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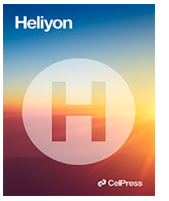

Research article

Quest for NetZero emissions in South African national parks: A tourism perspective

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ABSTRACT

Globally, national parks contribute to tourism and conservation. Several iconic national parks in Africa attract millions of tourists. These include Table Mountain, Kruger, the Serengeti, Chobe, Hwange, and Gorongosa National Park. Tourism contributes substantially to global warming and climate change through carbon emissions from tourism activities. Regardless of this understanding, minimal effort has been put into understanding and documenting the national park's carbon risk. The current debate on sustainability transitions calls for a relook of various economic sector strategies to reduce their carbon footprint. This aligns with SDG 13 on climate change action and the sector's calls for carbon neutrality. To that effect, this study examines how South African National Parks (SANParks) seeks to transition to net zero in its park operations to ensure responsiveness to the climate change agenda. This study included 150 interviews with national park and hospitality professionals in 19 national parks to address the research objective. In addition, the study draws upon extensive field observation, document analysis, and 871 tourist questionnaire surveys. Data analysis from the survey was conducted using QuestionPro Analytics, while interview data were analysed through systematic content and thematic analysis. The study found that South Africa's national parks have primarily carbon-intensive tourism facilities from an energy perspective. South African national parks, however, have taken steps to respond to the four essential pillars of NetZero emissions by 2050. These pillars are outlined in the Glasgow Declaration on climate change and the revised Nationally Determined Contributions. Within SANParks estates, these pillars include planning, measuring, reporting, and advocating for accelerated climate change action. NetZero initiatives should be funded in a variety of ways, including by tourists, the private sector, and other stakeholders.

1. Introduction

Debates surrounding sustainable tourism cannot be elaborated outside the broader global agenda on sustainable development, popularised in the Brundtland Commission Report of 1987, Our Common Future [1]. From the report, global leaders came to a consensus that defined sustainable development as "development that meets the needs of the current generations without compromising the needs of future generations [1:43]. The understanding was that a purely capitalist mode of development resulted in the degradation of life-support systems from the environment and social dimensions. Hence, sustainable development sought a balance

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between the economic, environmental and societal dimensions that propel growth and development.

After Our Common Future, the Rio de Janeiro Earth Summit of 1992 advanced the sustainable development agenda by marrying environmental concerns to developmental needs. Several principles, such as polluter pay and precautionary principles, were agreed upon during the Rio Summit [2]. Global conventions, including the Convention on Biological Diversity, United Nations Framework Convention on Climate Change and the Convention to Combat Desertification, were other landmarks of the 1992 Earth Summit. A follow-up global gathering 20 years later, code-named Rio+20, resulted in another outcomes document; The Future We Want [3]. This outcomes document was succeeded in 2015 by Transforming Our World: The 2030 Agenda for Sustainable Development, which embraces the 17 Sustainable Development Goals – SDGs [4]. In between, Butler [5] magnified the sustainable tourism agenda. To this end, the quest for NetZero emissions in (South African) national parks and a focus on tourism must be understood within the broader sustainable development and sustainability transitions discourses.

Regardless of their conservation status, national parks and other game reserves have been flagged for being unsustainable in many respects [6]. Buckley [7] argues that given the increasing number of tourists in national parks, there are concerns over this growth and its impact. For example, Sandham et al. [8] (2020) highlight the adverse impact on waste generation in South African national parks. On the other hand, tourism development in Victoria Falls and Hwange National Parks is regarded as one of the main contributors to carbon emissions which drives climate change [9]. Climate change is expected to considerably challenge park management and other tourist destinations worldwide [10]. Innovative ideas will be needed to address these genuine concerns [11,12].

Camps, transport, and other activities in national parks produce significant carbon emissions that must be dealt with to ensure sustainability [13,14]. The consciousness of the environmental impacts of tourism, particularly on climate change, has led many tour companies to rethink sustainability in general and in the context of climate change [15,16]. The demand from tourists for sustainability, the cost of pollution, and legislative pressure have raised the need for sustainability transitions within the tourism industry. Tussyadiah and Miller [17] place sustainability transitions at the centre of the future of tourism. Tourais and Videira [18] argue that sustainability transitions are still an under-explored thematic area in the tourism industry and offer a suggestive model that can be used to drive transition within the sector.

The demand for sustainability has been heightened in recent years due to the adverse impact of the COVID-19 pandemic and the increased frequency of extreme weather events attributed to climate change [19,20]. These extreme weather events have impacted tourism, enterprises, and local indigenous communities, resulting in societies demanding accountability and stewardship concerning high carbon footprints to ensure the world stays within the 1.5 °C temperature mark. Decarbonising the tourism enterprise and assisting hosting communities to mitigate and adapt to climate change has been a central debate in the sustainability transition of the tourism sector. Tourism scholars and stakeholders have fronted possible measures to address the carbon footprint. Amongst these critical debates, there have been calls for tourism degrowth [21,22], a central theme which dominated the debate during the height of the COVID-19 pandemic. Higgins-Desbiolles [23] argues that reconfiguring this sector is critical for tourism to protect the ecological integrity on which the sector depends.

As the race towards Netzero transitions rages on, it is critical to know how the tourism sector, which is touted as one of the key leaders in addressing the Sustainable Development Goals, in particular, SDG 13 (climate change action), is faring in this regard to understand key success drivers, challenges and opportunities. To that extent, this study examines how the tourism sector in South Africa through the South African National Parks is responding to the need for sustainability transitions with a focus on how the parks aim to address their carbon burden to ensure sustainability. This understanding is critical given the warning that returning to normal post-COVID-19 will require significant efforts to ensure sustainability [24] (Dube, 2022).

