of the product
Plastic usage management	Reuse and recycling	The utilization rate for plastics is fragmented, with 20% of the material being allocated for repurposing through resale, while the remaining 80% undergoes a recycling process
Laundry services	The hotel makes use of laundry services for both guest and outsiders	90% of the participants concur on the utilization of laundry amenities for individuals beyond the confines of the host's residence, as well as for visiting guests. 10% respondents favor exclusively providing laundry services for guests.

Source: Field Survey 2023

Table 9. Perception and assessment of hotel management on carbon emission and carbon footprints in hotels in Akure, Nigeria (4 Star category).

Variables	Themes [theme description]	Perception
Source of power	Both generator and PHCN	100% respondent claims to run on both generator and PHCN as electricity supply from PHCN is conflicting and questionable.
Transportation services	Carpool and designated driver	80% concurs on utilizing carpool administrations for bringing their diasporas visitor whereas 20% concurs on them finding their way down to the hotel
Kitchen transportation services	Designated driver	100% have designated driver to transport their kitchen staff due to frequent visit to purchase
Fuel usage	Diesel fuel and usage in bogus quantity	Seventy-five percent of the respondents concur with the notion that there is a substantial reliance on fuel owing to the inadequate power supply
Waste generated	Quantity of waste generated in the hotels are high	The present study indicates that the majority of waste generated, specifically 95%, is attributed to high range, while the remaining 5% is associated with medium range waste, owing to the relatively small size of the hotel under consideration.

Variables	Themes [theme description]	Perception
Sorting of waste	The sorting of waste in each hotels varies	According to the findings, a majority, specifically 70% of hotel entities, do not prioritize waste sorting practices. Conversely, only 30% of hotels adhere to this practice due to regulatory frameworks and policies applicable to their operations.
Waste management	Government is in charge of sorting of waste	100%wastes generated by hotels are efficiently managed by the government's waste management system, and there have been no reported instances of delayed arrivals, indicating a satisfactory performance.
Use of plastics	Plastics bottles and takeaways are being used	The employment of plastics finds concurrence among 90% of individuals, whilst a minority of 10% exhibit skepticism towards its utilization.
Rate of plastics usage	The rate of plastic usage in the hotel industry is quite high due to ordering takeouts	A majority comprising 75% of respondents concurs with the notion of moderate usage, while the remaining 25% agrees with the proposition of limited usage.
Plastic usage management	Reuse and recycling	The utilization of plastic waste follows a distribution whereby a considerable percentage, specifically 40%, is subjected to reuse and subsequently offered for sale, whilst the larger quota of 60% undergoes a recycling process.
Laundry services	The hotel makes use of laundry services for both guest and outsiders	100% of the respondents expressed concurrence regarding the employment of laundry facilities for both external parties and visitors.

Source: Field Survey 2023

Table 10. Perspective of respondents to carbon emission.

Variable	Means of identification	Subjective response	Objective response
Source of electricity	Interview and observation	100% of the hotels around Ijapo estate admitted to using both generator and PHCN light as light needed to be generated for the guests 24hours	Most of the hotels assessed during interview have their generator on. As a standby generator in working was observed. The uses of electricity were not available during the interview.
Number of rooms	Interview and observation	42% of the hotels are of medium sized hotels in which the receptionist answer with number of rooms available,36% of the hotels were of medium sized and 22% are small sizes and guest houses	Each hotel was observed based on their sizes and services in which were duly noted some of the hotel rooms were small rooms and they offer small scale services. These were all observed during the interview
Transportatio e9 service	Interview and observation	40% of the hotel makes use of carpool services in transporting their diasporas guest to the hotel as part of services offered, 60% of the hotel guests find their way down to hotels. The kitchen services uses designated driver for their purchase which is frequently used 20% percent use public transport.	The transportation services was observed as it was part of the interviewed, each cars were shown and carefully observed.
Fuel Usage	Interview	80% of the hotels uses high percentage of fuel due to instability of light while 20% uses more of electricity generated by the PHCN	_

Source: Field Survey 2023

Evaluation of Emission Factors

The list of emission factors in the range of 1-4 hotel star ratings in Akure was assessed which lead which results to the bigger the hotel the high the rate of emission generated (tables 11, 12, 13, 14). The number of rooms and the services they offer ranges from each other which ascertain the fact that bigger hotels generates GHG gases than medium/smaller hotels which correlates with the study of [2], because of the extra facilities such as restaurants, bars, SPAs, and swimming pools, which generate more trash and demand more energy,

large hotels with high class have higher emissions than guest homes and self-catering flats.

The CO_2 emissions of the hotel industry were calculated by using the methods recommended on fossil fuel combustion and cement production [19, 27] and [38] According to physical characteristics, the direct coefficient of carbon (c) conversion to CO_2 in fossil fuel combustion is 3.67.