2. Literature review

This section includes two main parts: sustainability discourses and tourism and NetZero emissions trajectory in national parks. Each section is considered in turn in the following sub-sections.

2.1. Sustainable and sustainability tourism

As the introduction highlights, the NetZero emissions by 2050 trajectory in (South African) national parks cannot be discussed outside the broader sustainable development, sustainability and sustainable tourism discourses. Such discourses bring to the fore a bi-directional relationship. Sustainable tourism results in preserving, especially nature-based attractions, while bringing financial, human and social sustainability dimensions to the industry [25,26]. Prideaux et al. [27] argued that the sector had to tap into transformative tourism post-pandemic, which addresses concerns of high resource consumption and ensures that the sector is accustomed to environmentally sound ways. In support of this, Hall and Wood [28] noted that challenges of over-tourism, for example, could be addressed through demarketing to reduce the associated environmental degradation.

From the United Nations Outcomes document, Transforming Our World, sustainable tourism was also considered. Bullet 33 emphasises the need to recognise that development remains a function of the sustainable management of the planet's natural resources [4:9]. To this end, global leaders committed "to conserve and sustainably use oceans and seas, freshwater resources, as well as forests, mountains and drylands and to protect biodiversity, ecosystems and wildlife". World leaders committed to promoting sustainable tourism. Given the importance of tourism in sustainable development, target 8.9 from SDG 8 calls upon the world to "devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products" by 2030 (p. 20). Target 12b from SDG 12 spells out the desire to "Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products" (p. 23). Lastly, target 14.7 looks at increasing "the economic

benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism" (p. 24). Therefore, the call to create green tourism growth. Hall et al. [29] emphasised the need for a sector responsive to NetZero emissions by 2050 if the tourism sector is to continue attracting tourists and creating sustainable jobs.

Regarding nature tourism sustainability, Karhu et al. [30] noted that in Koli National Park, Finland, the concept of sustainable nature tourism, part of the Finnish national parks planning and management strategy introduced at the turn of the millennium. The authors found that large-scale tourism developers have embraced sustainable nature tourism and the sustainability paradigm. This paradigm is partly shaped by customer perceptions which inform how hotels, parks and equipment are set up [31]. How land uses, sales and entrepreneurship play out in ecotourism are also critical [32]. Given the preceding, the next sub-section focuses on how national parks are warming up to sustainable tourism and the NetZero emissions by 2050 trajectory (net zero emissions means removing an equal amount of CO_2 from the atmosphere as the amount released through anthropogenic activities).

2.2. Towards NetZero emissions in national parks

The NetZero emissions by 2050 narrative were solidified as one of the outcomes of the United Nations Convention on Climate Change's (UNFCCC) 26th Conference of Parties (COP 26) that took place in Glasgow, Scotland, in 2021 [33]. During the run up to this conference, the tourism sector saw the adoption of the Glasgow Declaration: A Commitment to a Decade of Tourism Climate Action. Regardless of the hype surrounding this declaration as making concrete steps towards addressing the sector's climate change 'sins,' respected academics noted advances in climate change action [34]. However, these fell short of providing a clear action plan for aggressively dealing with the increasing carbon emissions from the sector [35]. Scott and Gössling [36] argue that the incoherence between tourism's growth trajectory and climate policy presented a considerable risk for the tourism sector.

Before COP26 and the subsequent adoption of the Glasgow Declaration, various facets of the NetZero emissions pathways emerged, driven by the desire to reduce carbon emissions that lead to global warming and climate change [37,38]. This is also driven by the need to green the national parks and the movement toward good environmental stewardship [39]. In greening parks, the U.S. Department of the Interior developed ten strategic goals that addressed the impact of facilities on the environment and human well-being. Among the ten goals were to be climate-friendly and climate ready, be energy smart, have green rides, and strengthen sustainability partnerships in national parks. This is in response to the climate change backlash witnessed in Virgin Islands National Park through the loss of coral reefs and Kenai Fjords National Park through the shrinking of glaciers. This has precipitated an ambitious project aimed at energy conservation, improving energy efficiency, and reducing the fossil fuel consumption of new assets within national parks.

Richardson and Loomis [40] found that concerns over global warming are among the key determinants of willingness to pay for trips to Rocky Mountain National Park in Colorado. Hence, NetZero emissions pathways remain relevant to reducing continuously increasing temperatures worldwide. The NetZero emission movement was also triggered partly due to the need for sustainable development, including sustainable tourism [41]. Critical areas for consideration and discourse emerge when considering climate change, NetZero emissions, and sustainable tourism in national parks. These include the potential use of renewable energy, especially solar and wind, and the potential for forest carbon sinks (sequestration). These and other related matters will now be considered in turn in the following paragraphs.

Simegn et al. [42] consider forest carbon stocks in Simien Mountains National Park of Ethiopia and their implications for climate change mitigation. Forests absorb carbon emitted from various sources, including industry, agriculture, residences and energy production, by sequestering and storing it. Assaye and Asrat's [43] study also focused on the same case study. The authors found that above-ground carbon held 34.4% of the total carbon stocks in Simien Mountains National Park, while below-ground carbon contained 8.3% of the carbon stocks. The soil organic carbon was 55.2% of the total carbon stock. To maintain good levels of carbon sequestration, Aryal et al. [44] argue that national park management should manage fires optimally. Taju and Marelign [45] looked at Godebe National Park northwest of the country. While the national park is relatively new, it has great potential for carbon sinks through its acacia and combretum Terminalia woodlands and riverine forest.