According to the chemical reaction equation of carbon combustion $C + O_2 = CO_2$; the relative atomic mass of C is 12, of O is 16, and of CO_2 is 44; thus, the conversion of C to CO_2 is 44/12, which is approximately equal to 3.67.

$$EC = EF \times AD$$

From the waste generated per week, the emission resulting for these wastes can be calculated using:

$$GHG(KgCO_2 - e) = AD \times EF$$

Where;
AD: Activity Data;
Emissions produced by open-burning of wastes.

Emissions were estimated using the IPCC Guidelines for GHG inventories [32]. The study adopted default unit emission factor for each pollutant, which expresses the emission per amount of MSW burned as follows: $Emi = MSWB \times EFi$ (2) Where, Emi = Emission of pollutant i; EFi = emission factor of pollutant i (g/kg of dry matter burned or kg-CO_2/ton MSW); and $MSWB$ = amount of MSW burned (kg/year).

EF: Emission Factor: The value of the emission factor for waste is based on the waste management method and the method widely used in Nigeria is Open burning, thus an Emission factor of 801.2per ton (0.88per Kg) [23]. The unit for this research Emission of CO_2. For solid waste is Kg-L/kg of fuel.

Table 11. List of emission factors in 1 star the hotels AKURE ONDO STATE.

Name of hotel	Years in operation	Number of rooms	Fuel consumed per week/(Avg)	Waste generated per week (liter)	No of guest per week/(Avg)	Emissions from fuel per week (Kg-CO_2)	Emissions from Waste generated
Crystal suits	7	10	700	1200	28	2569	1056
Primus suits	13	14	630	720	49	2312.1	633.6
Lafe Inn		7	300	960	33	1101	844.8
Osopadec guest house	15	14	402	960	24	1475.3	844.8
Metropolitian guest house	14	10	200	480	18	734	422.4
Cozy suites	5	16	455	630	21	1669.9	554.4
Midas	5		600	1200	30	2202	1056
Stateline	10	15	555	240	42	2036.9	211.2
The Edgewood Manor	1	1	20	120	4	73.4	105.6

Source: Field survey 2023

Table 12. List of emission factors in 2 star ratings hotels AKURE ONDO STATE.

Name of hotels	Years in operation	No of rooms	Fuel consumed per week/(Avg)	Waste generated per week/(liter)	No of guests per week/(Avg)	Emissions from fuel per week (Kg-CO_2)	Emissions from Waste generate
Flourish	13	30	780	1680	175	2862.6	1478.4
Eureth House	2½	23	1400	1440	161	5138.0	1267.2
Grand Capital	6	33	880	2160	224	3229.6	1900.8
Grand Otad	17	33	620	1920	42	2275.4	1689.6
Treasure	1	40	504	960	104	1849.7	844.8

Name of hotels	Years in operation	No of rooms	Fuel consumed per week/(Avg)	Waste generated per week/(liter)	No of guests per week/(Avg)	Emissions from fuel per week (Kg-CO$_2$)	Emissions from Waste generate
Benny Rose	3	46	100	1440	17	367	1267.2

Source: Fields survey 2023

Table 13. Emission factors in 3 star hotels AKURE ONDO STATE.

Name of hotel	Years in operation	No of rooms	Fuel consumed per week/(Avg)	Waste generated per week (liter)	No of guest per week/(Avg)	Emissions from fuel per week (Kg-CO$_2$)	Emissions from Waste generated
Rotswell	20	54	1,050	2880	250	3853.5	2534.4
Heritage continental	6	42	1,148	3120	271	4213.2	2745.6
Bliss world	15	41	980	2400	150	3596.6	2112
Groovy	7	45	1,110	2640	201	4073.7	2323.2
Ade super	30	35	940	2880	210	3449.8	2534.4
Winners Guest House		90	990	3360	225	3633.3	2956.8

Source: Field survey 2023

Table 14. List of emission factors in 4 star hotel in Akure, Nigeria.

Name of hotel	Years in operation	No of rooms	Fuel consumed per week/(Avg)	Waste generated per week (litre)	No of guest per week /(Avg)	Emissions from fuel per week (Kg-CO$_2$)	Emissions from Waste generated
De Ja Vu	1	71	1,750	4320	445	6422.5	3801.6
Sunview	17	72	1,680	4080	448	6165.6	3590.4
St Jacobs	2	74	1,750	3840	335	6422.5	3379.2

Source: Field Survey 2023

4. Discussion

According to a World Tourism Organization (UNWTO) report, the hotel industry's carbon footprint accounts for 1% of worldwide emissions. [33]. Carbon emissions remain one of the most significant environmental challenges facing the planet today. The hotel industry is a major contributor to carbon emissions due to the large amount of energy required in running these establishments.