Given the ability of forests to absorb carbon, many national parks have also been targets of international carbon markets. One example is Mount Elgon National Park in eastern Uganda, which was targeted in a partnership between the Uganda Wildlife Authority and a Dutch NGO [46]. While the carbon offset scheme was expected to sequester up to 3.73 million tonnes of carbon dioxide equivalent (tCO2e) between 1994 and 2034, this did not happen as conflicts forced the scheme to be terminated in 2003. Carbon neutrality (sometimes interchanged with NetZero emissions) remains a goal in many national parks. This cannot be attained without contributions from forest sinks [47] and renewable energy projects. The Rock Cut State Park (RCSP) in Illinois State has developed a roadmap for its carbon-neutral future by 2050 (Ibid.).

Phophe and Masubelele [48] assessed the carbon footprint in nature-based conservation management estates in South African National Parks (SANParks). The national parks are viewed as providing natural solutions to climate change through their mitigation abilities from carbon sinks. The SANParks have set an objective to contribute toward the national targets of reducing greenhouse gas (GHG) emissions by reducing their consumption of fossil fuels by two per cent annually till they reach carbon neutrality. Using 2015 to 2019 as the reference period, the SANParks was estimated to have emitted, on average, 73,732 tCO_2e annually. Fifty-five per cent of the emissions came from electricity usage. This was followed by fuel usage for stationary combustion at 35%. This implies that if SANParks is to move quicker toward carbon neutrality, it has to deal with these two primary sources of GHG, making up to 90% of the total emissions. While SANParks is said to have achieved an estimated one per cent year-on-year energy emissions reduction from bringing onboard renewables, this needs to be ramped up to eight per cent to align with the ambitious global demand for a 1.5 °C threshold (Ibid.). Moving with speed in curtailing carbon emissions is hampered by several factors, including lack of knowledge,

technological transfers and lack of financial means [49].

3. Materials and methods

The study explored all the 20 national parks managed by SANParks across South Africa (Fig. 1). The mixed methods approach was adopted as it allowed the researcher to respond to various data needs commensurate with the type of study conducted between 2020 and 2021. A range of data collection tools was employed to gather the required data. This included semi-structured guided interviews with about 150 employees from the 20 national parks in South Africa. Those interviewed included park managers, section rangers, field rangers, hospitality managers, camp managers, ecologists, scientific services managers, curators, tour guides and other park employees with relevant knowledge. The interviews investigated culture and practices regarding energy savings, energy efficiency, and water management measures within SANParks. The questions also centred on understanding the influence of climate change on sustainability within SANParks and the whole debate on carbon management. Questions on energy usage, trends and conservation were largely uniform, with minor deviations to focus on usage within various units. Issues regarding challenges and opportunities concerning green energy transition space were also explored during the interviews.

Questions to climate scientists focussed on the general overview of energy and water usage within SANParks with a focus on project initiatives and actual quantification of the costs of the projects and the expected negative or positive spinoffs from such initiatives. Scientists also oversee climate change mitigation and adaptation strategies in the main climate. As such, questions regarding the challenges and opportunities of the same were interrogated. Snowball sampling was employed to select the participants for the in-depth interviews. The starting point of the researchers was the park managers. These then directed the researchers to a chain of SANParks employees who knew the study subject.

In addition, a questionnaire survey was conducted, gathering views from 871 tourists. The questionnaire survey captured their perceptions concerning the culture and practice of sustainability that addresses energy and water savings in national parks. The surveyed visitors were selected randomly in all the studied national parks. As part of primary data collection, the researchers

Fig. 1. Studied national parks.

conducted field observations aimed at viewing and understanding the various projects that were put in place to deal with the greening of South African national parks, as it were. Observations were also meant to validate some major discussion points during in-depth interviews. Site visits to solar (PV) plants were conducted with technical teams from SANParks to understand the plants' operational aspects. The participatory action research approach was also adopted, where the researchers resided at some accommodation facilities for experiential observation and learning. One of the visited green buildings was the Skukuza Safari Lodge.

The researchers also explored secondary and archival data to complement the interview data. The document analysis focused on understanding the history of green energy and energy conservation in South African National Parks. To that effect, annual reports produced by SANParks between 2010 and 2021 were analysed with other policy and draft policy documents such as the Green Energy Strategy to understand where the park program is coming from and going.

Data analysis followed the research tools that were adopted for the research. The online responses were automatically analysed using the inbuilt QuestionPro functionality. On the other hand, packages such as word cloud functionality within QuestionPro were used to analyse qualitative data. On this platform, functionality such as word cloud was used to assist in making meaning of qualitative data. Other data that required graphs analysis and production were analysed using Microsoft Excel Toolpak. The interview data were transcribed by qualified transcribers and forwarded for processing, cleaning and analysis.

4. Presentation of key findings

The study found that SANParks has several sources of carbon emissions that must be well managed to ensure that the park addresses

Fig. 2. Thick snow in Golden Gate National Park's Witsiehoek Mountain Resort in August 2022: Image courtesy of Victor Mokoena.

its emissions targets and responds to the need for tourism operations to achieve NetZero emissions status. SANParks has various sources of emissions under Scope 1 (direct emissions from fuel combustion on site, from owned vehicles, and fugitive emissions), Scope 2 (indirect emissions from electricity purchased and used by the organisation), and Scope 3 (all other indirect emissions that occur from sources that SANParks do not own or control). The study found that in many respects, the tourism and conservation organisations emit considerably high amounts of carbon in terms of Scope 1 and Scope 2 emissions, given the vastness of its estates, which comprise 19 national parks in various areas of the country.

The old age of the facilities gives rise to some of the main challenges SANParks faces with carbon emissions. Field observations and interviews with staff, including park managers, revealed that some parks have decrepit infrastructure and technology. Retrofitting some of these enterprises have occurred slower than the need to offset carbon emissions. Most of the infrastructure and technology in most parks tend to be intensive in energy consumption which ultimately translates to a huge carbon footprint.

Realising some of these challenges and the demand for SANParks to project itself as a leader in conservation continuously, the organisation has embarked on various programmes to cut its carbon footprint. In that regard, SANParks has started auditing and reporting on its water and electricity usage to improve its annual performance continuously. The same is said in its annual report. Recognising the need for mitigation, SANParks started auditing energy usage in 2014. Data obtained from climate change scientists' interviews showed that the primary drivers of carbon emissions in SANParks were electricity usage and fuels. The study found that the leading emitters were the Kruger, Garden Route, Golden Gate, Kgalagadi, Augrabies Falls, Table Mountain National Parks and the SANParks head office in Pretoria. This is equally confirmed by a study by Ref. [48].

Various factors give rise to the above national parks being the biggest emitters. Among other factors are climatic conditions, tourist numbers, and the intensity of activities in those parks. National parks such as Kruger National Park (KNP) have a considerable carbon footprint given their vastness, the high number of tourists, the old age of infrastructure, the substantial operating fleet and climatic factors. The national park stretches across two provinces of Mpumalanga and Limpopo and between the borders of Zimbabwe and Mozambique, with popular camps dotted across the park. The main administrative centre is in Skukuza. This means that much fuel is also spent on covering long distances as employees travel to and from their camps to their head office in Skukuza. The study found that large amounts of fuel are spent deploying rangers to ensure environmental protection across the park's vast boundary. Before the outbreak of COVID-19, Kruger National Park was the second most visited national park in South Africa after Table Mountain National Park and is one of the three leading top income generators in the entire SANParks estate [50].

Apart from the Kruger National Park, the study also found that the Golden Gate National Park significantly contributes to SANParks's carbon footprint. The park is at a very high altitude, between 1,890 m and 2,830 m [51] (SANParks, 2020). It enjoys much lower temperatures and experiences temperatures experienced in the Drakensberg mountains. Consequently, the area tends to record sub 0 °C temperatures during winter and late winter. Consequently, the park experiences high energy consumption in terms of electricity, wood and coal usage that tourists and employees often utilise during the peak winter season. One employee noted that, "… on extremely cold days and snowfall, the park often draws the highest number of visitors. Electric blankets are switched on in such occurrences, and management often distributes coal to employees to keep people warm. There is also increased demand for hot water and air conditioners to warm guests, which drives up our energy consumption."

This was equally confirmed by interviews and historical records showing that the park occasionally receives heavy snow in winter (Fig. 2) and early summer, increasing the need for heating energy. High occupancies also coincide with energy peak demands as high occupancy tallies with high energy use.

One of the factors emerging from the study is that up until the establishment of Skukuza Safari Lodge, the Golden Gate National Park was the only park with a hotel inside and one of the few hotels in Clarence (the town closest to Golden Gate National Park), which ultimately translated to more visitors and high energy demand from hotel activities. In addition, the study found that the design of the accommodation units, mainly the hotel, does not foster energy efficiency. Specifically, excessively spacious hotel rooms require more energy for the air conditioning system to warm up or cool the entire room due to prolonged running time. Given the near sub 0 °C temperatures that prevail in the area during winter, the hotel and other units in the camp are fitted with electric blankets, increasing the demand for electricity usage. The electricity bill also increases during the more significant part of the year due to geysers used to warm water for bathing tourists.

The Kgalagadi Transfrontier Park is unique in many respects. The park is on the border between three countries, South Africa and Botswana, but stretches to the Namibia border. This is one of the most remote national parks in South Africa, apart from Ai Ai

Table 1
Kgalagadi Camps and their capacity.

Name of Camp	Capacity (Units: Bed Persons)
Twee Rivieren	106
Nossob	79
Mata Mata	50
Kalahari Tented Camp	38
Urikaruus	10
KielieKrankie	10
Grootkolk	8
Bitterpan	8
Gharagab	8

Source: Fieldwork 2021

Richtersveld on the border between Namibia and South Africa. Given its location, the park has challenges ensuring all its areas are connected to the electricity grid. As such, several camps are powered by diesel generators. Major camps (Table 1), such as Mata Mata and Nossob, run entirely on a diesel generator, switched on at 05:00 h and turned off at 22:00 h every day of the week. This means a continuous diesel burn of 17hrs daily, contributing enormously to carbon emissions. The data from South African Weather Services archives and field observations show that the park is located in a semi-desert environment, and the rainfall amounts are erratic. Still, daily temperatures run into extremes as high as above 45 °C during hot summer days, and daily minimum temperatures can be as low as −6 °C. The park's heating and cooling demand are always high, raising the energy demand for guests to be comfortable.

In Augrabies National Park, also located in Northern Cape Province, the primary cause of high energy demand is high temperatures, which peak in summer. Evidence from climatic data and interviews indicates that in recent years, monthly average temperatures have reached as high as 41 °C and some days going as high as in the mid and late 40s at the peak. The temperature in the offices and the camping facilities in this rocky national park can excruciatingly raise the demand for cooling. The camp is located on large rock boulders not very far away from the waterfalls and suffers immensely as rocks absorb heat during the day and slowly release this heat at night, which results in high day and night temperatures, increasing the increased demand for cooling during the day and night at the campsite and the offices which leads to high energy usage.

Other high-carbon-emitting national parks include Table Mountain, Garden Route National Park and Addo Elephant National Park. These parks generate significant amounts of revenue for SANParks through high tourist turnout. The massive carbon footprint is a factor in increased tourist numbers, distance length, and the intensity of operations in those parks. The parks also constitute marine protected areas that require deploying monitoring teams into the sea to hunt for poachers, consequently adding to the carbon footprint. These parks also stretch hundreds of kilometres which means greater patrolling distances.