4.1. Sources of Emission in Hotels of the Study Area

In this study, transportation was one of the aspects assessed.

The rate of visitors in each hotel in the range of 1 to 4 stars influences the range in which transportation services emit CO$_2$ due to the high range of hotel numbers. In Akure, one source of emissions in the hotels, as assessed, is transportation. Due to the high level of hotels and the volume of guests that visits the hotel is quite high, thereby leading increase in GHG which was in correlation with the study of [5] that the transport segment may be a major source of CO$_2$ contamination within the climate, with a worldwide commitment of around 7.3 billion metric tons of carbon dioxide emissions in 2020.

However, from all that seem to gather, transportation is overwhelming within the Nigerian transport division. This involves an intemperate utilization of inside combustion motor vehicles (Frosts) and, subsequently, a monstrous

commitment to CO_2 emanation through the combustion of petroleum-based items like PMS, Back, and ATK; moderately little sums of methane (CH_4) and nitrous oxide (N_2O) are radiated amid fuel combustion which relates with the study of.

4.2. Energy Consumption and Greenhouse Gas Emissions (GHGs)

From 1 to 4 Star classifications, the energy usage and carbon emissions from Akure hotels were carefully examined. The rate at which fuel or diesel is used in hotels demonstrates the range at which the quantity of fuel purchased directly relates to CO_2 emissions because of the high fuel usage. The main sources of greenhouse gases are the production and use of energy, which correlates with the study of [1] In Juba that emission that are produced when fossil fuels like coal, oil, and natural gas are used. The production of energy is responsible for around 40% of carbon emissions worldwide. Electricity is produced on-site using diesel generators Due to their convenience and inexpensive installation costs, diesel/petroleum generators remain the primary choice for electricity generation as discussed in the interview.

In this study the use of generator in Akure hotels are evident as some makes use of more than one standby generator into generating electricity supply, due to inconsistency in the electricity since none are making use of any renewable energy, which was supported by [21] that generators account for more than 6% of Africa's installed energy generation capacity. Due to a lack of financial means to develop accessible renewable energy sources, diesel generators are used to generate electricity. As a result of the lack of on-grid electricity, the city has seen an increase in the number of privately-owned diesel generator sets of different capacity.

This study shows the rate at which fuel is consumed by the hotels in Akure which is at a high rate. For instance this is as high > 6000kg-CO_2 per week in some hotels especially the 4 star category of hotels. The use of fuel has been their major source of power to keep up their facilities smooth and running, nevertheless the high combustion of fuel releases certain chemical pollutant to the atmosphere which contributes to the GHG in the atmosphere and causes climate changes or detriment to the people living in that certain environment. This also correlates with [2] study that Fuel/diesel burning generates harmful pollutants into the atmosphere, including carbon dioxide (CO_2), nitrogen oxide (NOX), nitrous oxide (N_2O), sulfur dioxide (SO_2), and methane (CH_4). These pollutants are probable GHGs that are causing global warming and climatic changes.

As a country that relies heavily on petroleum and crude oil, it is unavoidable that the hotel and accommodation sector is one of the leading GHG emitters, second only to agriculture. With the increased demand for hotel services in J, petroleum-fired electricity-related GHG emissions will continue to rise dramatically as hotels expand their operations without considering sustainability. According to [30] as presented in Global Hotel Decarbornisation Report, hotels needs to reduce their absolute carbon emissions from fossil fuels and waste by 60% by 2030 and by 90% by 2050 to ensure that the predicted growth of the industry does not lead to a corresponding increase in carbon emissions.

4.3. Carbon Emission from Waste

In this study, the solid waste generated in each star ratings in Akure, Ondo state was assessed the result being that hotel/hospitality generate hundred tons of waste per day making it one of the leading factors of emitting CO_2 as hotels generate significant amount of waste. Solid wastes have the potential to contribute to global warming and climate change by emitting greenhouse gases into the environment, with accordance to the study of [32] which was also in line with [20, 10] findings that Hotels generate a significant amount of waste, which has a negative influence on the environment. Every year, Akure creates hundreds of tons of garbage. Estimation of above 3,000 metric tons of waste is generated each day with organic matter accounting for the majority of the hotel industry and contributing significantly. This equally led to high emission of carbon (3801.6kg CO_2/ton).

During the assessment, it was discovered that hotels in Akure have a waste management system and records managed by the government, as some made use of reuse of waste as supported by [36] study, a good management trajectory for strengthening the sector and driving it towards producing sustainable solutions such as reduce, reuse, and recycle is an effective hotel trash recording. As a first step toward mainstreaming sustainability into the sector and reducing carbon emissions, hotels in should improve their waste management practices by maintaining adequate records of the amount and composition of the solid waste they generate.