4.1. South African national parks' quest to address carbon emissions

South African national parks use vast amounts of energy. Evidence from archival records shows that in the 2019/2020 financial year, SANParks consumed 38.4 GWh of electricity, translating to about US $ 4,9 million. Of that amount, $3.7 million went to purchase electricity from Eskom, and the balance of approximately $1.2 million went towards diesel purchases. Carbon emissions in national parks have been on exponential growth for years. The amount of carbon emissions produced in the process equated to about 47,000 tonnes of CO_2 emissions. Given the preceding, a business and environmental case exists for SANParks to considerably cut its carbon emissions and transition towards a green and sustainable path.

The path toward NetZero started in 2007 when SANParks instituted an Energy Efficiency Programme. The project targeted retrofitting heat pumps, installing energy-efficient air conditioners, installing low-flow showerheads, and rolling out some solar projects. In 2010 Kruger National Park started in earnest by conducting the first-ever water and energy baseline under SANParks. A key informant from Kruger National Park remarked that:

Since we started the energy efficiency program in 2010, we have targeted and managed to reduce our electricity consumption by 2% yearly. Between 2010 and 2019, we have reduced our consumption of energy by close to 20% using a mixture of strategies …

The Energy Efficiency Programme in the SANParks Strategic Plan for 2016/2017–2019/2020 was adopted in 2016 with a target to reduce fossil fuel-generated energy by 2% per annum. Consequently, several projects aimed at ensuring energy efficiency and savings were conducted. Several parks were prepared to have their baselines for energy and water covering all the parks under SANParks.

SANParks is currently adopting a comprehensive Green Energy Strategy with the objectives shown in Fig. 3.

The strategy seeks to embark on several initiatives and interventions, with the first price being in the ability to achieve energy

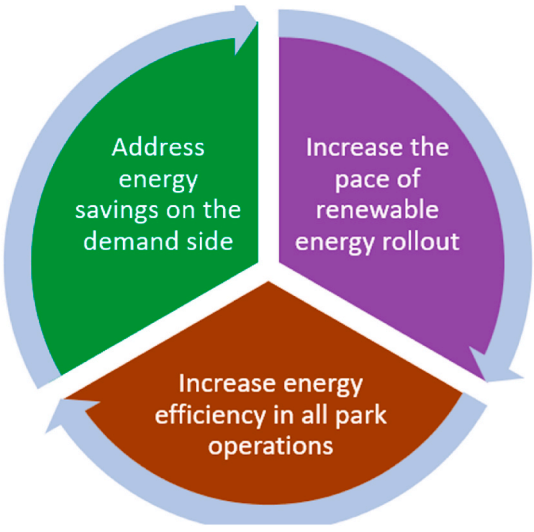

Fig. 3. SANParks green energy strategy.

savings by fostering changes in behaviour for both tourists and employees, switching off lights and setting all the geysers at 50 °C temperature. The second strategy is ensuring energy efficiency by adopting LED lights and improving building insulation. Thirdly SANParks sought to switch to renewable energy by adopting solar and purchasing energy supplies from those selling renewable energy. It is envisaged that under this plan, the energy mix for national parks will move totally from the current Eskom energy supply and adopt the plan. Evaluations on how the plan will play out across the 19 study parks and other executed NetZero emissions-related facets are shown in Table 2.

SANParks also seek to tap into the carbon market and participate in the carbon capture market as a carbon offset to deal with its carbon footprint. This is the last resort for SANParks.

4.2. Selected projects aimed at ensuring NetZero transitions within SANParks

Between 2007 and 2022, SANParks has done considerable work to address its carbon footprint to reflect the park management company's trajectory. As much as there is still some considerable ground to cover transitioning to NetZero, the Kruger national park has witnessed some of the most inspiring projects. Since 2009 there is an acknowledgement that in as much as tourist numbers have soared, it had seen an average of 2.76% energy savings. Like many other parks, Kruger National Park has benefitted from the solar borehole project, which sought to use solar for almost all the pumps for watering animals. The major flagship projects have been the Skukuza and Lower Sabi solar farms. The Skukuza solar project, at maximum, has PVs with an installed capacity of 823 KW, while the Lower Sabie has an installed capacity of 542 KW. However, the full capacity of these plants is not being fully utilised because of the presence of trees near the PV tables. This was reviewed by a key informant who said:

Skukuza and Lower Sabie Camps run simultaneously on electricity from the main grid, and Solar PV plants at these camps contribute between 8% and 10% of the total demand for power … However, we are into conservation, so we built the solar plants without removing the trees and navigated and used open spaces. Where there were trees we did not remove …. as the Sun moves around, the shades eventually impact the solar panels, so we are not using the plants' full capacity, but we are still getting the best of more than 80% of the plant capacity.

Pafuri Rest Camp also has a small solar farm which has helped cut down diesel for generators at this remote camp. KNP has a total installed capacity of 2065 KW, the most considerable installed capacity among the 20 national parks in South Africa. All the SANParks solar projects were funded to about US $5 million, most of which went to Kruger National Park. Indeed, much more investment is needed to ensure a significant impact regarding the transition to clean energy in the park and other national parks nationwide. Other smaller camps within the park use a particular portion of solar energy or are 100% off the grid. Some picnic spots with convenience shops largely dependent on gas have benefitted from solar installations.

The inspiration to go green has resulted in developing green building-inspired accommodation infrastructure, such as the Skukuza Safari Lodge building, which mimics the green building concepts in many respects. The lodge officially opened days before the COVID-19 lockdown and has many installations promoting energy efficiency. One of the significant energy consumers in hotel establishments is heating for cooking [53]. The Skukuza Lodge's kitchen is designed to run on gas which assists in reducing the energy consumption at the lodge. The new building is well insulated, and lighting in the club utilises LED lights, low-flow shower heads, and new refrigeration and air cooling technology equipment. Roofs are also insulated and utilise local grass thatching, ensuring the lodge is cooler in summer and warmer in winter, helping save energy. The use of hotel keycards and automatic light switches is another aspect of the lodge that assists in energy savings and ensures energy efficiency.

The near Olympic size swimming pool installed at the lodge allows the consumers and tourists to cool off, particularly during the

Table 2
Proposed energy mix and executed projects from focus national parks.

Name of Park	Planed Solar	Installed Solar Capacity (kW)	Planned Wind Power
Addo	Yes	268	Yes
Agulhas	Yes	2.6	Yes
Ai-|Ais/Richtersveld	Yes	0.48	No
Augrabies	Yes	10	No
Bontebok	Yes	None	No
Camdeboo	Yes	160	No
Garden Route	Yes	0.1	No
Golden Gate Highlands	Yes	None	No
Karoo	Yes	0.15	No
Kgalagadi Transfrontier	Yes	None	No
Kruger	Yes	2063	No
Mapungubwe	Yes	0.33	No
Marakele	Yes	1.7	No
Mokala	Yes	None	No
Mountain Zebra	Yes	None	No
Namaqua	Yes	24	Yes
Table Mountain		None	No
Tankwa Karoo	Yes	47	No
West Coast	Yes	None	Yes

Source: SANParks [52].

peak summer season when temperatures can reach 40°. Given that tourists will spend time at the pool, it reduces pressure and demand on energy for cooling at those times, helping save energy. The lodge also has a grey water recycling facility which assists in water savings and reuse. The garden landscaping also uses water-wise flowers and indigenous plants to save on water use which was a critical consideration in the design process of the hotel. The lawn also uses a water-efficient hydraulic system.

Another significant rollout project of the solar project has been in the Tankwa Karoo National Park, which operates 90% of its operations from renewables. Tourists who visit that particular national park are assured that the park operations are sustainable. Across the national parks, including Mountain Zebra and Tankwa Karoo, it was observed that some rustic, remote smaller camps are already operating 100% off the grid, being powered by gas and Solar and using borehole water pumped using solar energy. Tourists who are insistent on green travel only are therefore catered to as they can book themselves on these off-the-grid camps, although these are still very few and, in most cases, exclusive.

The 2020/2021 annual reports noted that SANParks used the funds that were availed through the Presidential Employment Stimulus Fund, to the tune of about $6.5 million, to install equipment that uses alternative energy and ensures energy savings. That year, 71 solar heaters were installed at Golden Gate, Augrabies, and Addo Elephant National Park [52]. Using the same funding vehicle, SANParks purchased 9750 LED lights to replace the energy-intensive lighting. Installing solar geysers in energy-intensive parks such as Golden Gate is critical in reducing energy usage, particularly for heating water.

4.3. Tourists' perceptions of SANParks' approach to NetZero

The tourists who participated in the survey highlighted several options that can be pursued by national park authorities to achieve carbon neutrality and remain on the sustainable development pathway. The possibilities include reducing energy consumption, investing in renewable energy options, tree planting, and replacing carbon-emitting with carbon-neutral systems. Fig. 4 presents the tourists' perspectives on carbon mitigation options in South African National Parks.

As shown in Fig. 4, tourists view the transition to solar energy systems and reduction in energy use as the key strategies toward the NetZero carbon emission trajectory. As indicated in Fig. 4, other strategies include vehicle use management to reduce carbon emissions, using other renewable energy options such as wind, efficient waste management systems, tree planting, education and awareness building, among different strategies.

The visitors suggested the need to increase the amount of renewable energy being used within the national parks. However, some participants have flagged the use of wind energy as undesirable during in-depth interviews. These views were predominantly expressed at Addo Elephant Park and the Garden Route. This was mainly because rotating wind turbines have increased the fatalities of avian fauna in the parks and induced upper air turbulence, making critical aerial surveillance operations difficult, if not impossible, to perform safely. Therefore, this calls for proper risk assessment in all parks before settling for the best form of renewable energy to adapt.

When tourists were engaged in the best approach to deal with carbon emissions through the survey, they proposed several interventions. The majority of tourists indicated that the most appropriate way of dealing with carbon emissions was to increase the amount of green lodging, followed by the use of low-carbon airlines, the use of electric or hybrid vehicles and the last option was the use of a shuttle transport and the purchasing of carbon credits.

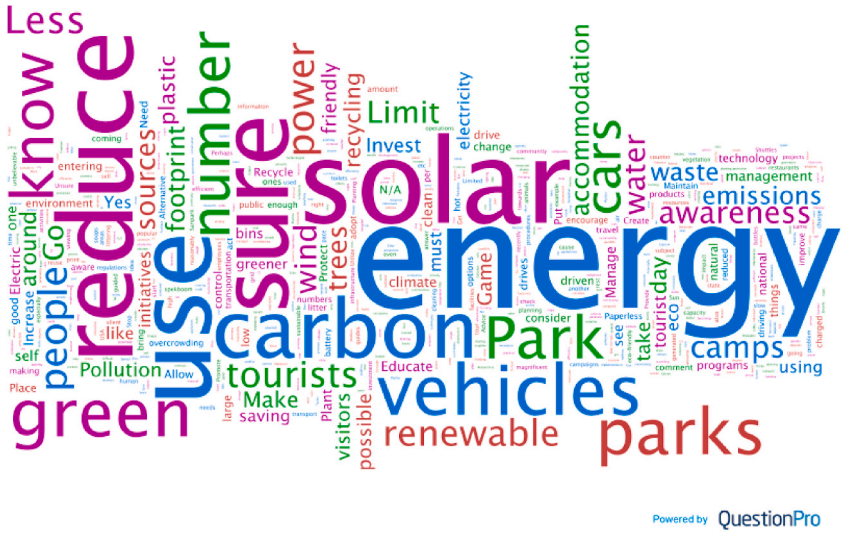

Fig. 4. Tourists' perspectives on how to address carbon emissions within South African National Parks.