4.4. Carbon Footprints of the Hotels

According to research, the population of construction developments affects carbon footprints. In place of these, the study examined the population of hotels in Akure, revealing the carbon footprints. Despite its importance to the national economy, the hotel industry contributes significantly to GHG emissions into the environment. The consumption-based carbon footprint of 30 Akure hotels was examined in this study, and the various sources of GHG emissions were described. In the absence of a good supply of energy, the GHGs were from fuel use, trash created, laundry service, and so on which correlates to the study [15]. Other than the travel sector of the tourism industry, emissions from the lodging component of the tourism industry is also among the highest as they tend to be energy-intensive operations given that they rely on heating and air conditioning, warm showers, heated pools and spas to meet their ongoing customer needs and demands. Even though Akure had an on-grid electrical supply when the study revealed the self-generation of elec-

tricity by each hotel using diesel generators the study discovered that there was no uniformity in the rates of GHG emissions across the hotels after a careful evaluation of the hotels' emission.

The factors of emission in Akure hotels makes it important to investigate the rate of GHG in Akure and rates at which it occurs which the study of [3] supports that the amount of carbon being emitted through either travel or hotel activities is an important indicator to assess the environmental impact that tourism generates.

A thorough examination of each hotel demonstrated a direct association between the hotel's class/services and the associated carbon emissions. High-quality hotels release higher GHGs due to the variety of services and accommodation capacity they provide than low-quality hotels with restricted services which correlates with the study of [2], because of the extra facilities such as restaurants, bars, SPAs, and swimming pools, which generate more trash and demand more energy, large hotels with high class have higher emissions than guest homes and self-catering flats.

4.5. Means of Reduction of Carbon Footprints in Hotels

In this study the need government intervention in making laws policy, more researcher are needed to mitigate this actions to mitigate GHG emissions which this is in similitude with the study of [11, 26, 36]. If we want to reach sustainable development goal, we urgently need to cut carbon emissions and we need everyone's help [30]. Practitioners, policymakers, researchers, and government authorities have focused on identifying mitigation measures and reporting mechanisms in order to meet national emission objectives.

In the study it was observed that the level of awareness about carbon emission is limited to the respondents which gives awareness opportunity a disadvantage, awareness to visitors and staff are needed to show educate them about the repercussions also actions of GHG emissions which is the with the study of [12], the reduction in energy use was dependent on educational initiatives aimed at visitors and staff in addition to these mitigating measures. Climate change themes must be emphasized in educational initiatives to raise awareness among the varied participants in the tourism experience. These initiatives must be based on the concepts of carbon literacy.

5. Conclusions

The goal of this study was to evaluate hotel operation in the study area (Akure, South western Nigeria) in terms of their carbon emissions status and GHG emission reporting. Thirty hotels' GHG emissions were measured in terms of CO_2 emissions. According to the data, the hotel industry emits a significant amount of greenhouse gases each year, with diesel usage for electricity generation serving as the

primary source. Water use, washing (including waste water), and solid waste generation are other sources of greenhouse gas emissions for hotels. It was further discovered that the method used in this study could be used to calculate the carbon footprints of other hotels that were not included in the study, producing a thorough record for setting representative emission benchmarks that would aid in monitoring and reducing the carbon footprints of hotels. According to the report, there are no pertinent regulations in Akure, Ondo state that would encourage hotels present to make environmental protection a priority in their daily operations. Due to this, hoteliers are reluctant to incorporate environmental management methods and provide accurate information on the hotels' performance. As a result, this study put forward a framework whose adoption by the hotel management would integrate environmental education into the hospitality sector through initiatives to build industry capacity, encourage partnerships with national authorities, and motivate hotels to routinely report their GHG emissions.

The use of alternative energy sources like solar energy and the mainstreaming of climate change are two potential GHG emission reduction solutions for the hospitality sector.

Steps that can ease the transition to sustainability practices that protect the environment while boosting profits, such as:
1) Taking safeguards when designing structures,
2) Implementing environmental and sustainability policies, and
3) Adhering to or enforcing national environmental regulatory measures.

It is pursued to conduct additional research to see whether these tactics are appropriate in the Akure environment. It is advised that more research be done to measure greenhouse gas emissions from cooling equipment used in the hospitality sector as well as emissions from other expanding industries like transportation.

Abbreviations

AISE: International Association for Soaps, Detergents and Maintenance Products
OECD: Organisation for Economic Co-operation and Development
SHA: Sustainable Hospitality Alliance

Conflicts of Interest

The authors declare no conflicts of interest.

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