5. Discussions

At the heart of addressing tourism, degrowth is the need to address the various environmental challenges the tourism industry faces [54,55]. While the focus of tourism degrowth has been on addressing the challenges caused by over-tourism in Africa, tourism is not much of an issue as the attractions have not reached their environmental threshold or carrying capacity. Nonetheless, the focus is on ensuring that as the tourism industry grows, it addresses the challenges caused by tourism to the environment and the community. One such issue is managing the carbon footprint so the sector grows sustainably across the industry.

This study acknowledged that nature tourism is not in harmony with nature as it should be in national parks [56]. In the South African National Parks, the study identifies electricity usage as one of the critical drivers of carbon emissions. This is also closely tied to the park size and, in most cases, tourist traffic and weather drivers. These results resonate with the findings by Sun [57], who drew parallels between tourism intensity and carbon emissions. The fact that carbon emissions are tied to tourists visiting the parks places tourists at the core of addressing the challenge of carbon emissions within the tourism sector. Indeed this can assist in decoupling tourism development from carbon emissions, as [58] proposed. This approach will require that the national parks put in place appropriate green infrastructure that allows the tourists to enjoy participating in the greening of tourism as it were. This means looking at accommodation and transport that tourists use to ensure sustainability.

Decoupling tourism development from carbon emissions has to be conducted from a perspective that considers the framework for a just transition framework [59]. This will require that actions that SANParks take to move towards NetZero must, in full respect, address the socio-economic needs of the host communities. SANParks could do this, for example, by leveraging the current public works program [6] to train the youths it is currently engaged in to train them to install solar panels and maintain and service green technology. This approach will assist the host community in addressing the challenges of poverty, which drives the vulnerabilities of climate change. Improved income and skills will also assist communities in adapting to threats imposed already by climate-induced extreme weather events. This approach will also allow for skills transfer which can usher in a green transition within the parks' neighbourhoods where most SANParks employees come from.

Achieving this is not an easy task as it requires that the parks embark on a program to retrofit and, in some cases, redesign camps to meet the requirements of green hoteling. This means a relook at the technology used in the camping, lodging and restaurant facilities in all the national parks. A deliberate effort has to be made to ensure that tools and appliances used in the park's establishment are energy efficient and placed in energy-efficient establishments. Ensuring energy-efficient devices such as cooling and heating equipment are critical to moving toward the NetZero target. Razzaq et al. [60] underscored the role of technological development in tourism on decarbonisation projects. Gössling and Scott [61] place technology at the heart of decarbonisation in the tourism industry.

In this light, efforts to ensure that new establishments such as Skukuza Safari Lodge and other off-the-grid campsites have some of the latest technology are commendable. The LED lights, use of hotel keycards, grey water recycling and centralised cooling have been touted to ensure degrowth within the tourism industry if one is to take a carbon derisking perspective [62,63]. The fact that SANParks is moving in to adopt this technology is, in many respects, encouraging. However, this rollout has to be matched with development geared at also rolling out the same technology to older camps where new technology and, in some cases, units must be redesigned to ensure that units are energy efficient.

In as much as SANParks has some green camps, these camps are not easy to identify or distinguish when one is making a booking. A dedicated section of the green camps on the website can foster and inspire green travellers or those who are avid green travellers. Such camps can compete with other green camps from private nature reserves if distinguished and appropriately marketed. In this regard, upgrades might be needed to match similar offerings from private game reserves, which can earn national parks in the continent and abroad significant revenue to propel the green travel program. These camps can be equipped with electric vehicle charging stations that run on solar to ensure that the vehicles that service these establishments are purely green.

It is understood that SANParks might not be able to roll out an overnight program to deal with its high dependence on fossil fuels that are responsible for climate change, such as diesel. Nonetheless, the organisation can use its research department to innovate and produce biodiesel and biogas to reduce its carbon footprint drastically. One of the biggest challenges SANParks faces is invasive species, and some of these species can be used for biodiesel production (for example, [64,65]. Such projects will therefore address the country's fundamental challenges of climate change from an adaptation and mitigation perspective.

Investment in alternative and renewable energy seems to be one of the most critical steps that can be taken in rolling out renewable energy to replace conventional electricity usage in national parks. Solar and geyser energy usage can address the burden of carbon emissions in the parks. Solar energy, wind energy, and other renewables can be used successfully to transition to clean energy. Transitioning to clean energy has effectively allowed tourism destinations to cut emissions significantly and save on money spent on energy purchases [66]. Indeed some of this money can be used by SANParks to increase investment in conservation and restoration works, support neighbouring communities to meet their sustainability projects or improve staff welfare contributing to responsible tourism [6]. There are real benefits that can accrue from investing in green jobs within the tourism sector, as it were.

Given that financing, these efforts have been problematic; if there is anything we have learned from the COVID-19 pandemic is the capacity of tourism and other sectors to pull together resources that can foster sustainability. The study would recommend that if climate change can be treated as an emergency in many respects [67,68], governments, businesses and tourists can assist in financing climate change action aimed at decarbonising the sector in national parks. Special green bonds, cheap finance and allowing people to invest in national parks in green initiatives as part of the carbon market schemes can assist protected areas in developing countries to decarbonise. These benefits are that numerous parks become areas of green innovation inspiration and foster environmental education. Still, most importantly, this will assist in triggering green jobs while helping the gardens enhance the protection of the environment, which is crucial to ecosystem services. This will also improve customer satisfaction levels as evidence shows that nature lovers

constantly expect [69,70] destinations such as national parks to be greener.

There is also a huge issue about the massive fuel-guzzling 4 × 4 vehicles and trucks that are a permanent feature of national parks in South Africa and the region. Which equally requires attention. Tourists and also SANParks use these vehicles. To assist in decarbonising the sector, parks need to develop a policy that looks into issues of these fuel guzzlers, which are not in tandem with what is expected. Investment in purchasing electric and hybrid vehicles is an option worth pursuing. This equally means an investment by the parks to roll out vehicle charging stations across camps. A penalty based on vehicle capacity can be instituted to discourage heavy-polluting vehicles from tourists. There is also a need to look at discouraging self-game drives and incentivising group game drives by making it affordable for individuals to do group game drives to reduce carbon emissions and vehicle congestion in the parks.

Currently, there is no SANParks option for tourists to offset their carbon emissions. This development is problematic given that SANParks has several projects where it can leverage and offset its carbon footprint. Rangeland rehabilitation and its indigenous tree plantation projects can be used as potential projects for establishing robust carbon offset projects. This approach is not unique to SANParks as other areas in the continent and worldwide have adopted the same approach [71,72]. The approach will allow SANParks to increase the pace of such project rollouts, which will address multiple community needs and address climate change challenges faced by rural communities currently providing indigenous trees [6]. Such a scheme could assist the national parks in accounting for their carbon footprint and offset it somehow. Such funds can also be used to fund green infrastructure projects in the parks, such as purchasing newer energy-efficient equipment, purchasing electric vehicles, setting up electric charging stations and rollout out solar and wind energy generating equipment, which can assist the enterprise in transitioning faster than at the current rate. The aviation industry has become a leader in this regard, and the entire tourism industry can learn a few things regarding the carbon market as it relates to tourism. This can start as a voluntary project, and tourists can participate in it as part of tourism philanthropy. Governments can support these by allowing tourists who purchase carbon credits to get some tax rebates from such initiatives. This can open up significant funding for national parks and foster sustainable tourism recovery.

6. Conclusion and recommendations

The study sought to investigate green transitions within the South African National Parks framework. To this end, the study presents several lessons that national parks can adopt from theoretical and practical perspectives worldwide. It emerged that although national parks are often considered hubs of conservation innovation, they need to catch up concerning conservation challenges posed by climate change and that parks are contributing towards climate change. Efforts to address climate change are hampered by a shortage of finance, a situation that the COVID-19 pandemic has worsened.

In addition, regardless of the challenges faced by national parks, efforts are underway to address the carbon-neutral initiatives through various means in the lead to NetZero by 2050. Amongst the efforts are solar projects for accommodation establishments and water pumping needs. However, the use of fuels such as petrol and diesel remains a critical challenge, although there are ways which can be adopted to address conservation and climate challenges faced by national parks. The study identified areas that national parks could tap into and create green jobs while at the same time addressing the carbon challenge faced by national parks. Therefore, the study recommends that carbon-neutral projects involve all the stakeholders, particularly tourists who are genuinely worried about the carbon risk caused by tourism activities in national parks. Green job potential is in areas such as indigenous tree plantations, installation, maintenance of green energy technology and carbon markets establishments.

Further employment can be created in research and technology innovation in producing biofuels. Additional climate funding can be obtained by creating a mechanism through which tourists can offset their carbon footprint. So SANParks and other national parks need to create a verified carbon market credit system in this regard. Such an approach integrates all the tourism role players, including host communities, who stand to benefit from the improved environmental performance and the economic spinoffs from the transition process.

Green financing and technological transfer remain among the biggest obstacles to NetZero transitions within the national parks. Given the rich ecosystem services provided by many parks, particularly in developing countries, how international financing houses can assist in this regard is critical to the fight against climate change. Therefore, an international financing vehicle must be provided to deal with the shortfall so that parks' green transformation can act as a societal catalyst for the green transition.

There might be a need to develop policies requiring that as part of the pricing system for car rentals, airline tickets, and accommodation, a certain portion of the price cost be dedicated to offsetting the carbon emissions generated from travel. Such funds can unlock a funding vehicle that can be used to mitigate and also be channeled towards climate change adaptation which can assist poor communities in rural areas where most of these parks are located to build climate resilience. There is a need to relook at how the polluter pays principle used in the country is being used to address climate change challenges. This will require transparency on how such funds are being used and who is benefitting from such funds to avoid duplication of efforts with the system being agitated for in this study that utilises the carbon credit system.

Given that SANParks is a conservation organisation, there might be a need to bolster environmental education to increase the green tourism movement, which is not happening much with national park estates. Incentives for green initiatives to tourists can be implemented to promote sustainable living. A green reward program that follows the principles adopted by the tourism sector for loyalty projects can be adopted to assist in this regard.

7. Limitations

The study was conducted at the height of the COVID-19 pandemic, which was a barrier to some key respondents. Given the sizes of

SANParks and the number of parks involved in this study, it was not feasible to get all the needed data; hence, it relied on secondary data sources in some sections.

Author contribution statement

Godwell Nhamo; Kaitano Dube; David Chikodzil; Lazarus Chapungu: Conceived and designed the experiments; Performed the experiments; Analysed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.<>

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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